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"It will flourish, if naturalists, chemists, antiquaries, philologers, and men of science in different parts of *Asia*, will commit their observations to writing, and send them to the Asiatic Society at Calcutta. It will languish, if such communications shall be long intermitted; and it will die away, if they shall entirely cease."

Sir Wm. Jones.

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CONTENTS.

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LIST OF PLATES.

INDEX TO PART I.

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OF THE

ASIATIC SOCIETY.

Part I.—HISTORY, LITERATURE, &c.

No. I.—1867.

The Initial Coinage of Bengal.—*By* Edward Thomas, *Esq.*

[Received December 5th, 1866. Reprinted from the Journal of the Royal Asiatic Society of Great Britain and Ireland, Vol. ii. p. I. N. S.]

Towards the end of August, 1863, an unusually large hoard of coins, numbering in all no less than 13,500 pieces of silver, was found in the Protected State of Kooch Behár, in Northern Bengal, the contents of which were consigned, in the ordinary payment of revenue, to the Imperial Treasury in Calcutta. Advantage was wisely sought to be taken of the possible archæological interest of such a discovery, in selections directed to be made from the general bulk to enrich the medal cabinets of the local Mint and the Museum of the Asiatic Society of Bengal. The task of selection, and with it of inevitably final rejection, was entrusted to Bábu Rajendra Lál Mitra—an experienced scholar in many branches of Sanskrit literature, and who, in the absence of more practised Numismatists, courageously encountered the novel study and impromptu exposition of Semitic Palæography as practically developed in his own native land six centuries ago. The Bábu, after having assiduously completed his selections for the Government,* was considerate enough to devote himself to renewed and more critical examinations of this mass of coined metal, with a view to secure for Colonel C. S. Guthrie (late of the Bengal Engineers), any examples of importance that might have escaped his earlier investigations. The result has been that more than a thousand additional specimens have been rescued from the

* J. A. S. Bengal, 1864, p. 480.

Presidency Mint crucibles, and now contribute the leading materials for the subjoined monograph.

An autumnal fall of a river bank, not far removed from the traditional capital of *Kunteswar Rája*, a king of mark in provincial annals,* disclosed to modern eyes the hidden treasure of some credulous mortal who, in olden time, entrusted his wealth to the keeping of an alluvial soil, carefully stored and secured in brass vessels specially constructed for the purpose, but destined to contribute undesignedly to an alien inheritance, and a disentombment at a period much posterior to that contemplated by its depositor. This accumulation, so singular in its numerical amount, is not the less remarkable in the details of its component elements—whether as regards the, so to say, newness and sharpness of outline of the majority of the pieces themselves, the peculiarly local character of the whole collection, or its extremely limited range in point of time. It may be said to embrace compactly the records of ten kings, ten mint cities, and to represent 107 years of the annals of the country. The date of its inhumation may be fixed, almost with precision, towards the end of the eighth century A. H., or the fourteenth century A. D. A very limited proportion of the entire aggregation was contributed by external currencies, and the imperial metropolis of Dehli alone intervenes to disturb the purely indigenous issues, and that merely to the extent of *less* than 150 out of the 13,500 otherwise unmixed produce of Bengal Mints.†

The exclusively home characteristics of the great majority of the collection are enlivened by the occasional intrusion of mementoes of

* Col. J. C. Haughton, to whom we are mainly indebted for the knowledge of this *trouvaille*, has been so obliging as to furnish me with some interesting details of the site of discovery and illustrations of the neighbouring localities. Col. Haughton writes :—" The place where the coin was found is about three miles S. W. of Deenhatta, not far from the Temple of Kunteswaree (or Komit-Eswaree) on the banks of the river Dhurla. Near to this temple is a place called Gosain Moraee, a short distance from which are the ruins of Kuntesur Raja's capital, called Kunteswaree-Pat, consisting of a mound of considerable extent, which has been surrounded with several ditches and walls, which are again protected at the distance of a mile or two by enormous mounds of nearly 100 feet high. The brass vessels, in which the treasure was deposited, were ordinary brass *lotahs*, to which the top or lip had not been fixed, but in lieu thereof the vessels were covered by canister tops, secured by an iron *spike* passing from side to side."

† I wish to explain the reservations I make in thus stating this total below that given in Rajendra Lál's list of 150 coins of *seven* Dehli kings (J. A. S. B.,

imperial re-assertions, and numismatic contributions from other independent sources aid in the casual illustration of the varying political conditions of the province, and of the relations maintained from time to time between the too-independent governors of a distant principality and their liege suzerains at Dehli.

Muhammadan writers have incidentally preserved a record of the fact, that on the first entry of their armies into Bengal, they found an exclusive *cowrie* or shell currency, assisted possibly by bullion in the larger payments, but associated with no coined money of any description ;* a heritage of primitive barter, indeed, which survived undis-

September, 1864, p. 481). In the first place, I greatly mistrust the reading of the sixth king's title. Muhammad bin Tughlak was called *Fakhrul-dín* Júnah in his youth only ; on his first mission to the Dakhin in 721 A. H., the higher title of *Ulugh Khán* was conferred upon him by his father, but from the date of his accession to the throne of Hindustan, he contented himself with the use of his simple name and patronymic ; no longer the "glory of the faith," he was the far more humble الوثق بتائيد الرحمن , or the conventional المجاهد في سبيل الله (Zia-i-Barní., Calcutta edit., p. 196), both of which were so persistently copied by the independent Bengal Sultans. Certainly no such title as فخر الدين occurs on *any* of the specimens of the *Kooch Bahár* collection, that the Bábu has selected for Col. Guthrie, with the exception of those bearing the names of Fakr-ud-din *Mubárak Sháh*.

The second question of the altogether improbable intrusion of coins of Muhammad Ádil Sháh ("new type") I must meet in a more direct way, by assigning the supposed examples of his money to the potentate from whose mints they really came, that is, *Ikhtiár-ud-din* Ghází Sháh (No. 7, infra), giving a difference in the age of the two kings, as far as their epochs affect the probable date of the concealment of this trouvaille, of more than two centuries (753 A.H. against 960 A.H.).[a] The Bábu has himself discovered his early error of making Shams-ud-dín Fírúz, *one of the Dehlí Patháns* (as reported in the local newspapers), and transferred him, in the printed proceedings in the Asiatic Society of Bengal, to an anomalous position at the end of the Bengal Pathans (p. 483), while omitting to deduct him from the total number of "*eight* Dehlí Patháns," which reckoning has been allowed to stand at p. 480. In the matter of date, we are not informed why this king should be assigned to A.D. 1491, instead of to the true 1320 A.D. which history claims for him.

* Minháj-ul-Seráj, who was resident in Lakhnauti in A.H. 641, writes چنان تقر یر کردند که دران بلاد کوده بعوض چیل روان است Tabakát-i-Násiri, p. 149, Calcutta printed edition (1864). Ibn Batutah gives an account of the collection of the cowrie shells in the Maldive Islands, from whence they were exported to Bengal in exchange for rice ; the gradational quantities and values are detailed as follows : سیاه = 100 cowries. فال = 700

a The title of Mohammed bin Toghlak on the specimens in the Society's cabinet is المجاهد في سبيل الله and the coin which was first taken for that of Adil Shah has on it *Ikhtiar uddin Gházi Shah.*—Ed.

turbed in many of the out-lying districts up to the early part of the present century. The consistent adherence of the people to this simple medium of exchange, goes far to explain an enigma recently adverted to* in my paper on the identity of Kraṉanda as to the general absence of all specimens of money of high antiquity within certain limits northward of the seaboard, and may serve to reconcile the anomaly of conterminous nationalities appearing in such different degrees of advancement when tried by similar isolated tests of local habitudes. For the rest, the arms of Islám clearly brought with them into Bengal what modern civilization deems a fiscal necessity—a scheme of national coinage; and the present enquiry is concerned to determine when and in what form the conquerors applied the theory and practice they themselves as yet but imperfectly realized.

When Muhammad bin Sám had so far consolidated his early successes in India, into a design of permanent occupancy, leaving a viceroy and generalissimo in Dehli, in the person of Kutb-ud-dín Aibek, while his own court was still held at Ghazní, the scattered subordinate commanders each sought to extend the frontiers of *the* faith beyond the limits already acquired; in pursuance of this accepted mission, Muhammad Bakhtíár Khiljí, *Sipahsálár* in Oude, in A. H. 599, pushed his forces southward, and expelled, with but little effort, the ancient Hindu dynasty of Nuddeah, superseding that city as the capital, and transferring the future metropolis of Bengal to the proximate site of Lakhnautí, where he ruled undisturbed by higher authority, till his own career was prematurely cut short in A. H. 602.

كنّي=12,000. بُستو=100,000, four *bustús* were estimated as worth one gold *dinár*; but the rate of exchange varied considerably, so that occasionally a *dinár* would purchase as many as twelve *bustús*, or twelve lakhs of cowries! (French edit., iv., p. 121. Lee's Translation, p. 178.) Sir Henry Elliot mentions that "in India, in 1740, a rupee exchanged for 2,400 cowries; in 1756, for 2,560 cowries; and (1845) as many as 6,500 could be obtained for a rupee."—Glossary of Indian Terms, p. 373. They were estimated in the currency scheme of 1833 at 6,400 per rupee.—Prinsep's U. T., p. 2. Major Rennell, who was in Silhet in 1767-8, speaking of the cowrie money, remarks: "I found no other currency of any kind in the country; and upon an occasion, when an increase in the revenue of the province was enforced, several boat loads (not less than 50 tons each) were collected and sent down the Burrampooter to Dacca." As late as 1801 the revenues of the British district of Silhet "were collected in cowries, which was also the general medium of all pecuniary transactions, and a considerable expense was then incurred by Government in effecting their conversion into bullion."—Hamilton's Hindostan, London, 1820, i. p. 195.

* J. R. A. S., vol. i., N. S., p. 473-4.

Considering the then existing time-honoured system of valuations by shells,—which would certainly not invite a hasty issue of coin,—Muhammad Bakhtiar's acknowledged subordination to Kutb-ud-dín, who, so far as can be seen, uttered no money in his own name, it may fairly be inferred that if a single piece was produced, it formed a part only of an occasional, or special, Medallic mintage constituting a sort of numismatic Fatah-námah, or assertion and declaration of conquest and supremacy alone, and designedly avoiding any needless interference with the fixed trade by adventitious monetary complications, which so unprogressive a race as the Hindus would naturally be slow to appreciate.

Similar motives may be taken to have prevailed in the north, where the least possible change was made in the established currency of the country, extending, indeed, to a mere substitution of names in the vernacular character on the coin, which was allowed to retain the typical "Bull and Horseman" device of Prithvi Rája and his predecessors. The pieces themselves, designated from their place of mintage *Dehli-walas*,* were composed of a mixture of silver and copper in intentionally graduated proportions, but of the one fixed weight of thirty-two ratis, or the measure of the old *Purána* of silver of Manu's day. Progressive modifications were effected in the types and legends of these coins, but no systematic reconstruction of the circulating media took place until the reign of Altamsh; who, however, left the existing currencies undisturbed, as the basis for the introduction of the larger and more valuable and exclusively silver نقرة popularly known in after times as the *Tankah*,† a standard which may also be supposed

* The name is written دلي وال in Kutb-ud-din Aibek's inscription on the mosque at Dehli. (Prinsep's Essays, i. 327). The Táj-ul-Maásir and other native authorities give the word as دهليول. Hasan Nizami, the author of the former work, mentions that Kubáchah, ruler of Sind, sent his son with an offering of 100 láks of Dehli-wals to Altamsh, and no less than 500 láks of the same description of coin were eventually found in Kubácháh's treasury, many of which were probably struck in his own mints. (See Ariana Antiqua, pl. xx., fig. 19; J. A. S. B., iv., pl. 37, figs. 28, 29, 47; and Prinsep's Essays, i., pl. xxvi., figs. 28, 29, 47.)

† Erskine derives this name from the Chagatai Túrki word, *tang*, "white." (History of India under Báber. London, 1854, vol. i. p. 546). Vullers gives a tenuis, suff. ɣ). Ibn Batutah carefully preserves the orthography as تنگه, different and clearly preferable derivation in تنگه (fort. ex. تُنُک s. تنگ s. टंक and टङ्क.

to have followed traditional weights in the contents assigned to it, as the 96 rati-piece modern ideas would identify with the *Tolah :* or it may possibly have been originated as a new 100 rati coin, a decimal innovation on the primitive Hindu reckoning by fours, a point which remains to be determined by the correct ascertainment of the normal weight of the rati, which is still a debated question. My own results, obtained from comparative Numismatic data of various ages, point to 1.75 grains,* while General Cunningham adheres to the higher figures of 1.8229 grains.†

* J. A. S. Bengal, 1865, p. 25, and Numismatic Chronicle. Vol iv., N. S. p. 131, March, 1864.

† General Cunningham's deductions are founded on the following estimates: —"I have been collecting materials for the same subject [Indian Weights] for nearly twenty years, and I have made many curious discoveries. I see that Mr. Thomas quotes Sir William Jones as fixing the weight of the *Krishnala*, or *Rati* seed, at $1\frac{5}{16}$ grain; but I am satisfied that this is a simple misprint of Jones's manuscript for 1 $\frac{5}{6}$ or 1·833 grain, which is as nearly as possible the average weight of thousands of seeds which I have tested. The great unit of mediæval and modern times is the *táka* of not less than 145 grains, of which six make the *chha-táka*, or *chhatak*, equal to 870 grains, or nearly two ounces; and 100 make the *sataka*, or *ser*, the derivation being *sat-táka*, or 100 *tákas*. For convenience I have taken, in all my calculations, the *rati* seed at 1·8229 grain. Then 80 *ratis* or 145·832 was the weight of the *tangka* of copper, and also of the golden *suvarna*, which multiplied by six gives 874.99 grains, or exactly two ounces for the *chha-táka* or chhatak."—J. A. S. Bengal, 1865, page 46.

Mr. N. S. Maskelyne, of the Mineral Department, British Museum, who, some time ago, entered into an elaborate series of comparisons of Oriental weights, with a view to determine the identity of one of our most celebrated Indian diamonds, has been so obliging as to draw up for me the following memorandum, exhibiting the bearing of an entirely independent set of data upon the question under review, the true weight of the Indian *Rati*. The value of this contribution in itself, and the difficulty of doing justice to it in an abstract, must plead my excuse for printing it in extenso in this place:—

I shall confine my answer to your question about the rati to the estimate of it, as derived from the Mishkâl. The other channel of enquiry, that namely of Hindoo metrology and numismatics, is too complicated, and so far as I have been able to follow it, too unsatisfactory in its results, to justify my urging any arguments derived from it. Indeed, the oscillations in the currencies, and our knowing so few very fine coins of reigns before Shír Shah, of critical value, make this branch of the subject almost unapproachable to one who is not an Oriental scholar. I would premise, however, that I do not believe very accurate results are to be obtained solely from the weights of coins, except in the few cases where, as in the coins of Akbar, or of Abd-el-Malek ben Merwán, we have some literary statements about them. Nor can you get any result from weighing carob beans to determine the carat, or abrus seeds to determine the *rati*. I weighed, long ago, hundreds of ratis, that Dr. Daubeny lent me, with an average of 1.694 troy grains. Sir William Jones found, I believe, one of 1.318, and Professor Wilson, I think, another value again. They vary according to the soil and climate they are grown in, and the time and atmosphere they have been kept in.

My investigation of the rati originated in a desire to determine whether the diamond, now the Queen's, was the same that Baber records as having been given to Humayûn at the taking of Agra, after the battle of Paniput, and which

However, these silver coins of Altamsh, let their primary static ideal have been based upon a duplication of the dirhams of Ghazni,

had once belonged to Alá-ed-dín (Khilji). I also was led to suppose that the diamond Tavernier saw at the Court of Aurungzebe was the same, and that he had confounded it with one that Meer Jumla gave to Sháh Jehán, and that had been recently found at Golconda. I would here observe that Tavernier's weights can be very little trusted; I can give you my reasons for this assertion, if you wish for them.

Báber, in his memoirs, says the weight of Humáyún's diamond was about 8 mishkâls. In his description of India, he gives the following ratios of the weights in use there:—

8 ratis	= 1 máshah.			
32 ,,	= 4 ,,	= 1 Tang (Tank).		
40 ,,	= 5 ,,	=	=	= 1 mishkál.
96 ,,	= 12 ,,	=	=	= 1 Tola.

Jewels and precious stones being estimated by the tang. Furthermore he states 14 tolas = 1 sir, 40 sírs = 1 man etc. Thus, then, the 8 mishkâls would be 320 ratis.

Tavernier says the diamond he saw weighed 319½ ratis. The Koh-i-Nûr, in 1851 (and, I believe, in Baber's day also), weighed 589.5 grains troy. The theory that it was Alá-ed dín's diamond, would demand—

a mishkâl	(8)	weight of	73.7	grains.
a tola	(3⅓)	,,	176.85	,,
a tank	(10)	,,	58.95	,,
a másha	(40)	,,	14.745	,,
a rati	(320 of 8 to the masha)		1.8425	,,
——	(240 of 6 ,,)		2.533	,,

Now, as to the mishkál—the Mahommadan writers speak of it as not having altered from the days of the Prophet. Doubtless, it has been a pretty permanent weight, and very likely, in Makrizi's time, was but slightly various in different places. At present, the following table represents the different mishkáls, so far as I have been able to ascertain them.

The gold and silver mishkál of *Bassorah* = 1½ dirham	= 72 grains.
The ,, ,, mussal or mishkal of *Gamroon* (71,75 miscals = 100 mahmoudias = 5136 grains)	= 71.6. ,,
The gold and silver miscal of *Mocha* = 24 carats = 24$\frac{1}{160}$ vakya (of 480 grains, nearly)	= 72 ,,
That of *Bushire* = $\frac{1}{720}$ of a maund of 53784 grains	= 74.7 ,,
The metical of *Aleppo* and *Algiers*	= 73 ,,
The ,, of *Tripoli*	= 73.6 ,,
In *Persian*, the demi mishkâl = $\frac{1}{1200}$ of the batman of Chessay (of 8871 grains) .... The taurid batman and mishkâl = half the above	= 73.96 ,,
The mishkâl corresponding to the (½) dirham used for gold and silver, in Persia	= 74.5 ,,
The abbasi corresponding to 1 mishkâl, Marsden says	= 72 ,,
The modern debased mishkâl of *Bokhara*	= 71 ,,

Báber, in speaking of the mishkâl, may either mean his own Bokharan mishkâl, or, as seems more probable, the current mishkâl as existing at that time in India, in short, the "Indian or Syrian mishkâl" of the Mahommadan writers—which was the Greek mishkâl + 2 kirats. The modern debased mishkâl of Bokhara we may leave out of our comparisons. It is surely a degraded weight in a country that has undergone an eclipse.

The old "Greek Dinar" is of course the Byzant, or solidus aureus—the denarius of Byzantium. It was nominally coined 72 to the Roman lb. The Byzantian Roman lb. in the British Museum weighs 4995 grains, so the solidus or, as is more probable, elaborated out of the elements of ancient

was *nomminally* coined at 69.4 grains. It *really* issued from the mint at a maximum weight of 68 (a very few of the most finely preserved coins reaching this amount). Now taking Makrizi's statement that the mishkâl was 24 kirats, and that of the Ayin-i-Akberi that the Greek mishkâl was 2 kirats less than this; we find the weight of the mishkâl $= 68 + \frac{68}{11} = 74.18$ grains troy Again, Makrizi mentions that Abdel-malek-ben-Merwah coined dinars and dirhams in the ratios of $21\frac{3}{4}$ kirats : 15 kirats. Now this Caliph's gold coins in the British Museum (in a very fine state of preservation), weigh 66.5 grains, and his silver, also well preserved, 44.5. Taking the former as coined at 67, we have the ratio :

$$\text{Dinar} : \text{Dirham} = 21\tfrac{3}{4} : 15 = 67 : 46.2,$$

Which latter gives a probable weight for the dirham as originally coined. (In Makrizi's time the ratio was dinar : dirham $= 10 : 7 = 21.75 : 15.22$; or supposing the gold coin unchanged at 67, the silver dirham would become 46.88). Then, as the ratio of the dinar (or gold mishkâl) to the mishkâl weight $= 21\frac{3}{4} : 24$, we have for the mishkâl weight a value of 73.93 grains.

These two values, thus severally adduced from different data—viz., 74.18 and 73.93—sufficiently nearly accord to justify, I think, our striking the balance between them, and declaring of the ancient mishkâl—("the Syrian or Indian mishkâl") to have been very nearly 74 grains. Hence the kirats would be 3.133 grains, troy. The modern carat varies from 3.15; the modern Indian carat to 3.28, the old French carat (made this probably to be an aliquot part of the old French ounce). The English carat = 3.168; the Hamburgh = 3.176, and the Portuguese = 3.171.

The above value of the mishkâl accords extremely well with my theory about the diamond.

That the "Greek Dinar" of Makrizi was the Sassanian gold is not at all likely, although the silver dirham was, no doubt, originally derived from the Sassanian drachma. Of the few gold pieces of Sassanian coinage, the one in the Museum, of Ardashir I., weighs now 65.5, and could not have been coined at less than 66.5 grains—which would give a mishkâl of 72.04. But under the Sassanidæ, the gold coinage was quite exceptional, and was not large enough to have formed the basis of the monetary system of the Caliphs, which was professedly founded on Greek coins, *current.*

As to the Bokháran mishkál of Báber's time, how are we to arrive at it? You—and if you can't, who can?—are able to make little firm ground out of the weights of Sassanian, or Ghasnavid coins—nor will the coins of the Ayubite, Mamluke and Mamluke Bahrite Caliphs (of which I have weighed scores), give any much more reliable units on which to base the history of the progress of change in the mishkâl. The limits of its variation in modern times seem to have lain between 74.5 and 72 troy grains; I believe 74 as a near as possible its true original weight, the weight of the Syrian and of the Indian mishkâl. This would give the rati on the goldsmith's standard of 8 to the masha, and 49 to the mishkâl, as 1.85 grains, and the limits of this rati would be 1.862 and 1.80. The value of the jeweller's rati (6 to the mashi) would be for the 74 grain mishkâl 2.47 grains, and its limits would be 2.483 and 2.40.

That Báber's and Humayûn's now worn and dilapidated coins of 71 and 71.5 grains were mishkâls, is not improbable; but they certainly were not coined at less than 74 grains.

Without entering into the Indian numismatical question, I may remind you of Tuglak's coin of 174 grains (one in the British Museum = 172.25), probably coined at 175 or 176; a fair weight of issue for a coin nominally of some 177 or 178 grains. These coins, I believe, you consider to represent the tola. A tola of 177.6 would accord on the ratios of Báber's table with a mishkâl of 74 grains. I am strongly tempted to enter further into this question of the ponderary systems of India, but I am warned by your own able papers of the difficulties in the path of one who deals only in translations and in the weight of coins.

24th Nov., 1865.

Indian Metrology—may be quoted in their surviving integrity of weight and design, as having furnished the prototypes of a long line of sequent Dehli mintages, and thus contributing the manifest introductory model of all Bengal coinages.*

The artistic merits of the produce of the southern mints, though superior in the early copies to the crude introductory issues of Altamsh, seldom compete with the contemporary design or execution of the Dehli die-cutters, and soon merge into their own provincialisms, which are progressively exaggerated in the repetition, until, at last, what with the imperfection of the model, the progressive conventiona-

* There three are varieties of Altamsh's silver coinage, all showing more or less the imperfection of the training of the Indian artists in the reproduction of the official alphabet of their conquerors. The designs of these pieces were clearly taken from the old Ghazní model of Muhammad bin Sám's Dirhams and Dínárs, and the indeterminate form of the device itself would seem to indicate that they mark the initial effort of the new Muhammadan silver currency which so soon fixed itself into one unvarying type, and retained its crude and unimproved lettering for upwards of a century, till Muhammad bin Tughlak inaugurated his reign by the issue of those choice specimens of the Moneyer's art which stand without compeers in the Dehli series.

No. 1, Silver. Size, vii.; weight, 162.5. Supposed to have been struck on the receipt of the recognition of the Khalif of Baghdád in 626 A. H.

Obverse: square area, with double lines, within a circle.

Legend, لا اله الله محمد رسول الله

Reverse: Square area, with double lines, within a circle.

Legend, قى عهد الامام المستنصر امير المومنين

No. 2, Silver. Size, viii.; weight, 168.5. Date, 630 A. H.

Obverse: Square area, with double lines,

Legend, السلطان الاعظم شمس الدنيا و الدين
ابو المظفر اليتمس السلطان ناصر امير المومنين

Reverse: Circular area.

Legend, لا اله الا الله محمد رسول الله المستنصر
امير المومنين

Margin, ضرب هذا اله

Mr. Bayley notices the occasional change of the name of the piece to the generic السكة as well as the ignorant substitution of المستنصر بامر الله for the Khalif's true title. J. A. S. B., 1862, p. 207. Col. Guthrie's coin (Type No. 2) discloses a similar error.

Legend, في عهد الامام المستنصر امير المومين
Margin, ضرب هذة الفضة

No. 3, Silver. Size, viii.; weight, 163.5 gr.

Obverse, as No. 2, but the square area is enclosed in a circle.

Reverse: Square area enclosed within a circle, identical with the obverse design.

lism of the designers, and the ignorance and crude mechanical imitation of the engravers, their legends become mere semblances of intelligible writing, and, as the plates will show, like Persian *shikastah*, easy to read when one can divine what is intended, but for anything like precision in obscure and nearly obliterated margins, a very untrustworthy basis for the search after exact results.

The different mints each followed its own traditions, and the school of art stood generally at a higher level in the eastern section of the kingdom, especially when Sonárgaon was held by its own independent rulers. The lowest scale of die execution, exemplified in the present series, was reserved for the capital of the united provinces under the kingship of Sikandar (No. 23 infrâ). The numismatic innovations of Muhammad bin Tughlak, were felt and copied in the south, especially in the reproduction of the titular legends, but his own coins struck at the "city"—he would not call it capital—of Lakhnautí, evince the haste and carelessness of a temporary sojourn, and still worse, the hand of a local artist, all which short-comings may be forgiven to a monarch who in his own imperial metropolis had raised the standard of the beauties of Arabic writing, as applied to coin legends, to a position it had never before attained, and which later improved appliances have seldom succeeded in equalling.

The Bengal Sultáns, mere imitators at first, were original in their later developments of coin illumination, and the issues of the fully independent kings exhibit a commendable variety of patterns in the die devices, damaged and restricted, however, in the general effect by the pervading coarseness and imperfection of the forms of the letters. Then, again, the tenor of the inscriptions is usually of independent conception, especially in the refusal to adopt the ever recurring *kalimah*, and in the suggestive mutations of titles assigned to the lieutenants of the prophet on earth, whose names they did not care to learn. So also was their elaboration of the titular adjuncts of the four Imáms uninfluenced by northern formula; many of which conventionalisms survived for centuries, till Shír Sháh, in the chances of conquest, incorporated them into the coinage of Hindustán, during the exile of the temporarily vanquished Humáyún.

The standard of the Bengal coinage was necessarily, like the pieces themselves, a mere imitation of imperial mint quantities, and the early issues will be seen to follow closely upon the proper amount in weight contemplated in the Dehli prototypes; but one of the curious results the Kooch Behár collective find determines is, that though the first kings on the list clearly put forth money of full measure, their pieces were, in most cases, subjected to a well understood Indian process of boring-out, or reduction to the exact weight to which we must suppose subsequent kings lowered the legal standard of their money, so that, although some of the silver pieces of Kai Káús and Fírúz have escaped the debaser's eye, and preserve the completeness of their original issue denomination, the great majority of the older coins have been brought down to the subsequent local standard of 166 grains, at which figure, in troy grains, the bulk of the hoard ranges; or, in more marked terms, 166 grains is the precise weight of the majority of the very latest and best preserved specimens, which must have been consigned to their recent place of concealment when very fresh from mints but little removed from the residence of the accumulator of the treasure, and be held to represent coin which could scarcely have changed hands.

The intrinsic value of the money of these sovereigns follows next in the order of the enquiry. This department of fiscal administration might naturally have been expected to have been subject to but limited check or control, when regulated by the uncertain processes of Oriental metallurgy; but, in practice, it will be seen that some of the native Mint-masters were able to secure a very high standard of purity, and, what is more remarkable, to maintain a singularly uniform scale in the rate of alloy. In the case of the imperial coins subjected to assay in Calcutta, specimens spreading over, and in so far, representing a sequent eighty years of the issues of the northern metropolis, vary only to the extent of six grains in the thousand, or 0.6 per cent. As the Dehli coinage proves superior, in point of weight, to the southern standard, so also does it retain a higher degree of purity; the 990 and 996 of silver to the test total of 1,000 grains, sinks, in the earliest examples of the Bengal mintages, to 989, from which figures it experiences a temporary rise, in possibly exceptional cases, under Bahádur Sháh, who may be supposed to have brought down, with his reinstituted honours and the coined treasure so lavishly bestowed upon him by Muhammad bin Tughlak, on his restoration to the government of

Sonárgaon, certain implied responsibilities for the equity and fulness of his currencies; while in the subsequent irregularly descending scale, Azam Sháh's officials arrived at the most unblushing effort of debasement, in the reduction of silver to 962 grains. Among other unexpected items for which the aid of modern science may be credited, is the support which the intrinsic contents of the erroneously-classed coins of Adil Sháh under native interpretation, lend to the correctness of the revised attribution of the pieces themselves suggested by the critical terms of their own legends, in the manifest identity of their assay touch with the associate coins of the lower empire of India.

Colonel Guthrie has furnished me with the following data, concerning the assay of the various coins composing the Kooch Bahár hoard:—" When the Bengal Asiatic Society made their selection of coins from the trove, they set apart four of each description for the Mint, two being for special assay, two for the Mint collection. The result of the assay was as follows (1,000 represents absolute purity) :"

DEHLI COINS.

1. Balban (A. H. 664) ... 990 and 996
2. Kai Kobád (A.H. 685) 990 and 996
3. Ghiás-ud-din Tughlak (A. H. 720) 990.
4. Adil Sháh [*i. e.* Ghází Sháh of Bengal, A.H. 751] 989.

BENGAL COINS.

1. Shams-ud-dín Firuz............ 989
2. Bahádur Sháh ...... 988 and 993
3. Mubárak Sháh 987
4. Iliás Sháh (1st type) 989; (2nd) 982; (3rd) 988.
5. Sikandar Sháh (return lost).
6. Azam Sháh (1st type) 981; (2nd) 989; (3rd) 962; (4th) 977; (5th) 985.

A question that has frequently puzzled both Oriental and European commentators on the history of India, has been the intrinsic value of the current coin at the various epochs referred to, so that the most exact numerical specifications conveyed but a vague notion of the sterling sum contemplated in the recital by any given author. Numismatists have been for long past in a position to assert that the Dehli Tankah contained absolutely 173 grains, which would presuppose a theoretical issue weight of 174 or 175 grains, and a touch of nearly pure silver; but assuming this specific coin to have been a *white* or *real* " Tankah of Silver" (تنکۀ نقره) a doubt necessarily remained as to what was to be understood by the alternative black Tankah (تنکۀ سیاه). Nizám-ud-din Ahmad, in his Tabakát-i-Akbari, seems to assign the introduction of these black Tankahs to Muhammad bin Tughlak, who notoriously depreciated the currency to a large extent, before he resorted to the extreme measure of a forced currency, though it may be doubted whether any such depreciation would have been thought of, even if there had been time to effect the conversion, at the very commencement of his reign, to which period Nizám-ud-din attributes the issue of these pieces, in the apparent desire of explaining the bare possibility of the possession of such numerical amounts as are stated to have been squandered in largesses by the newly-enthroned monarch. However, the real debasement of the coin need not have extended much beyond the point indicated by the superficial aspect of his own Bengal mintages, and Azam Sháh's coins of the same locality probably exceed that accusatory measure of debasement; while, on the other hand, Muhammad bin Tughlak, on reverting to specie currencies, after his futile trial of copper tokens, seems to have aimed at a restoration of the ancient purity of metal in his metropolitan issues, as I can quote a coin of his produced by the Dehli Mint in A. H. 734, which has every outward appearance of the component elements of unalloyed silver, and equally retains the fair average weight of 168 grains.* All these evidences would seem to imply that the Bengal ratio of purity was intentionally lower, and that a very slight addition to the recognised alloy would bring the local issues fairly within the category of black Tankahs. Such a supposition of the inferiority of the coinages of the southern kingdom appears to be curiously illustrated by Báber's mentioning that, in A. H. 932, a portion of the revenues of the district of Tirhút, a sort of border-land of his kingdom, which did not extend over Bengal, was payable in *Tankah Nukrah*, and the larger remainder in *Tankah Siáh*,† an exceptional association of cur-

* This coin is similar, but not identical in its legends with the gold piece, No. 84, of 736 A. H., p. 50 Pathán Sultáns. The following are the inscriptions:

Obverse— و الله الغني و انتم الفقرا

Reverse— في عهد محمد بن تغلق

Margin— بدار الاسلام سنة اربع و ثلثين و سبعماية.

† Báber has left an interesting account of the revenues of his newly-acquired kingdom in India, as estimated after the battle of Panipat, in A. H. 932, to the effect that "the countries from Bhíra to Bahár which are now under my dominion yield a revenue of 52 krores" of Tankahs. In the detail of the returns from different provinces, Tirhút is noticed as Tribute (Khidmatána) of the Tirhúti Rajah 250,000 *tankah núkrah*, and 2,750,000 *tankah siáh*. William Erskine, History of India under Báber and Humáyun, London, 1854, vol. i., p. 540. See also Leyden's Memoirs of Báber, London, 1826, p. 334.

rencies in a given locality, which can scarcely be explained in a more simple and reasonable manner than by assuming the lower description of the conventional estimate piece to have been concurrent with a better description of the same coin, constituting the prevailing and authorized revenue standard of the northern portions of the conquering Moghul's Indian dominions.

Another important element of all currency questions is the relative rate of exchange of the precious metals *inter se.* And this is a division of the enquiry of peculiar significance at the present moment, when Her Majesty's Government are under pressure by the European interest to introduce gold as a legal tender at a fixed and permanent rate, or, in effect, to supersede the existing silver standard, the single and incontestable measure of value, in which all modern obligations have been contracted, and a metal, whose present market price is, in all human probability, less liable to be affected by over production than that of gold: the bullion value of which latter had already begun to decline in the Bazárs of India, simultaneously with the arrival of the first fruits of Australian mining.

If the contemplated authoritative revolution in the established currency had to be applied to a fully civilized people, there might be less objection to this premature experiment; but to disturb the dealings of an empire, peopled by races of extreme fixity of ideas, to give advantages to the crafty few, to the detriment of the mass of the unlettered population, is scarcely justified by the exigencies of British trade, and India's well-wishers may fairly advance a mild protest against hasty legislation, and claim for a subject and but little understood Nationality, some consideration before the ruling power forces on their unprepared minds the advanced commercial tenets of the cities of London and Liverpool.

The ordinary rate of exchange of silver against gold in Marco Polo's time (1271-91 A. D.),* may be inferred to have been eight to one;

* The Province of KARAIAN. "For money they employ the white porcelain shell found in the sea, and these they also wear as ornaments about their necks. Eighty of the shells are equal in value to a saggio of silver, or two Venetian groats, and eight saggi of good silver to one of pure gold." Chap. xxxix.

The Province of KARAZAN. "Gold is found in the rivers, both in small particles and in lumps; and there are also veins of it in the mountains. In consequence of the large quantity obtained, they give a saggio of gold for six saggi of silver. They likewise use the before-mentioned porcelain shells in currency, which, however, are not found in this part of the world, but are though exceptional cases are mentioned in localities within the reach of Indian traders, where the ratios of six to one and five to one severally obtained.

Ibn Batutah, in the middle of the fourteenth century, when he was, so to say, resident and domesticated in India, reports the relative values of the metals as eight to one.*

brought from India."—Chap. xl.; also Pinkerton (London, 1811), vol. vii., 143.

The Province of Kardandan. "The currency of this country is gold by weight, and also the porcelain shells. An ounce of gold is exchanged for five ounces of silver, and a saggio of gold for five saggi of silver; there being no silver mines in this country, but much gold; and consequently the merchants who import silver obtain a large profit." Chap. xli.

The Kingdom of Mien (*Ava*). "You then reach a spacious plain [at the foot of the Yunnan range], whereon, three days in every week, a number of people assemble, many of whom come down from the neighbouring mountains, bringing their gold to be exchanged for silver, which the merchants who repair thither from distant countries carry with them for this purpose; and one saggio of gold is given for five of silver." Chap. xliii. Travels of Marco Polo, by W. Marsden, London, 1818; and Bohn's Edition, 1854.

* رايت الارز يباع في اسواقها خمسة و عشرين رطلا دهلية بدينار فضى الدينار الفضى هو ثمانية دراهم و درهمهم كالدار هم النقرة سواءً iv. 10,

"J'ai vu vendre le riz, dans les marchés de ce pays [Bengale], sur le pied de vingt-cinq rithl de Dihly pour un dínár d'argent : celui-ci vaut huit drachmes, et leur drachme équivaut absolument á la drachme d'argent." (iv. 210.)

The difficulty of arriving at any thoroughly satisfactory interpretation of theocbscure Arabic text, as it now stands, may be frankly admitted, nor do I seek to alter or amend the French translation, further than to offer a very simple explanation of what probably the author really designed to convey in the general tenor of the passage in question. It was a crude but established custom among the early Muhammadan occupying conquerors of India, to issue gold and silver coins of equal weights, indentical fabric, and analogous central legends; hence, whenever, as in the present instance, the word *Dinár* is used in apposition with and contrast to the secondary term *Dírham*, the one *primá facie* implies gold, the other silver; and there can be little doubt but that the original design of the text was to specify that one gold piece of a given weight passed *in situ* for eight silver pieces in similar form and of slightly greater bulk. It is possible that the term *Dínár* may in process of time have come to stand for a conventional measure of value, like the "pound sterling," susceptible by common consent of being liquidated in the due equivalent of silver; but this concession need not affect the direct contrast between the Dínár and Dirhams so obviously marked in the case in point.

Ibn Batutah, in an earlier part of his work (iii. 426), [Lee's edition is imperfect at this portion, p. 149] gives us the comparative Delhi rate of exchange—of which he had unpleasant personal experiences: he relates that he was directed to be paid (55,000 + 12,000 =) 67,000 pieces of some well understood currency, neither the name or the metal of which is defined, but which may legitimately be taken to have been "Silver Tankahs," and in satisfaction of this amount, deducting the established one-tenth for *Dastúrí*, which left a reduced total of 60,300, he received 6,233 gold tankahs. Under this scale of payment the gold must have borne a rate of exchange of one to 9.67 of silver, or very nearly one to 10, a proportion which might be supposed to clash with the one to eight of the more southern kingdom, but the existing state of the currencies of the two localities afford a striking illustration of the consistency

The Emperor Akbar's minister, Abúl Fazl, has left an official record of the value of gold in the second half of the sixteenth century, at which period the price was on the rise, so that the mints were issuing gold coin in the relation of one to 9.4 of silver. But a remarkable advance must have taken place about this time, as in the second moiety of the seventeenth century, Tavernier* found gold exchanging against fourteen times its weight of silver, from which point it gradually advanced to one to fifteen, a rate it maintained when the East India Company re-modelled the coinage in 1833.†

of the African observer's appreciation of money values in either case. His special patron, Muhammad bin Tughlak, Emperor of Dehli, had, from his first elevation to the throne, evinced a tendency to tamper with the currency, departing very early in his reign from the traditional equality of weights of gold and silver coins; he re-modelled both forms and relative proportions, introducing pieces of 200 grains of gold, styled on their surfaces *dínárs*, and silver coins of 140 grains, designated as *adalis*, in supersession of the ancient equable tankahs, both of gold and silver, extant examples of which in either metal come up to about 174 grains. More important for the present issue is the practical result, that, from the very commencement, Muhammad Tughlak's silver money is invariably of a lower standard than that of his predecessors, whether this refers to the early continuation of the full silver tankah, or to his own newly devised 140 grain piece, a mere reproduction of the time-honoured local weight, which the Aryan races found current in the land some twenty-five centuries before this Moslem revival; but in either case, this payment to Ibn Batutah seems to have been made after the Sultan had organised and abandoned that imaginary phase of perfection in the royal art of depreciating the circulating media, by the entire supercession of the precious metals, and following the ideal of a paper currency, the substitution of a copper simulacrum of each and every piece in the order of its degree from the *Dínár* to the lowest coin in the realm, the values being authoritatively designated on the surface of each. This forced currency held its own, more or less successfully, from 730 to 733, when it came to its simple and self-developed end. Taking the probable date of this payment as 742-3 A. H. (Ibn B. vi., p. 4, and vol. iii., p. xxii.), it may be assumed that the 174 (or 175) grain old gold tankah, which had heretofore stood at the equitable exchange of one to eight tankah's of good silver, came necessarily, in the depreciation of the new silver coins, to be worth ten or more of the later issues. Pathan Sultans, p. 53).

* "All the gold and silver which is brought into the territories of the Great Mogul is refined to the highest perfection before it be coined into money."—Tavernier, London Edition, 1677, p. 2. "The roupie of gold weighs two drams and a half, and eleven grains, and is valued in the country at 14 roupies of silver."—Page 2. "But to return to our roupies of gold, you must take notice that they are not so current among the merchants. For one of them is not worth above fourteen roupies." The traveller then goes on to relate his doleful personal experiences, of how, when he elected to be paid for his goods in gold," the king's uncle " forced him to receive the gold rupee at the rate of fourteen and a half silver rupees, whereby he lost no less than 3428 rupees on the transaction. Sir James Stewart, writing in 1772, also estimates the conventional proportionate value of silver to gold, as fourteen to one—"The Principles of Money applied to the present state of the Coin of Bengal." Calcutta, 1772.

† Prinsep's Useful Tables, pp. 5, 72, 79.

Afterwards, with prospering times, the metal ran up occasionally to fabulous premiums, to fall again ignominiously when Californian and Australian discoveries made it common in the land.

I revert for the moment to a more formal recapitulation of the computations, which serve to establish the ratios of gold and silver in Akbar's time.

Abúl Fazl's figured returns give the following results :—

First.—Chugal, weight in gold Tolah 3, Másha 0, Rati $5\frac{1}{4}$=30 Rs. of $11\frac{1}{2}$ Máshas each : 549.84: : 172.5×30 (5175.0) : 1 : : 9.4118.

Second.—Áftábí, gold, weight T. 1, M. 2, R. $4\frac{3}{4}$=12 Rs. : 218.90 : : 172.5 × 12 (2070.0) : 1 : : 9.4563.

Third.—Ilahí, or Lál Jalálí, also Muíanni, gold, weight M. 12, R. $1\frac{3}{4}$=10 Rs. : 183·28 : : 172·5 × 10 (1725·0) : 1 : : 9·4118.

3 A.—The larger piece, the Sihansah, in value 100 Lál Jalálís, gives an identical return. Weight in gold, T. 101, M. 9, R. 7 = 1000 Rs. : 18328· : : 172,500 (172·5 × 100 × 10) : 1 : : 9·4118.

Fourth.—Adl.-Guṭkah, or Muhar, also called Mahrábí, gold, weight 11 Máshas=9 Rs. : 165 : : 172·5×9 (1552·5) : 1 : : 9·40909.

4 A.—The higher proportions specified under the piece of 100 round Muhars, produce a similar result. Weight in gold, T. 91, M. 8=900 Rs. : 16500 : : 155250· (172·5 × 100 × 9) : 1 : : 9·40.

These sums are based upon the ordinary Tolah of 180 gr., Másha of 15, and Rati of 1·875 grs. The question of corresponding values in the English scale need not affect the accuracy of comparisons founded upon the conventional measure by which both metals were estimated.

I have given more prominence to the above calculations, and even tested anew my earlier returns by the independent totals afforded by the larger sums now inserted, because the obvious result of gold being to silver as one to 9·4, has been called in question by an official of the Calcutta Mint (a Dr. Shekleton), who, however, while unable either to correct my data, or to produce any possible evidence against my conclusions, ventures to affirm, that "9·4 to one is a relative value of gold to silver, which never could really have existed."* Nevertheless, here is a series of comparative weights and values, furnished by the highest authority of the day, and each and all pro-

* Jour. As. Soc. Bengal, 1864, p. 517.

duce returns absolutely identical up to the first place of decimals. My original estimates were sketched and published at Dehli, in 1851, where I had access to the best MSS., to the most comprehensive range of antiquarian relics, and at command the most intelligent oral testimony in the land. When reprinting Prinsep's "Useful Tables" (London, 1858), I had occasion to quote these calculations, and was able to fortify them, had it been needed, by the precisely analogous results obtained by Colonel W. Anderson, who had tried Abúl Fazl's figures, from a different point of view, and for altogether independent purposes.* But if there were the faintest reason for doubting so moderate rate as one to 9·4, the whole discussion might be set at rest by Abúl Fazl's own statement as translated into English in 1783 when, in concluding a very elaborate review of the profit and loss of refining gold, for the purpose of coinage, he concludes, and the process "leaves a remainder of about *one-half a tolah* of gold, the value of which is four rupees."† It may be as well that I should add, that some of my totals differ from those to be found in Gladwin's translation of the original Persian text.‡ I do not recapitulate the several divergencies, but it is necessary to prove the justice of one, at least, of my emendations. Gladwin's MSS. gave the rupee at 11¼ *mâshas*, (i. p. 34). The more carefully collated Dehli texts showed the real weight to be 11·5 *máshas,* a static fact of some importance, which is curiously susceptible of proof from Gladwin's own data: at page 46 of his Calcutta edition, a sum is given of the refining charges and profits, as understood by the mints of those days, wherein 989 tolas, 9 máshas of impure silver is stated to be reduced by 14 T. 9 M. 1 R. in refining, and a further 4 T. 10 M. 3 R. in manipulation, leaving 11641 *máshas* of silver (989. 9. 0. — 14. 9. 1. — 4. 10. 3. = 11641) which is officially announced as ordinarily coined into 1012 rupees, (1012 × 115=11638) giving, as nearly as may be, the essential 11½ máshas, which the translated text *should* have preserved in its earlier passages.

Richard Hawkins, who was at Agra in A. D. 1609-11, during the reign of Jahángír, has left a notice of certain accumulated treasures of that prince which he was permitted to behold, and amongst the rest he specifies, "In primis, of Seraffins Ecberi, which be ten rupias

* U. T., Vol. ii., p. 32. † Gladwin, i. 44. ‡ 4to., Calcutta, 1783.

apiece ;" to this passage is added in a marginal note, that, "a tole is a rupia challany [current] of silver, and ten of these toles are of the value of one of gold."* This evidence might at first sight seem to militate against the conclusion arrived at from the official returns above summarized, but the value of gold was clearly on the rise, and one of the aims of Akbar's legislation on metallic exchanges, which had necessarily been disturbed by progressive modifications in the relative values of the precious metals, was manifestly to secure an authoritative *even* reckoning by tens and hundreds. The old round *muhar*, (No. 4 of the above list) represented the inconvenient sum of nine rupees, or 360 *dáms ;* by raising the weight of the piece to the higher total given under No. 3, the gold *iláhí* was made equivalent to ten rupees, or in fiscal reckoning to 400 *dáms.* Similarly, in the case of the silver coin, the old rupee passed for 39 *dáms*, in the new currency a value of 40 *dáms* was secured, not by an increase of weight, but by the declared and doubtlessly achieved higher standard of the metal employed, aided by the advantage that contemporary mintages so readily secured in India.

The subdivisions of the standard silver Tankah, as well as the relative exchange ratios of silver and copper in their subordinate denominations, claim a passing notice. Though Bengal proper probably remained satisfied with its lower currency of cowries, supplemented by the occasional intervention of copper, for some time after the introduction of gold and silver money, yet as the earliest copper coins of that kingdom must have been based upon and, in the first instance, supplied by Dehli mintages, the Imperial practice comes properly within the range of the local division of the general enquiry.

It has been seen that Minháj-ul-Siráj, in comparing the circulating media of Hindustán and Bengal, speaks of the currency of the former as composed of *Chitals*, a name which is seemingly used by himself and succeeding authors in the generic sense for money, as if these pieces continued to constitute the popular standard both in theory and practice, notwithstanding the introduction of the more imposing *tankahs* of gold and silver. Up to this time it has not been possible satisfactorily to demonstrate the actual value of the coin in question; in some cases indirect evidence would seem to bring its intrinsic worth down to a very low point, while at times the money calcula-

* Purchas' Travels, folio, 1625-26, i. 217.

tions for large sums, in which its name alone is used, appear to invest it with a metrical position far beyond the subordinate exchanges of mere bazár traffic.

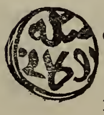
In the details of the "prices-current" in the reign of Alá-ud-dín Muhammad, as well as in the relation of certain monetary re-adjustments made by Fírúz Sháh III., the name of the *Chital* is constantly associated in the definition of comparative values with another subdivision entitled the Káṇi, which may now be pronounced with some certainty to have been the $\frac{1}{64}$ of the original *Tankuh*, of 175 grains, and $\frac{1}{50}$ of the new silver coin of 140 grains, introduced by Muhammad bin Tughlak. The temporary forced currency of this Sultán necessitated in itself the positive announcement of the names and authoritative equivalents of each representative piece, and this abnormal practice contributes many items towards the elucidation of the quantitative constitution of the real currency of the day, which these copper tokens were designed to replace. In illustration of this point, I insert a woodcut and description of a brass coin, which was put forth to pass for the value of the silver piece of 140 grains, to whose official weight it is seemingly suggestively approximated.

Brass; weight, 132 grs.; A. H. 731; *Common.* *Obverse.*— مهرشد تنكه پنجاه كاني در روزگار بنده اميدوار, محمد تغلق Struck (lit. *sealed*), a tankah of fifty káṇis in the reign of the servant, hopeful (of mercy), Muhammad Taghlak.

Reverse.—Area, الرحمن. من اطاع السلطان فقد اطاع "He who obeys the king, truly he obeys God."*

Margin, در تخت گاه دولت‌اباد شال برهفصد سي يك. At the capital Daulat-ábád, year? 731.

In addition to this 50 *káṇi*-piece may be quoted extant specimens



of this Sultán's forced issues, bearing the definitive names of "*hastkáṇi*" (8 káṇis). "*Shash-káṇi.*" (6 kánis) and *Do-káṇi* (2 káṇis.) An obverse of the latter is given in the margin. The reverse has the unadorned name of محمد تغلق.

* In other examples of the forced currency, he exhorts his subjects in more urgent terms to submit to the Almighty, as represented in the person of the ruling monarch, and to adopt, in effect, the bad money he covers with texts from the Kurán—the "Obey God and obey the Prophet and those in authority among you," and "Sovereignty is not conferred upon every man," but "some" are placed over "others"—were unheeded on his coinage of pure metal.

Next in order, may be quoted historical evidence of Fírúz Sháh's fiscal re-organizations, in the course of which mention is made of pre-existing pieces of 48, 25, 24, 12, 10, 8, and 6 ḵáṉis, the lowest denomination called by that name; afterwards the narrative goes on to explain that, in addition to the ordinary *Chital* piece already in use, Fírúz Sháh originated, for the benefit of the poorer classes of his subjects, subdivisional $\frac{1}{2}$ Chital and $\frac{1}{4}$ Chital pieces.

As the spoken languages of the Peninsula enables us to restore the true meaning to the misinterpreted Sanskrit *karsha*,* so the Dravidian tongues readily explain the term *káṇi*, which finds no place in Aryan vocabularies, but which was incorporated into the vernaculars of Hindustán, during the southward migrations of the Scythic tribes. In Telugu, *káṇi* means $\frac{1}{64}$, or one quarter of a sixteenth" (Brown). In Canarese $\frac{1}{64}$ (Reeve), and in Tamil $\frac{1}{80}$ (Winslow). Wilson's Glossary gives "*Káṇi*, corruptly, *Cawney*. Tel. Tam. Karn. $\frac{1}{80}$, or sometimes $\frac{1}{64}$."†

The term *káṇi*, in addition to its preferable meaning of $\frac{1}{64}$, was, as we see, also used for the fraction $\frac{1}{80}$, but its application in the former sense to the ruling integer in the present instance, seems to be conclusively settled by the relative proportions assigned to the modified *tankah* of Muhammad bin Tughlak, when compared with the normal weight of the earlier coin (: 64 : : 175 : 50 : : 136·718).

The method in which the subdivisional currency was arranged, consisted, as has already been stated, of an admixture of the two metals, silver and copper, in intentionally varying proportions in pieces of identical weight, shape and device; so that the traders in each case had to judge by the eye and hand of the intrinsic value of the coin presented to them. To European notions this system would imply endless doubt and uncertainty, but under the practised vision and delicate perceptive powers of touch, with which the natives of India are endowed, but little difficulty seems to have been experienced; and I myself can testify to the accuracy of the verdicts pronounced by the experienced men of Delhi, whose instinctive estimates were tested repeatedly by absolute assay. I published many of these

* Num. Chron. iv. 58; J. A. S. B. xxxiii. 266.

† There is a coin called a "Do-gáni or Doodee," still quoted in the Madras Almanacks.

results, some years ago, in the Numismatic Chronicle,* where the curious in these matters may trace many of the gradational pieces of the *káṉis* above enumerated. As some further experiments in reference to the intrinsic values of these coins were made, at my instance, in the Calcutta Mint, I subjoin a table of the authoritative results, which sufficiently confirms the previous less exhaustive assays by the native process.

LIST OF DEHLI COINS,

Composed of Silver and Copper in varying proportions, forwarded for examination by Edward Thomas, Esq., C. S., 10th June, 1853.

No. of Packet.	A. H.	Reference to Numbers of Coins in "Pathán Sultans."	No. of Coins in Parcel.	Weight in Grains.	Dwts. Fine Silver per ℔. in each.
1	716	Mubárak Sháh. No. 66.	1	53.22	5.375
2	726	Muhammad bin Tughlak. No. 91.	1	55.15	13.300
3	895	Sikandar Bahlol. No. 163.	1	143.438	1.900
4	896	" "	4–1	142.163	2.025
"	"	" "	1	142.936	1.925
"	"	" "	1	138.913	1.615
"	"	" "	1	140.088	2.200
5	898	" "	1	141.500	1.5625
6	900	" "	2–1	140.800	2.6000
"	"	" "	1	127.600	3.0125
7	903	" "	1	143.100	4.650
8	904	" "	3–1	142 500	5.624
"	907	" "	3–1	143.250	15.5
"	"	" "	1	141.150	16 0
"	"	" "	1	139.900	16.0
9	905	" "	1	144.500	17.5
10	909	" "	1	141.500	15.0
11	910	" "	1	140 200	15.0
12	912	" "	2–1	142.500	12.0
"	"	" "	1	135.500	15.0
13	913	" "	2–1	132.250	15.0
"	"	" "	1	140.750	15.0
14	914	" "	4–1	140.000	15.0
"	"	" "	1	138.500	15.5
"	"	" "	1	141.000	16.5
"	"	" "	1	140.500	16.0
15	918	" "	4–1	138 250	10.0
"	"	" "	1	133.250	10.0
"	"	" "	1	139.750	9.0
"	"	" "	1	125.000	8.0
16	919	" "	3–1	135.250	32.0
"	"	" "	1	137.250	8 0
"	"	" "	1	137.500	8.0

* Vol. xv. 1852, p. 121, *et seq.*

The Institutes of Manu have preserved a record, reproduced in the subjoined table, of the various weights in use, some centuries before Christ,* and among other things explain, that the values of gold and copper were calculated by a different metric scheme, to that applied to silver. A larger number of Ratis went to the Másha in the former, and the progression of numbers commenced with a five (5 × 16), while the silver estimates were founded on the simple arithmetic of *fours* (2 × 16), which constituted so special a characteristic of India's home civilization. Still, the two sets of tables, starting from independent bases, were very early assimilated and adapted to each other in the advancing totals, so that the 320 ratis constituting the *satamána* of the quarternary multiplication, is created in the third line by the use of a *ten*, and the quasi exotic scheme corrects its independent elements by multiplylng by *four*, and produces a similar total in the contents of the *Pala* or *Nishka*. The second lines of the tables are severally filled in with the aggregate numbers, 32 and 80, and as the duplication of the former, or 64, has been seen to

* Manu. viii. 131.—"Those names of copper, silver, and gold (weights) which are commonly used among men for the purpose of worldly business, I will now comprehensively explain. 132.—The very small mote which may be discerned in a sunbeam passing through a lattice is the first of quantities, and men call it a *trasarenu*. 133.—Eight of those *trasarenus* are supposed equal in weight to one minute poppy-seed *(liksha)*, three of those seeds are equal to one black mustard-seed (*rajasarshapa*), and three of these last to a white mustard-seed (*gaura-sarshapa*). 134.—Six white mustard-seeds ar equal to a middle-sized barley-corn (*yava*), three such barley-corns to one *krshnala* [raktika], five *krshnalas* of gold are one *másha,* and sixteen such *máshas* one *suvarna.* 135.—Four *suvarnas* make a *pala*, ten *palas* a *dharana*, but two krshnalas weighed together are considered as one silver máshaka. 136.—Sixteen of those máshakas are a silver *dharana* or *purána,* but a copper *kársha* is known to be a *pana* or *karshapana.* 137.—Ten *dharanas* of silver are known by the name of a *satamána,* and the weight of four suvarnas has also the appellation of a *nishka*." These statements may be tabulated thus as the

ANCIENT INDIAN SYSTEM OF WEIGHTS.

	SILVER.			
2 ratis	= 1 másha			
32 „	= 16 „	= { 1 dharana, or purána.		
320 „	= 160 „	= 10 „	1 satamána.	
	GOLD.			
5 ratis	= 1 másha.			
80 „	= 16 „	= 1 suvarna.		
320 „	= 64 „	= 4 „	= { 1 pala, or nishka.	
3200 „	= 640 „	= 40 „	= 10 „	= 1 dharana
	COPPER.			
80 ratis	= 1 kárshápana.			

do duty in the case, the probability of the use of the 160 naturally suggests itself in connexion with the theoretical organization of the copper coinage.

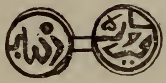
In proceeding to test the relations of the minor and subordinate currencies, the cardinal point to be determined is, the exchangeable value of copper as against silver. It has been affirmed by Colebrooke,* that the ratio stood in Manu's time at 64 to 1: accepting the correctness of this estimate, which has, I believe, remained unchallenged, and supposing the rate to have remained practically but little affected up to the Muhammadan conquest, the 175 grains of *silver* of Altamsh's new coinage would be equivalent in metallic value to 11,200 grains of *copper*. The ancient copper *kárshápana* is recognised and defined as 80 ratis in weight, so that under the above conditions, and calculating the rati at 1.75 grains, each kárshápana was equal to 140 grains, and eighty of these, under the same calculations, give a return of 11,200 grains. Without at present advancing any more definite proposition, or quoting dubious coincidences, it may be as well to test these preliminary results by the Numismatic data Fírúz Sháh's Mints have left as an heritage behind him. Among the incidents quoted regarding that monarch's monetary innovations he is stated to have introduced, for the first time, *half* and *quarter* Chitals. On the occasion of a very elaborate revision of my monograph on the Pathán Sultáns of Dehli, while residing under the very shadow of so many of their memorial edifices, I acquired and described, among others, two specimens of the money of this king, which seemed to be closely identifiable with his Utopian productions of new and infinitesimal subdivisions of the leading copper coinage, in his expressed desire of securing for the poorest of the poor, the fractional change they might be entitled to in the most limited purchases.† These coins responded singularly in their mutual proportions, and contributed in the form of once current money, definitive weights in copper amounting severally to 34.5 and 17.8 grains, from which a very low estimate was deduced of 34.8 and 17.4, as a normal official standard.

* As. Res. v. 95.

† Shams-i-Siráj, in his work entitled the Táríkh-i-Fírúz Sháhi, gives the following incidents regarding Fírúz Sháh's coinages :—

شرح بیان احوال سکّهٔ مهر شش کانی نکلست سلطان فیروزشاه در

If the 34.8 grain of the first of these be multiplied by 160, it will give a return of 5568.0 grains, and accepting this trial piece, conditionally, as Fìrúz's novel *half-Chital*,* it will be seen to furnish a general total of 11136 grains for the copper equivalent of the 175 grains of silver contained in the old Tankah, and confirms the range of the Chital at 69.6 grains, or only .4 short of the full contents tradition would assign it, as the unchanged *half kárshápaṉa* of primitive



½ Chital of Fírúz.

طور عظمت و دور مکنت خویش چون سلاطین اهل گیتي سکهاء
بچندین نوع پدید اورد چنانچه زر تنکه ونقره وسکه چهل و هشت
کانی ومهر بیست و پنجکانی و بیست وچهار کانی و دوازده کانی ودہ کانی و
هشتکانی و ششکانی ومهر یك جیتل چون فیروزشاه بچیدین اجناس
بي قیاس مهر وضع کردانید بعده در دل مبارک بالهام حضرت حق
تبارک تعالي گذرانید اگر بیچاره فقیران از اهل بازار چیزی
خرید کنند و از جمله مال نیم جیتل ویا دانکي باقي ماند آن
دوکاندار دانکه خود ندارد اگراین راهگذاري ان باقي بر او بگذارد
ضایع رود اگر ازان دوکاندار طلب کند چون این مهر نیست از
کجا چه دهد باقي او دهد برین وجوه میان بایع و مشتري مقالت
این حالت بتطویل کشید سلطان فیروزشاه فرمان فرصود که مهر
نیم جیتل که انرا ادہ گویند ومهر دانك جیتل که انرا پنکه گویند
وضع کنند تاغرض فقوا ومساکین حاصل شود

The original and unique MS., from which the above passage is extracted, is in the possession of the Nawáb Ziá-ud-dín of Lohárú, in the Dehli territory.

* I once supposed these two coins to be whole and half Chitals, instead of the half and quarter pieces now adopted.

† It may be as well to state distinctly that the most complete affirmation of the numismatic existence of a *Chital* of a given weight and value, supported even by all anterior written testimony, in no wise detracts from the subsequent and independent use of the name for the purposes of account, a confusion which perchance may have arisen from the traditional permanency of the term itself, which in either case might eventually have been used to represent higher or lower values than that which originally belonged to it. Ziá-i-Barni at one moment seems to employ the term as a fractional fiftieth of the *Tankah*, while in other parts of the same or similar documents he quotes a total of "sixty Chitals," and in his statement of progressive advances of price, mentions the rise from twenty Chitals to *half a Tankah*. Ferishtah following, with but vague knowledge, declares that fifty Chitals constituted the *Tankah;* while Abúl Fazl, who had real information on these matters as understood in his own day, asserts that the *dám* was divided "in account" into twenty-five Chitals. (See Suppt. Páthan Sultáns, p. 31; N. C. xv. 156; Ferishtah, p. 299; Gladwin A. A., I., p. 36.) Then again there seems to have been some direct association between *Chitals* and *Kánis*, as General Cunningham has published a coin which he as yet has only partially deciphered, bearing the word جتلة on the one side, and اكاني [يكاني] on the other. J. A. S. B., 1862, p. 425.

ages.† To pass to the opposite extreme for a test of the copper exchange rate, it is found that when Shír Sháh reorganised the northern coinage of Hindustán, by the lights of his southern experience, and swept away all dubious combinations of metals, reducing the copper standard to its severe chemical element; his Mint statistics show that the 178 grains of silver, constituting his revised Tankah, exchanged against 40 *dáms*, or double chitals of copper, of an ascertained quadrupled weight of 323.5 grains each, producing in all a total of 12,940 grains of the latter metal, as the equivalent of 178 grains of silver, or in the ratio of 72.69 to 1; though, even in the altered weights and modified proportions, still retaining inherent traces of the old scheme of *fours*, in the half *dám* of 80, and the quarter *dám* of 160 to the new " Rupee."

It remains to discover upon what principles the new silver coinage of Altamsh was based. That copper was the ruling standard by which the relative values of the more precious metals were determined, there can scarcely be a doubt. The estimate by Paṇas of the ancient Lawgiver, the constant reckoning by Chitals of the early Muhammadan intruders, down to the revenue assessments of Akbar, all of which were calculated in copper coin, sufficiently establish the permanency of the local custom, and the intrinsic contents of Altamsh's *Sikkah* or السکّة of 174 or 175 grains, must primarily have been regulated by the silver equivalent of a given number of Chitals. Had the old silver *Puráṇa* been still in vogue, the new coin might have been supposed to have been based upon their weights and values; three of which Puráṇas would have answered to an approximate total of 96 ratis; but although the weight of the old coin had been preserved in the more modern *Dehli-wálas*, the metallic value of the current pieces had been so reduced, that from 16 to 24 would probably have been required to meet the exchange against the original silver *Tankah;* on the other hand, although the number of 96 ratis does not occur in the ancient tables, the combination of the inconvenient number of *three* Puráṇas into one piece, is by no means opposed to Vedic ideas; and there can be no question but that the traditional 96 ratis, of whatever origination, is constant in the modern *tolah;* but, as I have said before, the question whether the new coin was designed to constitute an even *one hundred* rati-piece, which, in process of time, by wear or intentional lowering of standard weights, came to settle down to the 96 rati *tolah*, remains to be proved by the determination of the decimals in troy-grains, which ought to be assigned to the normal *rati*.

I now proceed to notice the historical bearings of the coins of the Bengal series.

Any general revision of a special subject, coincident with the discovery of an unusually large amount of new illustrative materials, owes a first tribute to previous commentators—whose range of identification may chance to have been circumscribed by more limited archæological data, the application of which may equally have been narrowed by the inaccessibility of written history, heretofore confined, as in the present instance, to original Oriental MSS., or the partial transcripts and translations incidentally made known to the European world. At the head of the list of modern contributors must be placed, in point of time, M. Reinaud, who, so long ago as 1823, deciphered and described several types of the Bengal Mintages, commencing with those of Ilíás Sháh (No. viii. of this series).* Closely following appeared Marsden's elaborate work, which, among other novelties, displayed a well-sustained sequence of Bengal coins, with corresponding engravings, *still unequalled*, though in point of antiquity producing nothing earlier than the issues of the same Ilíás Sháh, who had inaugurated the newly-asserted independence of the southern monarchy, with such a wealth of coinages.† Next in order must be cited a paper, in the Journal of the Asiatic Society of Bengal, by Mr. Laidlay, which added materially to the numismatic records of the local sovereigns, though still remaining deficient in the development of memorials of the more purely introductory history of the kingdom.‡ I myself, in the course of the publication of the Imperial Coins of the Pathán Sultáns of Dehli,§ had occasion to notice two pieces of Bahádur Sháh, one of which proved of considerable interest, and likewise coins of both Shams-ud-dín Fírúz, and Mubárak Sháh, whose defective marginal legends, however, defeated any conclusive assignment to their original producers.

* Journal Asiatique, Paris, vol. iii., p. 272.

† Numismata Orientalia, London, 1825, pp. 561-585.

‡ Vol. xv. (1846), p. 323.

§ Wertheimer, London, 1847, pp. 37, 42, 82, and Supplement printed at Delhi in 1851, p. 15. See also Numismatic Chronicle, vol. ix., pp. 176, 181; vol. x., p. 153; and vol. xv. p. 124.

The chronicles of a subordinate and, in those days, but little accessible country were too often neglected by the national historians at the Court of Dehli, even if their means of information as to the course of local events had not necessarily been more or less imperfect. Two striking exceptions to the ordinary rule fortuitously occur, at conjunctions specially bearing upon the present enquiry, in the narratives of Minháj-ul-Siráj, Juzjáni, and the "Travels of Ibn Batutah," the former of whom accompanied Tughán Khán to Lakhnauti, in A. H. 640,* where he resided for about two years. The Arab from Tangiers,† on his way round to China, as ambassador on the part of Muhammad bin Tughlak, found himself in Eastern Bengal at the inconvenient moment when Fakhr-ud-dín Mubárak was in a state of undisguised revolt against the emperor, to whom they jointly owed allegiance; but this did not interfere with his practical spirit of enquiry, or his placing on record a most graphic description of the existing civilization and politics of the kingdom, and further compiling a singularly fresh and independent account (derived clearly from *vivâ voce* statements) of the immediately preceding dynastic changes to which the province had been subjected. So that, in effect, Ibn Batutah, with his merely incidental observations, has done more for the elucidation of the obscurities of the indigenous

* The Tabakát-i-Násiri of Abú Umar Minháj-ud-dín bin Siráj-ud-dín, *Juzjáni*, has been printed and published in the Persian series of the Bibliotheca Indica, under the auspices of the Asiatic Society of Bengal (Calcutta, 1864, pp. 453.) The chapters on Indian and Central Asian affairs, with which the author was more or less personally conversant, have alone been reproduced. The usual Oriental commencement with the history of the world, the rise of Muhammadanism, etc., being mere compilations from secondary sources, have been very properly excluded from this edition. A full notice of the original work will be found in Mr. Morley's Catalogue of the MSS. of the R. A. S., p. 17 (London, 1854). Several other works of native historians, bearing upon the subject of this paper, have also been made accessible to the public in a printed form in the same collection, among which may be noted the Táríkh-i-Fírúz Sháhí (the third king of the name in the Dehli list), by Ziá-i-Barni (Calcutta, 1862, pp. 602), and the Muntakhab-ul-Tawáríkh of Abd ul Kádir, *Budáúni* (Calcutta, 1865, pp. 407). The editors have unadvisedly, I think, omitted the early portions of the original relating to India, and commence the publication with the accession of Akbar. An outline of the entire contents of the work will be found in Sir H. Elliot's Historians of India (Calcutta, 1849, p. 305).

† An English version of Ibn Batutah's Travels (taken from an abridged text), by Dr. S. Lee, was published in the series of the Oriental Translation Fund in 1829 (1 vol., 4to, London). A new and very complete edition of his entire Arabic Text, with a French Translation, chiefly the work of the late M. C. Defrémery, has been issued within the last few years by the Société Asiatique of Paris (4 vols. 8vo., Paris, 1853-1858).

history of the period represented by the earlier coins of the Kooch Bahár hoard, than all the native authors combined, to whose writings we at present have access.

The merits of these authors may or may not appear upon the surface in the subsequent pages, as it is only in doubtful or difficult cases that their aid may chance to be invoked, but for the obscure series of the first Governors of Bengal, the one stands alone; and for the space of time intervening between the provincial obscuration of Násir-ud-dín Mahmúd, the unambitious son of Balban, to the revival of public interest in Bengal, consequent upon the subjection and capture of a rebel Vassal by Ghiás-ud-dín Tughlak Sháh, the chance traveller describes more effectively the political mutations and varying monarchical successions than the professed historiographers treating exclusively of the annals of their own land.

The following list of Local Governors has been compiled, the early portion from the precise statements of Minháj-ul-Siráj, the latter part from the casual notices of Bengal, to be found in Ziá-i-Barni, who professed to continue the history of India from the latest date reached by the former author, or from A.H. 658 to 753, being a period of 95 years, covering the reigns of eleven kings. The last-named work was finally completed in A.H. 758.

The arrangement of the names and dates of accession of the chiefs will be found to depart occasionally from the details given by Stewart,* in his excellent History of Bengal, but I have designedly sought to draw my materials independently from the original authorities, whom he was perhaps in a less favourable position for consulting than the student of the present day.

* The History of Bengal, by Charles Stewart. London, 1813. 4to.

GOVERNORS OF BENGAL.

ACCESSION. A.H.	NAMES OF GOVERNORS.	REMARKS.
600	1. محمد بختيار خلجي	First Muhammadan conqueror of Bengal, under Kutb-ud-dín of Dehli.
602	2. عزالدين محمد شيران خلجي	Succeeds to the local government after the death of Muhammad Bakhtíár.
605	3. علاء الدين علي مردان خلجي	Nominated to the government by Kutb-ud-dín, on whose decease in A.H. 607, he assumes independence.*
608	4. حسام الدين عوض خلجي (سلطان غياث الدين)	Commandant at Deokót, establishes his power and assumes royal honors. He submits to Altamsh in A.H. 622, but almost immediately commences an active revolt, which is put an end to in his capture by Násir-ud-dín Mahmúd, the eldest son of Altamsh, in A.H. 624.
624	5. ناصر الدين محمود بن سلطان التمش	Násir-ud-dín had been appointed by his father Governor of Oudh, in A.H. 623, from whence he advanced against Hisám ud-dín in 624, and recovered the kingdom of Bengal, where he remained as sub-king till his death early in 626
627	6. علاء الدين جاني	After temporary disturbances in the province, Altamsh, having restored order in A.H. 627, designated Alá-ud dín Jání to the charge of Bengal.
	7. سيف الدين ايبك يغان تت	Nominated to Bengal on the dismissal of Alá-ud-dín Jání (date not given). Dies in 631 A.H.

* Minháj-ul-Siráj, who treats of the history of his own and immediately preceding times, introduces the reigns of the more powerful sovereigns with a full list of the Court notabilities, forming a sort of *Almanach de Gotha* of Muhammadan India. These lists embrace the various branches of the Royal Family, Ministers, Judges, and Governors of Provinces. The following names of the ضابط's or military administrators of Bengal, which appear in the official returns, may serve to check or confirm the imperfect data obtained from the casual notices of local history to be met with in the general narrative of the events of the Empire at large. There is this discrimination, however, to be made that these imperial nominations were often merely titular, while the effective executive was in other and independent hands:

Under Altamsh, A.H. 607-633.

ملك لكهنوتي ملك اختيار الدين محمد برادر زاده

Under Násir-ud-dín Mahmúd, A.H, 644-664.

الملك الكبير عز الدين طغرل طغانخان ملك لكهنوتي

الملك الكبير تمرخان قيران ملك اوده و لكهنوتي

الملك الكبير جلال الدين خلج خان ملك جاني ملك لكهنوتي وكره

GOVERNORS OF BENGAL—*continued.*

ACCES-SION A. H.	NAMES OF GOVERNORS.	REMARKS.
631	8. عزالدين طغرل طغان خان	Pledges his allegiance to Rizíyh on her elevation in A. H. 634; continues in the Government till 642 A. H., when he surrenders the kingdom to No. 9. (Minháj-ul-Siráj, the historian, was at his court at this latter period.
642	9. قمرالدين تمرخان قيران	Obtains possession of Lakhnauti on the 5th Zul Káad, A. H. 642—dies in 644.
	10. اختيار الدين يوزبك طغرل خان	Dates uncertain. First appointed during the reign of Násir-ud-dín Mahmúd of Dehlí. He seems to have been a powerful ruler and a daring commander, and finally met his death in his retreat from an over-venturesome expedition into Kámrúp. He had previously assumed independence under the title of سلطان مغيث الدين.
656	11. جلال الدين مسعود ملك جاني	Appointed in A. H. 656. (قتلغ خان subsequently in temporary possession).
657	12. عزالدين بلبن اوزبكي	Recognised, on receipt of his tributary presents at head-quarters, in the early part of A. H. 657.
657	13. تاج الدين ارسلان خان سنجر خوارزمي	Obtains a momentary advantage over No. 12 in his absence from his Capital; eventually taken prisoner and superseded by No. 12.
659	14. (محمدارسلان خان) تتر خان	Son of No. 12.* On the accession of Balban in A. H. 664, he forwards elephants and tribute to Dehli.
676?	15. مغيث الدين طغرل	Appointed by Balban.† He afterwards asserts his independence, and assumes the title of سلطان مغيث الدين. Balban sends armies against him without success, and at last proceeds in person to Bengal. Finally, Toghral is surprised and killed.
681	16. تترا خان ناصرالدين محمود	Second son of Balban, installed with royal honors.

* Ziá-i-Barni in one place, page 53, calls him وتترخان پسر ارسلان خان and again, at page 66. محمد ارسلان خان كه اورا تتر خان گفتندي

† Ziá-i-Barni, pp. 82-92.

As I have such frequent occasion to quote the names of the Kings of the Imperial Dynasty of Dehli, I annex for facility of reference a full list of these Sovereigns.

LIST OF THE PATHA'N SULTA'NS OF HINDUSTAN.

(DEHLI).

DATE OF ACCESSION. A.H.	NO.	NAMES OF SULTANS.
589	1	Muiz-ud-dín Muhammad bin Sám (1st Dynasty.)
602	2	Kutb-ud-dín Aibek.
607	3	Arám Sháh.
607	4	Shams-ud-dín Altamsh.
633	5	Rukn-ud-dín Fírúz Sháh I.
634	6	Sultán Rizíah.
637	7	Muiz-ud-dín Bahrám Sháh.
639	8	Alá-ud-dín Masaúd Sháh.
644	9	Násir-ud-dín Mahmúd.
664	10	Ghíás-ud-dín Balban.
685	11	Muiz-ud-dín Kaikubád.
688	12	Jalál-ud-dín Fírúz Sháh II., *Khiljí* (2nd Dynasty).
695	13	Rukn-ud-dín Ibráhím.
695	14	Alá-ud-dín Muhammad Sháh.
715	15	Shaháb-ud-dín Umar.
716	16	Kutb-ud-dín Mubárak Sháh I.
720	17	Násir-ud-dín Khusrú.
720	18	Ghíás-ud-dín Tughlak Sháh (3rd Dynasty).
725	19	Muhammad bin Tughlak.
752	20	Fírúz Sháh III., *bin Salar Rajab.*
790	21	Tughlak Sháh II.
791	22	Abúbakr Sháh.
793	23	Muhammad Sháh bin Fírúz Sháh.
795	24	Sikandar Sháh.
795	25	Mahmúd Sháh bin Muhammad Sháh (Timúr, 800).
797	26	Nusrat Sháh, *Interregnum,* Mahmúd restored, 802.
815	27	Daulat Khán Lodí.
817	28	Khizr Khán *Syud* (4th Dynasty).
824	29	Muiz-ud-dín-Mubárak Sháh II.
839	30	Muhammad Sháh bin Faríd Sháh.
849	31	'Aálam Sháh.
854	32	Bahlól Lódí (5th Dynasty).
894	33	Sikandar bin Bahlól.
923	34	Ibráhím bin Sikandar (Báber, 930 A.H.)
937	35	Muhammad Humáyún, *Moghul.*
946	36	Faríd-ud-din Shír Sháh, *Afghán.*
952	37	Islám Sháh.
960	38	Muhammad 'Aádil Sháh.
961	39	Ibráhím Súr.
962	40	Sikandar Sháh (Humáyún, 962 A.H.)

The unenlivened Chronicles of the Local Governors of Bengal enter upon a more interesting phase, in the nomination of Násir-ud-dín

Mahmúd, the son of the Emperor Balban, who subsequently came to prefer the easy dignity of Viceroy, in the more even climate of the south, in derogation of his birth-right's higher honours, and the attendant dangers of Imperialism at Dehli. One of the most touching chapters of Indian history is contributed by the incidents of this monarch's meeting with his own arrogant son, Muiz-ud-dín Kaikubád, who had succeeded to the superior dignities abjured by the father.* They then met as nominal Vassal and Suzerain, but little unequal in power, and each occupying independent and preparedly hostile camps, on the ordinary route between their respective capitals. Oriental etiquette, and more reasonable distrust, for a time delayed the interview, in which, at last, nature was destined to re-assert its laws, and to reconcile even conflicting royal interests, by subduing, for the moment, the coarse vices of the son in the presence of the tempered virtues of the father. Repeated amicable conferences, however, merely resulted in each returning on his way, with but little change in the relative political position of either; and the comparatively obscure repose of Násir-ud-dín Mahmúd remained undisturbed, while other successors filled his son's throne at Dehli. The more immediate question bearing upon the attribution of the earliest coins in the Kooch Bahár treasure, is exactly how long did Násir-ud-dín continue to live and reign. Ziá-i-Barni,† and those who follow his ill-digested history, affirm that he retained his provincial kingship till 699 A.H., when he divested himself of all symbols of royalty in the mere dread of the confessedly overwhelming power of Alá-ud-dín Muhammad Sháh, to be, however, reinstated by that Sultán; and, finally, it is asserted that Násir-ud-dín was still in existence, and once again reinvested with the full insignia of a king, by Tughlak Sháh, in A.H. 724.

Ibn Batutah, a higher authority in proximity of time, and obviously more intimate with the purely indigenous history, states that Násir-ud-dín, on his ruturn from his interview with his son, reigned some years (سنين),‡ an expression which is scarcely compatible with

* Ziá-i-Barni, p. 142; Ibn Batutah, iii., p. 178; Lee's Translation, p. 117; and قران السعدين of Amír Khusrú, *Dehliví.*

† Printed edition, p. 451; Budauni MS.; Ferishtah (Briggs, i. p. 406).

‡ French edition, iii., p. 179, and xiii. Dr. Lee's سنتين "two years," p. 118, is an error.

the idea of a nearly continuous rule of "forty-three solar years," and a decease in A.H. 725, as adopted by Stewart:* a prolongation of administrative functions indeed altogether inconsistent with the direct evidence of the dates on the money of Kai Káús, or the parallel proof of Shams-ud-dín's exercise of the functions of sovereignty in 702 A.H., associated as they are with the uncontested historical and numismatic demonstration of the succession of one grandson, Shaháb-ud-dín, whose ejection from his inherited section of the kingdom by his more powerful brother, Bahádur, formed so prominent a ground for imperial interference in the affairs of Bengal. There facts are each and all too well ascertained to leave any doubt that the authors who make Násir-ud-dín's reign extend to 725 must be in error; the source of the mistake seems as simple as it is obvious, the mere omission of the son's name as preceding that of the father, in Persian MS. writing, or simple ignorance of the order of local successions, would account for the whole difficulty. And, as is obvious, Ibn Batutah's own personal knowledge, and possibly correct autograph version, reproduced independently in other lands, have not saved later transcripts of his work from analogous imperfections.†

But there are other and more direct internal evidences in the texts of the Indian authors, of confusion and imperfect knowledge in the relation of the incidents attendant upon the re-settlement of Bengal by Alá-ud-dín A.H. 699, where it is stated that "a chief, named Bahádur Khán," was at this time appointed to "the eastern districts of Bengal,"‡ with the object of dividing the province, and thus rendering its rulers "more subservient to the Court of Dehli." It is highly improbable, had Násir-ud-dín been living at the epoch in question, that a grandson of his should have been selected for such a charge to the supercession of his own father, Shams-ud-dín, or in priority to the son of that father, Shaháb-ud-dín, who was the elder or perhaps better-born brother of Bahádur, each of whom, Ibn Batutah

* Stewart's Bengal, p. 80.

† Ex. gr., Bahádur is made the *son* of Násir-ud-dín, at p. 179, vol. iii., instead of the grandson, which the text at p. 210, vol. iii., and p. 213, vol. iv., affirms him to have been. Lee's MS. authorities again, in omitting the intermediate name of Násir-ud-dín, skip a generation, and ante-date Shams-ud-dín (Fírúz) in constituting him a son of Ghiás-ud-dín Balban (p. 128).

‡ Ferishtah, Briggs, i., p. 406; Stewart, p. 79.

certifies, in turn succeeded to royal honours in the old capital of Bengal.

Having completed this simple outline of the historical data, I now proceed to describe the coins in their due order; first on the list in priority of time is a piece which I can only doubtfully assign to Bengal, and whose individual appropriation, moreover, must remain to a certain extent inconclusive. The coin itself will be seen to bear the hereditary name of the first Moslem Conqueror of India, *Mahmúd* of Ghazní, and the oft-revived title of the founder of the dynasty, *Násir-ud-dín* Subuktagín, a conjunction of royal designation already seen to have been applied to a succession of Pathán princes, whose intitulation followed antecedent conventionalisms.

Násir-ud-dín. Mahmúd Sháh.

No. 1.

Silver. Size, viii. Weight, 163.1 grs. Unique, *British Museum.*

Obv.	Rev.
السلطان الاعظم	في عهد الامام
ناصر الدنيا والدين	المستنصر بالله امير
ابو المظفر محمود	المومنين لله
شاه بن سلطان	

Margin, illegible.

The incidental details of the legends restrict the assignment of this piece to one of *two* individuals, the eldest or the youngest son of Altamsh, the latter of whom was authoritatively designated by the like name and title on the decease of his brother, in 626 A.H.* The

* سلطان اسلام ناصر الدين محمود چنانچه وارث اسم ولقب او است Tabakát Násirí, p. 181; بلقب ونام پسر مهتر مخصوص گردانيده p. 201.

citation of the formula, "during the reign of (the Khalif) Al Mostansir billah," on the reverse, limits the final period of the issue of the coin, not exactly to the 5th month of the year A.H. 640, when that Pontiff died, but with clear precision to A.H. 641, when the knowledge of his death was officially declared by the substitution of a new name in the Mintages of the capital of Hindustán.*

This younger son was destined eventually to succeed to the throne of his father at Dehli, in 644 A.H., after the intervening reigns of Rukn-ud-dín Fírúz Sháh, Rizíah, Muiz-ud-dín Bahrám Sháh, and Alá-ud-dín Masaúd Sháh, in all, however, extending only over a space of eleven years, posterior to the death of Altamsh. The second Mahmúd, must, under these conditions, have been but of tender years, and though, at this conjuncture, promoted to the titular honours of an elder brother, not in any position to exercise authority in his own person, and less likely to have had medallic tribute paid to him by his father, should such have been the origin of the exceptional specimen under review. To the first-born Násir-ud-dín Mahmúd, no such objections apply; he was very early invested by his sire with the administration of the important government of Hánsi, and in 623 A.H., advanced to the higher charge of the dependencies of Oudh, from which *quasi* frontier, he was called upon to proceed against Hisám-ud-dín Avaz, (No. 4 in the list of Governors, *supra*), who had already achieved a very complete independence in the province of Bengal. Here, his arms were fortuitously, but not the less effectually, successful, so that he had honours thrust upon him even to the Red Umbrella, and its attendant dignities,† whatever the exact measure of these may have been. Under such triumphant coincidences, it is possible that the universal favourite, the still loyal heir-apparent, may have placed his own name on the coinage, without designed offence, especially as at this time Moslem Mints were only beginning to adapt themselves to their early naturalization on Indian soil, and when the conqueror's camps carried with them the simple machinery, and equally ready adepts, for converting bullion plunder on the instant into the official money of a general, or his liege sovereign. Altamsh's

* Pathán Sultáns of Dehli, coin No. 33, p. 22.

† His title is usually limited by Minháj-ul-Siráj to ملك pp. 177, 181, 201; but on one occasion سلطان crops out incidentally in the Court list where, in his place among the sons of the Emperor Altamsh, he is so designated, p. 178.

own circulating media were only in process of crude development at this period, and had scarcely risen superior to the purely Hindu currencies it had served the purpose of his predecessors to leave virtually intact: his own strange *Túrkí* name,* and that of many of his successors, continued to figure in the *Nágarí* letters of the subject races on the surfaces of the mixed silver and copper coins of indigenous origin, at times commemorative of imperfectly achieved conquests, and the limited ascendancy implied in the retention of the joint names of the conqueror and the momentarily subject monarch;† while the Sultán's own trial-pieces, in silver, were indeterminate in their design and legends, as well as utterly barbarous in their graphic execution.

Had the coin under review followed the usual phraseology and palæography of the Imperial Násir-ud-dín Mahmúd's Mint legends, it might have been imagined that an ancient and obsolete reverse had been, by hazard, associated with a new obverse. But the obverse inscription in the present instance differs from the latter Dehli nomenclature in the addition of the word *Sháh* after the name of *Mahmúd*,‡ and contrasts as singularly in the forms of the letters, and the

* This name I have, as a general rule, retained in the form accepted as the conventional English orthography—*Altamsh*. The correct rendering of the original is still an open question, but the more trustworthy authors reproduce the designation as التتمش, a transcription supported in a measure by the repetition of the third letter in the Kufic dies, and made authoritative, in as far as local pronunciation is concerned, by the Hindí correlative version of ल्लितितिमिसि (Pathán Sultáns, Coin No. 14). The inscription on the Kutb Minár, at Dehli, has ايلتمش, which accords with the Arabic numismatic rendering on the reverses of the Hindí Coins now cited.

See also Táj-ul-Maásir, *Alitimish*: Wasáf, *Alitmish*, and at times اتلمش Badauni, *Ailtitimish*.

Elliot's Historians of India, p. 111.

† See coins of *Chahir deva*.

Obverse. Bull. Legend: असावरी श्री समसोरखदिवि।

Reverse. Horseman. Legend: श्री चाहड देवं।

— Pathán Sultáns, No. 15; Ariana Antiqua, pl. xix. 16. 31, 34; Prinsep's Essays, i. 333, pl. xxvi. 31; Minhaj-ul-Siráj, pp. 215, 240; Tod's Rajasthan, ii. 451; and J. A. S. Bengal, 1865, p. 126.

‡ So, in written history, Násir-ud-dín Mahmúd, the Emperor, is called by his own special biographer, سلطان المعظم ناصر الدنيا والدين محمود بن السلطان (pp. 9, 177, 178, 201, etc) which is in contrast to the nominal adjunct so constant with his predecessors, Fírúz Sháh, Bahrám Sháh, Masáúd Sháh. On one occasion only does the additional Sháh appear in a substituted list of Altamsh'a Court (p. 178), where the text gives—1. Sultán Násir-ud-dín * * 2. Sultán Násir-ud-dín Mahmúd; and at the end, after the name of Rukn-ud-dín Fírúz Sháh, comes "Násir-ud-dín Mahmúd *Sháh*."

insertion of the short vowels with the more deferred issues, as it, on the other hand, closely identifies itself in these marked peculiarities with the initial dies of Altamsh and the closely sequent coinages of Rizíah, two of which latter are now known to be the produce of the Lakhnauti Mint.

RIZIAH.

The earliest coins that can be definitely attributed to a Bengal mint, are those of the celebrated Queen Regnant of Muhammadan India—Rizíah, the daughter of Altamsh. The ministers at her father's court were scandalized at the preference it was proposed to extend to a daughter, in supercession of the claims of adult male heirs to the throne; but the Sultán justified his selection, alike on account of the demerits of his sons, and the gifts and acquirements of his daughter, who had been brought up under the unusual advantages of freedom from the seclusion enjoined for females by the more severe custom of ordinary Moslem households, aided by the advantages incident to the exalted position occupied by her mother as the leading and independently-domiciled wife. After the brief reign of Rukn-ud-dín Fírúz, extending over less than seven months—who freely exemplified by his misconduct his father's prophetic reproach—Rizíah succeeded in establishing her supremacy in the city of Dehli (A. H. 734), and Eastern eyes witnessed the singular spectacle of an unveiled and diademed Queen—the first in India—directing the hosts of Islám, under the canopy of the immemorial regal seat on an elephant. Rizíah's early inauguration was attended with no inconsiderable danger and difficulty, arising from the organised military resources of the various governors of provinces, who hesitated in conceding their allegiance. Eventually, however, to use the expression of Minháj-ul-Siráj, quiet was established throughout the empire, and Rizíah's sway was acknowledged from "Daibal to Lakhnautí." In A.H. 737, the Empress proceeded in person to quell an outbreak on the part of Ikhtíár-ud-dín Altúníah, Governor of Tiberhind; but was taken captive in the engagement that ensued, and, possibly with scant ceremony, introduced into the harem of the conqueror, who shortly afterwards advanced upon Dehli in the hope of recovering the sovereignty, to which he had thus acquired an adventitious claim; but

Bengal Coins

PL. I.

W. West. sc.

his army was in turn defeated, and himself and Rizíah met their deaths near Kaithal in the month of Rabi-al-Awal, A.H. 738. *

The contemporary biographer in his official lists styles this queen السلطان رضية الدين, a title which she affects on the ordinary copper coins,† but on the silver money she adopts the designation of جلالة الدين

Jalálat-ud-din. Rizíah.

Coin No. 2.

Laknautí, A.H. ?

Silver. Size, vii. Weight, 168 grs. Plate I., figure 1.

Type, *Obverse*, the whole surface is occupied by the legend.

Reverse, circuler area, enclosing a double-lined square. Narrow margin.

Obv.	Rev.
السلطان الاعظم	في عهد الامام
جلالة الدنيا والدين	المستنصر امير
ملكة ابنت التمش السلطان	المومنين
مهرة امير المومنين	

Reverse Margin, * * هذا الفضة بلكنوتي سنة * *

(See also a similar coin from the Laknautí Mint, Plate i., fig. 27, page 19. Coins of the Pathán Sultáns of Hindústán.‡

* Tabakát Násiri, pp. 183, 185, 251. See also Ibn Batutah, iii. pp. 167, 168.

† Pathán Sultáns, Nos. 28, 29.

‡ It would seem from the orthography adopted in this earliest record of the name of *Laknauti* (لكنوتي) that the original Semitic transcription was designed to follow the classical derivation of *Lakshmaṇavatí* (लक्ष्मणावती), which was soon, however, adapted to the more colloquial *Luchhman* (لچهمن) by the addition of an *h* after the *k*, as لكهنوتي; in which form it appears under the first local Sultáns (coin No. 3, etc.). Minháj-ul-Siráj relates its elevation to the rank of the capital in supercession of Nuddeah by Muhammad Bakhtiár in the following terms:

چون محمد بختيار آن مملکترا ضابط کرد شهر نوديهرا خراب
بگذاشت و بر موضعي که لکهنوتی است دارالملک ساخت

Printed edit. p. 151. The same author, at p. 162, gives a full account of the remarkable size, progress, and general topography of the city as existing in 641 A.H. on the occasion of his own visit.

It is difficult to say when the name of the city was changed to *Gaur*, a denomination which is never made use of by the older authorities. Abul Fazl says,

I.—RUKN-UD-DI'N KAI KA'U'S.

The full and satisfactory identification of the king who ruled under the designation of Káús has yet to be accomplished. Rájendralála Mitra has suggested a notion that Násir-ud-dín Mahmúd, the son of Balban, so often mentioned in this article, sought, as local ruler of Bengal, "to continue his allegiance to his grandson Kaimurs [momentarily king of Dehli], even after his deposition, and possibly after his death,"* by retaining his name on the public money. I should be disposed to seek a less complicated explanation of the numismatic evidences. Kai Káús' date, tested by the examples of his mintages in the Kooch Bahár hoard, is limited, in range of time, to five years (691–695 A.H.);† a latitude might be taken beyond the ascertained units, which are somewhat indeterminate in their tracings, and have equally suffered from abrasion, on the exposed margins of the coins, but the *ninety* and the *six hundred* can scarcely be contested. If we examine the political state of India at this period, we find that Hindustán was abnormally quiet under the feeble rule of Jalál-ud-dín Fírúz (687–696 A.H.): Alá-ud-dín's conquests in the Dakhin could have but little affected Bengal, so that any changes that may have taken place in the latter kingdom were probably due to successional or revolutionary causes arising within its own limits. We can scarcely build up a theory of an access of vigour and assumption of

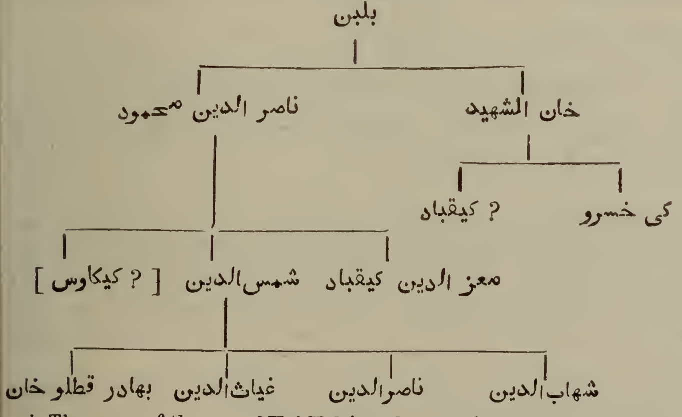
"Formerly it was called Lucknouty, and sometimes Gour" (A.A. ii. p. 11); while Budáuni gives a ridiculous version of the origin of the designation as being derived from غوري. He writes و محمد بختيار معابد و بتخا نهاي كفاررا ويران ساخته مساجد و خوانق و مدارس كرد و دارالملك بنام خويش تعمير فرمود كه كور نام دارد. The obvious imperfection of the critical philology of the derivation, however, debars its reception, as does the caustic alternative of گور="grave," which the often deserted site, under the speedy action of water and a semi-tropical vegetation, may have deservedly earned for it. But it is quite legitimate to infer that as गौड was the ancient name for central Bengal (Wilson, Glossary, *sub voce;* Albírúní, quoted J. R. A. S. i., N. S., p. 471), and so intimately associated with the tribal divisions of the indigenous Brahmans, that the designation originated in the popular application of the name of the country to its own metropolis, and that the town continued to be called *Gaur* in vernacular speech in spite of the new names so frequently bestowed upon it by its alien lords.

* Jour. As. Soc. Beng., 1864, p 508.

† Rájendra Lála says, "the units *one* and *three* are perfectly clear." Col. Guthrie's three coins are imperfect in the word for the unit. I observe traces of a *four* on two specimens; and I read, with some certainty, 695 on another.

independence by Násir-ud-dín himself; nor is it probable that, in such a case, he would have changed both his title and his name. Besides, the array of title on the coins in the triple succession of *Sultáns* is altogether inconsistent with his actual origin. Though he was the son of one emperor of Dehli, and the father of another, he could scarcely ignore the rise of the former from a state of slavery, or conceal the fact that Balban himself never pretended to have been the offspring of a king. The two alternatives remain, of either supposing that Násir-ud-dín died before 691 A.H., a question discussed elsewhere, or to conclude that his son Rukn-ud-dín Kai Káús temporarily assumed kingship during the lifetime of his father,* and that his limited reign and local obscurity saved his memory from the comments of history. I fully endorse Rajendra Lál's suggestion that Kai Káús would have been likely to be selected as a name for one of a family who took so many of their designations from Persian heroic ages, and the elaborate intitulation adopted by that prince, on his coins, of the "son and grandson of a Sultán," favours such an identification.† It will be seen that, although the opening terms of his obverse legends follow the conventional and unvarying mint phraseo-

* The following is the genealogical tree, according to Ibn Batutah. See vol. iii., pp. 174-5, 179, 210, 462; vol. iv., p. 212.



† The name of the son of Kai Kobád, who was elevated to the throne of Dehli on the death of his father, is variously given by Oriental writers as Shams-ud-dín کیومرث and کیکاوس. Budáuní and the Mirát-ul-Alm (MS.) give *Kai Kaus*, but the majority of authors prefer the *Kaiomurs*. Ziá-i-Barni does not state the name of the boy, but mentions a son of Altamsh, in the previous generation, as having been called *Kaiomurs* (printed ed. p. 126).

logy in the use of السلطان, *the* (reigning) Sultán, yet after his own proper name he styles himself merely سلطان, and seemingly desired to strengthen his position by the insertion of the regal titles of his father and grandfather; though there is so far room for questioning this supposition in the fact that the father had fallen short of supreme power, and was only doubtfully authorized to call himself Sultán, while in strictness the Imperial *Balban* should have been designated *the Sultán* (past *regnant)*; but on the other hand, Násir-ud-dín had been so long virtually a king in the south, that the complimentary use of the term was quite within heraldic licence; and it is to be remarked, that a similar omission of the supreme prefix occurs in *Nasir-ud-dín Mahmúd Sháh's* coin (No. 1), which, if correctly attributed, would prove the legitimacy* of the optional use of one or the other form.

These are avowedly mere speculations; but when it is considered how much attention was paid in India, in those days, to every varying shade and degree of honorary rank, how much importance was attached to even the colours of official umbrellas,† and other, to us, minor observances, it cannot but be felt that these subordinate indications may chance to prove of material aid in illustrating doubtful interpretations.

Kai Káús.

No. 3.

Lakhnautí, A.H. "691, 693,"‡ and 694–695.

Silver. Size, vii. Weight, 168 grs. Very rare. Plate I. fig. 2. Type, as in the previous coins.

* The Bengal Mints, after the initial uncertainty, soon settle themselves down to follow the established Dehli models. In the latter, it will be seen, great care was taken by all those sovereigns who could boast of a Royal descent, to define the fact upon their coins. Bahrám Sháh, Masáúd Sháh, Násir-ud-dín Mahmúd bin Altamsh, and Ibrahim bin Fíráz all entitle themselves بن السلطان. Balban, Kai Kubád, Jalál-ud-dín Fírúz, and the great Alá-ud-dín Muhammad Sháh have to be content with their own self-achieved السلطان

† وسه چتر برداست لعل وسیاه و سپید Minháj-ul-Siráj, p, 263; اقطاع بداون وچتر سبز یافت ditto, p. 181, A.H. 625.

‡ Bábu Rájendralála Mitra notices four coins of this king with the dates 691 and 693. Journ. As Soc. Bengal, 1864, p. 579. He was disposed to read the mint as Sunárgaon. Of Col. Guthrie's three specimens, two bear distinct traces of the name of Lakhnautí.

Obv.	Rev.
السلطان الاعظم	الامام
ركن الدنيا والدين ابو	المستعصم
المظفر كيكاوس سلطان	امير المومنين
بن سلطان بن سلطان	

Margin, ضرب هذا الفضة بحضرت لكهنوتي سنة خمس وتسعين وستمائة

II.—SHAMS-UD-DI'N FI'RUZ.

Whatever may have been the actual date of Násir-ud-dín's decease or political obscuration, we tread upon more firm ground in the conjoint testimony of the coins and the historical reminiscences of Ibn Batutah, in the assurance that his son, Shams-ud-din Fírúz, was in full possession of power in Western Bengal at the time of Muhammad bin Tughlak's abortive revolt against his own father, in 722–3 A.H.* The African traveller incidentally mentions that to the court of this southern monarch fled the nobles who had engaged in the contemplated treason, which originated in the camp of the army of the Dakhin, of which the imperial heir was commander. Professedly written history is altogether at fault in establishing the existence or illustrating the reign of this sovereign; and even Ibn Batutah†

* As this passage presents no particular difficulty, beyond the difference of the texts from which English and French translators have drawn their inspiration, I merely annex the rendering given in the amended Paris edition, vol. iii., p. 210. "Les autres émirs s'enfuirent près du Sultan Chems eddîn, fils du sultan Nâcir-eddîn, fils du sultan Ghiyâth eddîn Balaban, et se fixèrent à sa cour. . . Les émirs fugitifs séjournèrent près du sultan Chems eddîn. Dans la suite, celui-ci mourut, léguant le trône à son fils Chihâb eddîn. Ce prince succéda à son père; mais son frère cadet, Ghiyâth eddîn Behâdoûr Boûrah (ce dernier mot signifie, dans la langue indienne *le noir*), le vanquit, s'empara du royaume, et tua son frère Kothloû Khân, ainsi que la plupart de ses autres frères. Deux de ceux-ci, le sultan Chihâb eddîn, et Nâsir eddîn, s'enfuirent près de Toghlok, qui se mit en marche avec eux, afin de combattre le fratricide. Il laissa dans son royaume son fils Mohammed en qualité de vice-roi, et s'avança en hâte vers le pays de Lacnaouty. Il s'en rendit maître, fit prisonnier soe sultan Ghiyâth eddîn Behadoûr et reprit avec ce captif le chemin de sa capitale." See also Lee's Translation, p. 128.

† Ibn Batutah in the following extract tells us so much about the real history of Bengal at, and previous to his own visit, that I quote the Arabic text *in extenso;* I feel it is the more necessary to reproduce the original version on this occasion, as Dr. Lee's translation is altogether deficient in any reference to the passage, which was clearly wanting in the MSS. at his disposal.

* ذكر سلطان بنجالة وهو السلطان فخر الدين الملقب بفخرة *

سلطان فاضل محبّ فى الغرباء وخصوصاً الفقراء والمتصوفة وكانت

does little more than place upon record the affiliation, elevation, and decease of Shams-ud-dín, whose own coins alone furnish the additional item of his regal name of Fírúz; and in their marginal records

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مملكة هذه البلاد للسلطان ناصر الدين بن السطان غياث الدين بلبن وهو الذي ولي ولدهُ معز الدين الملك بدهلي فتوجه لقتاله والتقيا بالنهر وسمي لقاوهما لقاء السعدين وقد ذكرنا ذلك وانه ترك الملك لولده وعاد الى بنجالة فاقام بها الى ان توفى وولى ابنه شمش الدين الى ان توفى فولى ابنه شهاب الدين الى ان غلب عليه اخوه غياث الدين بهادور بور فاستنصر شهاب الدين بالسلطان غياث الدين تغلق فنصره واخذ بهادور بور اسيرا ثم اطلقه ابنه محمد لما ملك على ان يقاسمه ملك فنكث عليه فقاتله حتى قتله وولى على هذه البلاد صهرا له فقتله العسكر واستولى على ملكها على شاه وهو اذ ذاك ببلاد اللكنوتى فلما راى فخر الدين ان الملك قد خرج عن اولاد السلطان ناصر الدين وهو مولى لهم خالف بسدكاوان وبلاد بنجالة واستقل بالملك واشتدت الفتنة بينه وبين على شاه فاذا كانت ايام الشتاء والوحل اغار فخر الدين على بلاد اللكنوتى فى البحر لقوته فيه واذا عادت الايام التى لامطر فيها اغار على شاه علي بنجالة فى البر لقوته فيه

Vol. iv. p. 212, Paris edition.

TRANSLATION.

C'est le Sultan Fakhr eddîn, surnommé Fakreh, qui est un souverain distingué, aimant les étrangers, surtout les fakîrs et les soufis. La royauté de ce pays a appartenu au Sultan Nâssir eddîn, fils du Sultan Ghiyâth ed dîn Balban, et dont le fils, Mo'izz eddîn, fut investi de la souveraineté à Dihly. Nâssir eddîn se mit en marche pour combattre ce fils; ils se rencontrèrent sur les bords du fleuve, et leur entrevue fut appelée la rencontre des deux astres heureux. Nous avons déjà raconté cela, et comment Nâssir eddîn abandonna l'empire à son fils et retourna dans le Bengale. Il y séjourna jusqu'à sa mort, et eut pour successeur son (autre) fils, Chams eddîn, qui, après son trépas, fut lui-même remplacé par son fils, Chihâb eddîn, lequel fut vaincu par son frère, Ghiyâth eddîn Béhâdour Boûr. Chihâb eddîn demanda du secours au Sultan Ghiyâth eddîn Toghlok, qui lui en accorda, et fit prisonnier Béhâdour Boûr. Celui-ci fut ensuite relâché par le fils de Toghlok, Mohammed, après son avénement, à condition de partager avec lui la royauté du Bengale; mais il se révolta contre lui, et Mohammad lui fit la guerre jusqu'à ce qu'il le tuât. Il nomma alors gouverneur de ce pays un de ses beaux-frères, que les troupes massacrèrent. 'Aly Châh, qui se trouvait alors dans le pays de Lacnaouty, s' empara de la royauté du Bengale. Quand Fakhr eddîn vit que la puissance royale était sortie de la famille du Sultan Nâssir eddîn, dont il était un des affranchis (ou clients), il se révolta à Sodcâwân et dans le Bengale, et se déclara indépendant. Une violente inimitié survint entre lui et 'Aly Châh. Lorsqu'arrivaient le temps de l'hiver et la saison des pluies, Fakhr eddîn faisait une incursion sur le pays de Lacnaouty, au moyen du fleuve, sur lequel il était puissant. Mais quand revenaient les jours où il ne tombe pas de pluie, 'Aly Châh fondait sur le Bengale par la voie de terre, à cause de la puissance qu'il avait sur celle-ci.

establish the fact of his possession of Lukhnautí during the period embraced between the years 702–722, and (at some moment) of his ownership the Eastern Province of Bengal represented by the mint of Sonárgaon. A subordinate incident is developed in the legends of the coins, that he felt himself sufficiently firm in his own power to discard the supererogatory adjuncts of descent or relationship, and relied upon the simple affirmation of his own position as السلطان.

Shams-ud-din. Fírúz Sháh.

No. 4.

Lakhnautí, A.H. 702,* 715, (Col. Bush), 720, 722.

Silver. Size, vii. Weight, 168.4 grs. Very rare. Plate I., fig. 3. Type as above.

Obv.	Rev.
السلطان الاعظم	
شمس الدنيا والدين	الامـــــام
ابو المظفر فيروز شاه	المـــستعصم
السلطان	امير المومنين

Margin, ضرب هذا الفضة بحضرت لكهنوتي سنة عشرين و [سبعماية]

No. 5.

Sonárgaon, A.H. ?

Silver. Size, vii. Weight, 168 grs. Unique.
Type as above.

III.—SHAHA'B-UD-DI'N. *BUGHRAH* SHA'H.

Neither history, incidental biography, nor numismatic remains avail to do more than prove the elevation, as they seem to indicate the brief and uneventful rule, of Shaháb-ud-dín, the son of Shams-ud-dín Fírúz, and grandson of the once recognised heir-apparent of Balban.

* See also Pathán Sultáns of Hindústán, p. 37, coin dated 702 A.H. This coin was published by me in 1848. I then read the date as 702 A.H. I was not at the time unversed in the decipherment of Arabic numbers, and probably from the very difficulty of placing the piece itself, I may the more rely upon the accuracy of my original interpretation. I mention this fact, as I am at present unable to refer to the coin itself.

The singularly limited number of the coins of this prince, confined —if Calcutta selections be not at fault*—to three examples amid the 13,500 accumulated specimens of the currencies of other kings of the land over which he temporarily held sway, sufficiently mark his status in the general list of the potentates of the century in which he lived. No date or place of mintage is preserved on his extant money, and the single additional item supplied by their aid is his personal or proper name, which appears on their surfaces as بعده; a crude outline which might suggest a doubt as to the conclusiveness of the transcription of بغره, now confidently adopted as expressing an optional rendering of the grandfather's title of بغراخان,† a name which was even further distorted from the Túrki original by the conversion of the medial ر *r* into the vernacular *cerebral* ड or ڈ = *ḍ*. For the rest, the pieces themselves, under the mechanical test, in their make, the forms of their letters, and the tenor of their legends, evidently follow closely upon Shams-ud-dín's mintages, and as clearly precede the money of the same locality, issued by Ghiás-ud-dín *Bahádur Sháh* who in 724 A. H. drove this, his own brother, Shaháb-ud-dín to take refuge with Ghiás-ud-dín Tughlak Sháh. Bahádur's career has yet to be told in connexion with his own coins; but to dispose of Shaháb-ud-dín,‡ as far as the exercise of his Mint prerogatives are concerned, he seems to have been lost to fame, from the

* The name of this king does not appear in any of Rajendralál's lists.

† The ancient name of طمغاج بغرا خان of Bokhára notoriety in 350 A. H. (Fræhn Recensio Numorum Muhammadanorum, pp. 139, 593, 578), was subjected to strange mutations on Indian soil. My authority for the substitution of the final ة in place of the vowel ا is derived from Ibn Batutah, who uniformly writes the word with an ة (iii. 231, 5, 293.) Ferishtah (*text*, p. 131) has بقرا; whence Stewart's *Bagora* (p. 74). Dow gave the name as *Kera*, and Briggs as *Kurra* (i. pp. 265, 270, etc.).

‡ Those who delight in interesting coincidences might see, in this name of Shaháb-ud-dín, a most tempting opportunity for associating him with a really important record by the Indigènes themselves, inscribed on a stone slab in the fort of Chunár, setting forth their victory over a "*Malik*" Shaháb-ud-dín, quoted as acting under Muhammad bin Tughlak, in Samvat 1390 (A. H. 734); but I confess I do not myself encourage the identification. Chunár is certainly not out of the range of access from Bengal; but other men of mark may have filled this command, and the name of the fortress itself is never heard of in reference to the affairs of the kingdom of Lakhnauti, in those early days, though the main road of communication between the two capitals of the north and the south took its course through Budáun or Kanauj and Jaunpore. The inscription is otherwise well worthy of further examination, in as far as it concerns the history of imperial influence upon proximate localities; and as such I transcribe

date when he was absorbed with an associate fugitive brother (Násir-ud-dín) under the ægis of the Emperor of Dehli.

Shaháb-ud-dín. Bughrah Sháh.

No. 6.

Mint, ?

Silver. Size, vii. Weight, 168.5 grs. Two coins only, *Col. Guthrie.* Plate I., fig. 4.

both the text and Dr. Mills' translation of the brief passages which may chance to illustrate the general subject.

Verse 5:

सद्दाब्दीनादिदुष्टात्मयवनेन्द्रमहम्मदा ।
सैराजो मि[लितोऽम]त्यो वैरिणापि कृपानिधिः ॥

"By MUHAMMAD, lord of the hostile Yavanas SHAHÁB-UD-DÍN and the rest, though an enemy, was SAIRÁJA, the treasure of benignity, employed as prime minister."

Verse 11:

संवत् १३९० भाद्रपदि ५ गुरौ सैराजदेवेनशर-
णागतमलिकसद्दाब्दीनरक्षितं ॥

"Samvat 1390, in the month of Bhadra, fifth day of the waning moon, on Thursday, was the kingdom set free from MALIK SHAHÁB-UD-DÍN, acting under the protecting favour of SAIRÁJA DEVA aforesaid."
—See Journal As. Soc. Bengal, vol. v., 1836, p. 341).

A subordinate but still more open inquiry also suggests itself in connexion with the mention of Shahàb-ud-dín in 734 A. H., as to whether, amid the strange confusion of names and titles, *the* "Kadr Khán," who is noticed by Ferishtah under the original designation of Malik Bídar Khilji, may not, perchance, have been the identical Shaháb-ud-dín *Bughrah*, reinstated as simple governor in Lakhnauti, as his brother Bahádur was restored to power in Sonárgaon. I am aware that this is treacherous ground to venture upon; but such a supposition is not without other incidental support, especially in Ibn Batutah's passage (original, iii. 214, quoted at p 48), where Kadr Khán is spoken of as if he had been in effect the last scion of the family of Násir-ud-dín Mahmúd Bughrah.

The original passages in Ferishtah are as follows (i. p. 237):—

و ملك بيدار خلجي را قدرخان خطاب كرده چون شاه ناصرالدين
فوت شده بود اقطاع لكهنوتي باو داد .(i. p. 244) درين وقت يكي از نوكران
قدرخان كه او را ملك فخرالدين گفتندی بعد از فوت بهرام خان در
بنگاله بغي ورزيد و قدرخان را كشته خزاين لكهنوتي متصرف شد

See also Briggs' Translation, i. pp. 412, 423.

The Tárıkh Mubárak Sháhi has the name in manifest mistranscription as *Bandár.*

و ملك بندار خلجي قدر خان شد و اقطاع لكهنوتي يافت

A difficulty necessarily suggests itself in regard to the tribe of *Khilji*, but the use of the name in its non-ethnic sense might readily be explained by the old subordination of the Bengal family to the Khilji dynasty of Firúz, or the specially *Khilji* serial succession of the earlier governors of Bengal.

Type as usual.

Obv.	Rev.
السلطـان الاعظـم	الامـــــام
غياث الدنيا و الدين	المستعصـــم
ابو المظفر بهادر شاه	امير المومنيـن
السلطان ابن سلطان	

Margin, (remainder illegible) ضرب هذا الـ

IV.—BAHA'DUR SHA'H.

The single point in the biography of Bahádur Sháh, which remains at all obscure, is the date of his first attaining power. Ibn Batutah records with sufficient distinctness, that he conquered and set aside his regnant brother *Shaháb-ud-dìn*, sometime prior to Ghiás-ud-dín Tughlak's reassertion of the ancient suzerainty of Dehli over the lightly-held allegiance of Bengal, and his eventual carrying away captive the offending Bahádur, who was, however, soon to be released, and restored with added honours,* by Muhammad bin Tughlak, almost immediately on his own accession. Indian home-authors, who so rarely refer to the affairs of the Gangetic delta, give vague intimations of the first appointment of Bahádur to Eastern Bengal by 'Alá-ud-dín Muhammad in A. H. 799,† assigning to him an inconceivable interval of placid repose until A. H. 717, when he is stated to have broken out into the turbulent self-assertion for which he was afterwards so celebrated.

The two statements are certainly at variance, but Ibn Batutah's is the most readily reconcilable with probabilities, and the demands of the up to this time legible dates on the coins which Bahádur put into circulation in Bengal. I might have some doubt as to the conclusiveness of the reading of the date 710 on his money in the Kooch Bahár *trouvaille*, but I have none as to the clear expression of A.H. 711 and 712, though the singular break occurring between 712 (or 714) and 720 suggests a suspicion of an originally imperfect

* چون سلطان بهادر سنار كامي را بملك اوده رخصت كرد انچه زر نقد در خزنه بود بيكبار در انعام او داد Tabakát-i-Akbari.

See also Ziá-i-Barni, printed edit. p. 461.

† Stewart, p. 75. Ferishtah (Briggs) i. 406.

die-rendering of the عشر = 10 for عشرين = 20 ;* which would bring the corrected range of Bahádur's dates to 720-724; but even these figures leave something to be reconciled in reference to their associate place of mintage, for in 720-722, his father, Shams-ud dín Fírúz, was clearly in possession of the already commemorated "*Lakhnauti*;" but such an anomaly might be explained by the supposition that Bahádur, in the earlier days, used the name of *Lakhnauti* as a geographical expression for a portion of the dominions ordinarily administered from that capital. Undoubtedly the first appearance of the contrasted designation of the Eastern capital "Sonárgaon" occurs on a coin of his father; but even this sign of discrimination of urban issues would not be altogether opposed to a continuance by Bahádur of the loose usage of Camp Mints, of naming the metropolis as the general term for the division at large, or inconsistent with the subsidiary legitimate employment of the designation of the province on a coinage effected anywhere within its own boundaries,—either of which simple causes may have prevailed, and been utilized with a new motive, if any covert ulterior meaning might be designed, as implying that Bahádur himself had special successional or other claims to the metropolitan districts.

Tughlak Sháh's intervention in the affairs of Bengal seems to have originated in an appeal on the part of the ejected Shaháb-ud-dín against the usurpation of his brother Bahádur. The result of the Imperial expedition to the South was the defeat, capture, and transport to Dehli of Bahádur Sháh; but among the first acts of the new Sultán, Muhammad bin Tughlak, was the release and re-installation of the offender, showing clearly that he was something more than an ordinary local governor, transferable at will, and that possibly the interests of the father and son, in their newly-established dynastic rank, and the confessed insubordination of the latter, were independently advocated by the opposing members of the royal line of Bengal, whose family tree could show so much more ancient a series of regal successions than their parvenu Suzerains, whose elevation dated scarce five years back. One of the most interesting illustrations

* Among more critical Arabic scholars than the Bengal Mint Masters ever affected to be, this point would have been easily determined by the insertion or omission of the conjunction و *vau*, which, as a rule, is required to couple the *units* and the *twenties*, but is not used with the *units* and *tens*.

of the present series is contributed by coin No. 9, in the legends of which Bahádur acknowledges the supremacy of Muhammad bin Tughlak over Eastern Bengal during A.H. 628.* The subjection seems, however, to have been of brief duration, as sometime in or after the year A.H. 730 Bahádur appears to have reverted to an independent coinage, in a new capital called after his own title *Ghiáspûr* (coin No. 8), and in A.H. 733 Muhammad bin Tughlak is found issuing his own coin in Bengal, and Bahádur, defeated and put to death, contributed an example to insurgent governors in his own skin, which was stuffed and paraded through the provinces of the empire.

IV. Bahádur Sháh.

No. 7.

Lakhnautí, A. H. 710 ?, 711, 712, 7-3, 7-4,† *break*, 720, 721, 722.

Silver. Size, vii. to viii. Weight, ordinarily, 166 grs.; one example is as high as 167.5 grs. Rare.

Obv.	Rev.
السلطان الاعظم	الامام
غياث الدنيا والدين	المستعصم
ابو المظفر بهادر شاه	امير المومنين
السلطان بن سلطان	

Margin, ضرب هذا الفضة بحضرت لكهنوتي سنة احد وسبعماية

* Ibn Batutah gives the following additional particulars of Bahádur's reinstallation:—"Il [Muhammad bin Tughlak] lui fit de nombreux cadeaux en argent, chevaux, éléphants, et le renvoya dans son royaume. Il expédia avec lui le fils de son frère, Ibráhím Khán; il couvint avec Behâdour Boûrah qu'ils posséderaient le dit royaume par égales moitiés; que leurs noms figureraient ensemble sur les monnaies; que la prière serait faite en leur nom commun, et que Ghiyâth eddîn enverrait son fils Mohammed dit Berbath (بر باط), comme ôtage près du souverain de l'Inde. Ghiyâth eddîn partit, et observa toutes les promesses qu'il avait faites; seulement il n'envoya pas son fils, comme il avait été stipulé. Il prétendit que ce dernier s'y était refusé, et, dans son discours, il blessa les convenances. Le souverain de l'Inde fit marcher au secours du fils de son frère, Ibrâhîm Khân, des troupes dont le commandant était Doldjí altatiry (ذلجي التتري) Elles combattirent Ghiyâth eddîn et le tuèrent; elles le dépouillèrent de sa peau, qu'on rembourra de paille, et qu'on promena ensuite dans les provinces."—Vol. iii. p. 316.

† The dates 7-3, 7-4, may perchance be obliterated records of 723 and 724. I have placed them among the lower figures, but I have no sanction for retaining them in that position.

No. 8.

Second Mint, Ghiáspúr. Date, 730.

Silver. Size, vii. Weight, 166 and 164.5 grs. Very rare. Two coins. *Col. Guthrie.* Plate I., fig. 5.

Margin, ✱ هذ السكة قصبه غياثپور سنة ثلاثين ✱

IV. Bahádur Sháh,

as Vassal *under* Muhammad bin Tughlak.

No. 9.

Sonárgaon, A.H. 728.

Silver. Weight, 140 grs. Unique. *Dehli Archæological Society.*

Obverse, السلطان المعظم غياث الدنيا و الدين ابو المظفر بهادر شاه السلطان ابن السلطان

Reverse, Area, ضرب بامر الواثق بالله محمد بن تغلق شاه

Margin, هذه السكة بحضرة سنار كانو سنه ثمان و عشرين و سبعماية

Muhammad *bin Tughlak Sháh*, Emperor of Hindustán,

(in his own name) after the re-conquest of Bengal.

No. 10.

Lakhnauti, A.H. 733.

Silver. Small coins. Size, v. to v¼. Weight of well-preserved coins, 168.5 grs. Five specimens, *Col. Guthrie.* Plate I., fig. 6.

OBV.	REV.
ابو بكر	
المجاهد في	لا اله الا الله
سبيل الله	محمد
محمد بن تغلق شاه	رسول الله

Reverse, Margin,

ضرب هذه الفضة بشهر لكهنوتي سنه ثلاث و ثلثين و سبعمايه

If the place of mintage of these imperial coins had been illegible, I should almost have been prepared, on the strength of the peculiarity of the forms of the letters, to have assigned their execution to a Bengal artist. The original model for the type of coinage may be seen in fig. 90, page 54, Pathán Sultáns. The late Mr. G. Freeling, of the Bengal C.S., has left on record his acquisition of a gold piece of the same design (from the Dehli Mint) dated A.H. 725.

V.—FAKHR-UD-DIN. MUBA'RAK SHA'H.

On the departure of Muhammad bin Tughlak from Bengal, Tátár Khán, honorarily entitled Bahrám Khán, an adopted son of Ghíás-ud-dín Tughlak, seems to have been left in charge of the provinces included in the government of Sonárgaon, while the Lakhnauti division of the kingdom of Bengal was entrusted to Kadr Khán. On the death of Bahrám Khán,* which is stated to have taken place in 739—but may probably have to be antedated to 737—Fakhr-ud-dín Mubárak, his *Siláhdár*, took possession of the government, and proclaimed his independence. He was in the first instance defeated by the troops sent against him from Lakhnauti, but finally succeeded in maintaining his authority, and, as the coins prove, in retaining his hold on Sonárgaon and its dependencies throughout the nine years, from 741 to 750 A.H., comparatively undisturbed. The history of the period is confused, and the dates given by the native authors prove of little value;† but the coins establish the fact that in 751 another ruler, designated *Ikhtíár-úd-dín* Ghází Sháh, presided over the Mints of Eastern Bengal.

v. *Fakhr-ud-din.* Mubárak Sháh.

No. 11.

Sonárgaon, A.H. 737,—741, 742, 743, 744, 745, 746, 747, 748, 749, 750.

Silver. Size, vi. to vi½. Weight, 166.0 grs. Unique.

Plate I., fig. 7.

Obv.	Rev.
السلطـــان الاعظم	يمين خليفة الله
فخر الدنيا والدين	ناصـــــــراميـــــر
ابو المظفر مباركشاه	المومنيــــــن
السلـــــــــــطان	

Margin,

ضرب هذه السكة بحضرة جلال سنار كانو سنة سبع و ثلثين و سبعماية

* Nizám-ud-dín Ahmad says, Mubárak killed Bahrám Khán; while Abul Fazl affirms that Mubárak put Kadr Khán to death.—Ayín-i-Akbari, ii. 21.

† Ferishtah, Briggs, i. pp. 412-413; iv. 328. Stewart, pp. 80-83.

The above specimen is unique in date, and varies in the opening legend of the reverse from the less rare coins of later years, which commence with يمين الخليفة*

VI.—'ALÁ-UD-DÍN. 'ALÍ SHÁH.

'Alí Sháh, whom Muhammadan writers, by a strange jumble, have endowed with the surname of his adversary Mubárak, and ordinarily refer to as "'Ali Mubárak,"† assumed kingship on the death of Ḳadr Khán, Muhammad Tughlak's representative at Lakhnauti, entitling himself 'Alá-ud-dín. The more important incidents of his reign are confined to his hostilities with his rival, Fakhr-ud-dín Mubárak of Sonárgaon, who possessed advantages in his maritime resources, while the rivers remained navigable for large vessels during the rainy season, but which were more than counterbalanced by Alí Sháh's power on land, which availed him for the greater part of the year, and which finally enabled him to establish his undisputed rule in the Western provinces.

His coins exhibit dates ranging from 742 to 746 A.H., and bear the impress of the new mint of the metropolis, Fírúzábád, an evidence of a change in the royal residence, which clearly implies something more than a mere removal to a new site proximate to the old Lakhnauti, whose name is henceforth lost sight of, and may be taken to indicate a strategetic transfer of the court to the safer and less exposed locality of the future capital, Pandua.‡ 'Alí Sháh is stated to have been assassinated by his foster brother, Hájí Ilíás.§

'Alá-ud-dín. 'Alí Sháh.

No. 12.

Fírúzábád, 742, 744, 745, 746.

Silver. Size, vi½. Weight, 166.7 grs. Rare. Plate I. fig. 8.

Type as usual.

* See also an engraving of his coin (dated 750) Pathán Sultáns, fig. 151 and page 82.

† Budauni MS. Ferishtah, iv. 329. Stewart, p. 82. Ayín-i-Akbari, ii. 21.

‡ Stewart, speaking of Fírúz's advance against Ilíás, says, "the Emperor advanced to a place now called Feroseporeábad, where he pitched his camp and commenced the operations of the siege of Pundua," p. 84. There is a *Mahal* Fírúzpúr in *Sircar* Tandah, noticed in the Ayín-i-Akbari, ii. p. 2. See also the note from Shams-i-Siráj, quoted below (p. 61), under the notice of Ilíás Sháh's reign.

§ Stewart, p. 83.

Obv.	Rev.
السلطان الاعظم	سكندر الزمان
علاء الدنيا والدين	المخصوص
ابوا المظفر عليشاه	بعنايت الرحمن ناصر
السلطان	اميرالمومنين

Margin,

ضرب هذه الفضة السكه في البلدة فيروز اباد سنة اثني اربعين وسبعماية

VII.—IKHTI'A'R-UD-DI'N. GHA'ZI' SHA'H.

At the period of this king's accession to the sovereignty of Sonárgaon in A. H. 750 or 751, we lose the aid of our most trustworthy recorder of the annals of Bengal during his own time. The conclusion of Ibn Batutah's narrative leaves Fakhr-ud-dín Mubárak still in power, while the native authorities are clearly at fault in their arrangement of dates and events, and altogether silent as to any change in the succession in Eastern Bengal, except in their allusions to the more than problematical capture of Fakhr-ud-dín and his execution by 'Alí Mubárak in 743 A.H., with the final accession of Iliás "one year and five months afterwards."*

The numismatic testimony would seem to show that Mubárak was succeeded by his own *son*, as the *Ul Sultán bin Ul Sultán* may be taken to imply. The immediately consecutive dates, and the absolute identity of the fabric of the coins, as well as the retention of the style of Right-hand of the Khalifat on the reverse, alike connect the two princes; while the cessation of the issues of Ghází Sháh simultaneously with the acquisition of Sonárgaon by Iliás, in A.H. 753, would seem to point to the gradual spread of the power of the latter, which is stated to have been at its zenith just before Fírúz III. assailed him in his newly consolidated monarchy in 754.†

* Stewart, p. 83.

† Shams-i-Siráj, speaking on hearsay, affirms that Shams-ud-dín Iliás captured and slew Fakhr-ud-dín after Fírúz III.'s first expedition into Bengal, and that the main object of the latter's second invasion of that province was for the purpose of reasserting the rights of Zafar Khán, the son-in-law of Fakhr-ud-dín (who had fled for protection to Dehli), to the kingdom of Eastern Bengal. It is asserted that although Fírúz succeeded in obtaining this concession from Sikandar, who, in the interval, had succeeded to his father's throne, Zafar Khán himself was wise enough to decline the dangerous

Ikhtíár-ud-din. Ghází Sháh.

No. 13.

Sonárgaon, A.H. 751-753.

Silver. Size, vi. Weight, 166 grs. Very rare indeed. Three coins, *Col. Guthrie.* Plate I. fig. 9.

Obv.	Rev.
السلطان الاعظم	
اختيار الدنيا والدين	يمين الخليفة
ابو المظفر غازيشاه	ناصر امير
السلطان بن السلطان	المومنين

Margin,

ضرب هذه السكة بحضرة جلال سنار كانو سنه احدي و خمسين و سبعماية

VII.—SHAMS-UD-DI'N. ILI'A'S SHA'H.

The modern application of old coins divides itself into two branches —the suggestive development of obscure tradition, and the enlargement and critical revision of accepted history. The transition point between these archæological functions, in the present series, declares itself in the accession of Ilíás Sháh, the first recognised and effectively independent Moslem Sultán of Bengal, the annals of whose reign have been so often imperfectly reproduced in prefatory introductions to the relation of the magnificent future his successors were destined to achieve as holders of the interests and the commercial prosperity of the Delta of the Ganges, to whose heritage, indeed, England owes its effective ownership of the continent of India at the present day.

proximity to so powerful a rival monarch, and to return in the suite of the Sultán. The Bengálı troops, under Zafar Khán, subsequently distinguished themselves in an opposite quarter of India, near Tattah, and their commander was eventually left in charge of Guzrát.—Shams-i-Siráj, book ii. cap. 9, etc.—See also Journal Archæological Society of Dehli (Major Lewis's abstract translation), 1849, p. 15.

The Táríkh-i-Mubárak Sháhi (dedicated to Mubárak II.), the concluding date of which is 838 A.H., also declares that Háji Ilíás killed Fakhr-ud-dín in 741 A.H. This last date is a manifest error; as is also, probably, the omission, by both authors, of the words *son of* before the name of Fakhr-ud-dín.

The compiler of the English version of the early history of Bengal* adopts the conclusion that Hájí Ilíás first obtained power on the assassination of " 'Ali Mubárak" in 745-6, but the previous rectification of the independent personality and status of the two individuals thus singularly absorbed into one, will prepare the reader for the corrections involved, though not, perhaps, for the apparent anomalies the coins disclose. Medallic testimony would seem to indicate a long waging of hostile interests between the real 'Alí Sháh and Hájí Ilíás, before the latter attained his final local triumph; for although Ilíás is seen to have coined money in Fírúzábád in 740 A.H., the chance seems to have been denied him in 741; and in 742 his adversary, 'Alí Sháh, is found in full possession of the mint in question. The Kooch Bahár hoard reveals no coin of either party dated 743, but in 744 the two again compete for ownership, which 'Alí Sháh for the time being continues through 745 into 746, when the annual series is taken up and carried on successively for an uninterrupted twelve years by his more favoured opponent. It is needless to speculate on the varying course of these individual triumphs; suffice it to say, that the increasing power of the ruler of Pandua, in 754, excited the Emperor Fírúz III, to proceed against him in all the pomp and following of an Oriental suzerain, resulting only in the confession of weakness, conveniently attributed to the periodical flooding of the country†—which effectively laid

* Stewart, p. 83.

† Stewart felt a difficulty about the right position of *Akdálah*, the real point of attack, and a place of considerable importance in the local history of Bengal. The following is Ziá-i-Barni's description of the place, taken from the concluding chapters of his history on the occasion of Firúz Sháh's (III.) invasion of Bengal in 754 A.H :—

واکداله نام موضعي است نزديک پنڈوه که يك طرف آن آب است
وطرف دوم جنگل است دران اکداله تحصين کرد و از پنڈوه مردم کارآمده
را با زن و بچه در اکداله برد P. 588, printed edit.

Rennell gives another Akdallah north of Dacca. "Map of Hindoostan."

In the following passage Shams-i-Siráj desires to make it appear that Fírúz III. gave his *own* name to the city of Pandua; but, as we have seen that the designation was applied to the new capital either in 740 or 742—that is, long before Fírúz became king of Dehli, it will be preferable to conclude that the name was originally bestowed in honour of the Shams-ud-dín Fírúz of Bengal, of the present series. The quotation is otherwise of value, as it establishes, beyond a doubt, the true position of the new metropolis:—

(فيروز شاه) در پنڈوه رسيد در آن مقام خطبه بنام حضرت فيروز شاه

the foundation of the ultimate independence of Bengal. A monarchy which was destined so to grow in power and material wealth as to be competent, indirectly, in the person of Shír Sháh, to recover for the old Muhammadan interest the cherished capitals of the north, and to eject from Hindustán the Moghuls who too hastily boasted of an easily-achieved conquest of the country "from Bhíra to Bahár."

Shams-ud-dín. Iliás Sháh.

No. 14.

Fírúzábád, A. H. 740, 744, 746, 747, 748, 749, 750, 751, 754, 755, 756, 757, 758.

Silver. Size, vii. Weight, selected specimens, 168.0 grs.; ordinary weights, 166.0 grs.

Type No. 1. The old Dehli pattern.

Obverse, Square area.

Reverse, Square area, within a circle.

Obv.	Rev.
السلطان الغازي	سكندر ثاني
شمس الدنيا والدين	يمين الخلافة ناصر
ابو المظفر الياس	امير المومنين
شاه السلطان	

Margin,

ضرب هذالفضة السكة في البلد فيروزاباد سنة اربع و خمسين و سبعماية

Type No. 1. Variety A. Silver. Size, vii. Weight, 166 grs.

Obverse, Lettered surface.

Reverse, Small circle, area.

No. 15.

Fírúzábád, A. H. 758.

Type No. 2. Broad coin. Size, ix. Weight of the best and selected specimens, 166.0 grs. only.

Obverse, Plain lettered surface.

Reverse, Circular area, with narrow margin.

خواندند و نام شهر فیروز آباد نهادند چون سلطان فیروز شاه اکداله را آزاد پور نام کرد و شهر پندوه را فیروز آباد * * * * (hence) آزاد پور عرف اکداله و فیروز آباد عرف پندوه

From the original MS. in the possession of Ziá ud-din Khán of Lohárú.

8

Legends, both obverse and reverse as in No. 1 type.

Marginal legend,

ضرب هذاه السكه بحضرة فيروزاباد سنه ثمان و خمسين و سبعماية

The Kooch Bahár trove must have been rich in this type of coin, and of the particular year A. H. 758, as out of 109 specimens in Col. Guthrie's collection, there is no single example of any other date.

No. 16.

Sonárgaon, A. H. 753, 754, 755, 756, 757, 758.

Type No. 3. Size, vii. Present weight, 166 grs. after the obvious reduction by boring out. Plate II., fig. 10.

Obverse, Square area.

Reverse, Circular area, with broad margin.

Obv.	Rev.
السلطان العادل	
شمس الدنيا والدين	سكندر الثاني
ابو المظفر الياس	يمين الخلافة
شاه السلطان	امير المومنين

Margin,

ضرب هذه السكه بحضرة جلال سنارگانو سنه خمس وخمسين وسبعماية

IX.—SIKANDAR BIN ILI'ÁS.

This king—the second only in the still incomplete assertion of local independence of allegiance to the throne of Dehli—exhibits in the material wealth of his national coinage the striking progress incident to comparative freedom and identity of home interests, which may be achieved, almost on the instant, by the denizens of a commercial centre so favoured by nature as the Delta of the Ganges.

Tried by such a test, few statistical returns could present more effectively the contrast disclosed in the Kooch Bahár treasure between the accumulated produce of the Bengal Mints, representing a century and a quarter's limited activity, attended with all the advantages of a diffused circulation, but under a subordinate government, as compared with the overwhelming array of coins bearing the impress of a single unfettered monarch, whose money was, in effect, new from the dies. To numismatists the enhanced proportion will be

Bengal Coins

PL. II.

W. West, sc.

more significantly shown by a reference to the additional number of Mint-cities, the singular variety of new types produced, and above all, by the sustained series and corroborating repetitions of annual dates. It is under the latter aspect alone that I have now to comment on the history of a reign already sufficiently told in other pages. Sikandar Sháh placidly succeeded his father towards the end of 759 A.H., and the coins of the period sufficiently support the date of such a transfer of power, in the final year 758 recorded on the issues of the father, though proof of the accession of the son is less marked, as the seeming anomaly obtained—under the conjoint efforts of father and son to achieve release from thraldom to a distant suzerain—of a concession to the son of much independent power, and, coincidently, the right to coin money in his own name, whether in his own camps or in his father's royal cities. Though some of the earlier designed coins give evidence of due humility in titular phraseology, the same simplicity is adhered to, in continuous mintages, long after the removal of any possible impediments or restrictions to the adoption of comparatively exalted titles; though in the more independent governmental mintages of 758 A.H. (No. 21) the السلطان المعظم is affected even during the life-time of the father, and, after his own accession, higher assumptions, and a more definite approach towards personal hierarchical honors, are discovered in the metropolitan issues of 766-780 (No. 22), while special service against the infidels seems to be implied in the novel intitulation of القاهر الاعدا الله "The conqueror of the enemies of God," on the Fírúzábád money of 769 A.H. (No. 23).

But the most interesting details furnished by Sikandar's coins are those which illustrate the geographical distribution of the chief seats of government. Unlike the Northern Moslems, who, in the difficulty of moving the Eastern hosts—conventionally deemed essential to an Imperial progress—over the imperfect highways of Hindustán, confined themselves ordinarily to one fixed metropolis, the kings of Bengal enjoyed facilities of river communication almost unprecedented: their various capitals, situated within easy distance of one another, were at all times accessible by water,—a differently constructed State barge secured at any season free approach to the seaboard cities of the Great Ganges or the towns on the narrow channels of the western streams. These frequent regal visitations are incidentally recorded on the coinage of the day, by the insertion of the prefix of حضرت to the name of the selected residence, which term colloquially marked the presence of royalty within the limits of the favoured fiscal division.

Sikandar's mint cities were five in number—No. 2, *Firúzábád;* 3, *Sâtgaon;* and 4, *Shahr Nau,* in Western Bengal; with 5, *Sonárgaon;* and 6, *Muazamábád,* in the Eastern division of the province.

2. The first-named mint, in addition to the preferential *Hazrat,** is styled variously *Baldat* and بلدة المحروسة "fortified city," a specification which probably refers to the separate though closely proximate citadel of *Akdálah,* so celebrated in the military annals of the time (coin No. 26).

3. *Satgaon* is distinguished by the prefix of عرصة (Atrium) a term which, in India, came to be conventionally used for a tract or geographical division of country,† a sense which would well accord with its application to Satgaon, as the third circle of government of Bengal proper.‡ In the subsequent reign of Aazam the mint specification is more directly brought into association with the town itself in the seemingly more definite localization involved in the word قصبة§

4. *Shahr Nau,* I suppose to have been the intitulation of the new city founded near the site of the old Lakhnauti :|| it is variously denominated as the simple *'Arsat* or عرصة المعمورة (populous, richly

* حضرة "Præsentia, Majestas; urbs, in qua est regis sedes."

† عرصة زمين in Persian, means "surface of the earth." Sir Henry Elliot remarks, "The words used before Akbar's time to represent tracts of country larger than a *Pergunnah* were سق , خطه , عرصه , ديار , ولايت, and اقطاع —Glossary of Indian Terms, *sub voc* "Circár."

‡ Zíá-i-Barni, in introducing his narrative of Tughlak Sháh's expedition to Bengal (A. H. 724), speaks of that province as consisting of the three divisions "Lakhnauti, Sunárgaon, and Satgaon" (p. 450, printed edit.).

The Ayín-i-Akbari, in the XVI. cent. A. D. thus refers to Satgaon, "There are two emporiums a mile distant from each other; one called Satgaon, and the other Hoogly with its dependencies; both of which are in the possession of the Europeans."—Gladwin, ii. p. 15. See also Rennell, p. 57. Stewart's Bengal, pp. 186, 240, 243, 330.

§ From قصب "amputavit:" hence قصبة "oppidum, *vel* potior, præcipua pars oppidorum."

|| The decipherment of the name of this mint (as Col. Yule reminds me) determines for mediæval geography the contested site of Nicolò Conti's *Cernove.* The Venetian traveller in the East in the early part of the fifteenth

cultivated).* This progressively less appropriate name may be supposed to have merged into the official Jannatábád, which follows in Mint sequence.

5. *Sanárgaon,* as a rule, retains its ancient discriminative designation of حضرة جلال, a title which it eventually had to cede to its rival Muazamábád.

6. *Muazamabad.* There is no definite authority for the determination of the site of this city, which, however, seems to have been founded by Sikandar about 758-759 A. H., when his own coins record that he himself assumed the title of المعظم, without trenching upon the superlative الاعظم usually reserved for the reigning monarch. I conclude that there was a gradual migration from the ancient Sonárgaon to the new city, which grew in importance from the governmental centre implied in the اقليم معظم اباد (No. 19) of 760 A. H., to the بلدة المعظم معظماباد, "the great city of Muāzamábád" (No. 18) of about 780 A. H., till, on the disappearance of the name of Sonárgaon

century is recorded to have said that "he entered the mouth of the river Ganges, and, sailing up it, at the end of fifteen days he came to a large and wealthy city called Cernove .... On both banks of the stream there are most charming villas and plantations and gardens. ...... Having departed hence, he sailed up the river Ganges for the space of three months, leaving behind him four very famous cities, and landed at an extremely powerful city called Maarazia. ... . having spent thirteen days 'on an expedition to some mountains to the eastward, in search of carbuncles' . . he , returned to the city of Cernove, and thence proceeded to Buffetania."—The travels of Nicoló Conti, Hakluyt Society, London, pp. 10, 11.

See also Purchas, vol. v. p. 508; and Murray's Travels in Asia, ii. 11.

There are also many interesting details regarding the geography of Bengal, and a very full and lucid summary of the history of the period, to be found in "Da Asia de Joáo de Barros" (Lisbon, 1777, vol. iv. [viii.], p. 465 *et seq.*). At the period of the treaty of Alfonso de Mello with, "El Rey Mamud de Bengala" (the king whom Shir Sháh eventually overcame) the name of Shahr Nau had merged into the old provincial designation of *Gaur,* which is described as "a principal Cidade deste Reino he chamada *Gouro,* situada nas correntes do Gange, e dizem ter de comprido tres leguas, das nossas, e duzentos mil vizinhos," (p. 458). Satigam makes a prominent figure on the map, and Sornagam is located on a large island within the Delta, the main stream dividing it from Daca, which is placed on the opposite or left bank of the estuary.

More modern accounts of the old city may be found in Purchas, i. 579; Churchill, viii. 54; also Rennell, Memoir of a Map of Hindoostan, London, 1788, p. 55; Stewart, p. 44, and in a special work entitled "The Ruins of Gour," illustrated with maps, plans, and engravings of the numerous Muhammadan edifices extant in 1817, by H. Creighton, 4to., London, Black, Parbury and Allen. See also Elliot's Glossary of Indian Terms, *sub voce,* Gour Brahmin.

* The adjective (derived from عمّر, Coluit) will admit of other meanings, and if understood as applying to a town, might signify "well built," locally *Pakka.*

from the marginal records of the general currency, the new metropolis appropriates to itself the immemorial حضرة جلال of Eastern Bengal (No. 32 A.)

With a view to keep these brief geographical notices under one heading, I advert for the moment to No. 7, *Ghiaspur*, of which locality I have been able to discover no trace; and likewise anticipate the due order of the examination of Aāzem Sháh's mint cities in referring to the sole remaining name of *Jannatábád*, an epithet which is erroneously stated to have been given by Humáyún to the re-edified Lakhnauti,* but which is here seen to have been in use a century and a half before the Moghuls made their way into Bengal.

The single item remaining to be mentioned in regard to Aāzam's mints is the substitution of the word قصبة in lieu of بلدة† as the prefix to Fírúzábád (No. 35), in parallel progress towards centralization with the Mint phraseology adopted in the case of Satgaon.

Sikandar Sháh *bin Ilias Shah.*

No. 17.

Fírúzábád, A. H. 750, 751, 752, 753, 754, 758, 759, 760.

Type No. 1. Ordinary simple obverse, with reverse circular are a and margin.

Obv.	Rev.
سكندر شاه	المجاهد
ابن الياس شاه	في سبيل
السلطان	الرحمن

Margin,

ضرب هذ الفضة السكة في البلده فيروز اباد سنة ثلاث و خمسين و سبعماية

* Ayín-i-Akbari, ii. p. 11; Stewart's Bengal, 124. Bengal itself was called جنّة البلاد, "The Paradise of Regions." Ibn Batutah, iv. p. 210, says the Persians called Bengal دوزخ بور نعمة, "ce qui signifie," en arabe, "un enfer rempli de biens." Marsden, Num. Orient. p. 578, gives a coin of 'Alá-ud-dín Husain Sháh, of A. H. 917, purporting to have been struck at "*Jannatabad.*"

† بلد "regio;" also "oppidum." The plurals are said to vary, in correspondence with the independent meanings, as بِلَاد and بُلْدَان

No. 18.

Sonárgaon, A. H. 756, 757, 759, 760, 763.

Type No. 2. The usual lettered obverse with circular area and margin reverse.

Obv.	Rev.
المجاهد في	
سبيل الرحمن	يمين خليفه
سكندر شاه ابن الياس	الله ناصر امير
شاه السلطان	المومنين

Margin,

ضرب هذه السكه بحضرة جلال سنارگانو سنه ستين وسبعمايه

No. 19.

Muâzamábád, A. H. 760, 761, 763, 764. Plate II. fig. 12.

Variety A.

Margin,

ضرب هذه السكه اقليم معظم اباد سنه احدي و ستين و سبعمايه

No. 20.

Fírúzábád, A. H. 764.

Variety B.

No. 21.

Sonárgaon, A. H. 758, 759.

Type No. 3. As usual.

Obv.	Rev.
السلطان المعظم	
سكندر شاه	يمين خليفه
ابن الياس شاه	الله ناصر امير
السلطان	المومنين

Margin, as usual.

No. 22.

Fírúzábád, A.H. 765, 766, 770, 771, 772, 773, 776, 779, 780.

Type No. 4. Coarse coins, badly formed letters. *Obverse*, simple lettered surface. *Reverse*, circular area.

Obv.	Rev.
الامام	يمين خليفة
الاعظم ابو	الله ناصر امير
المجاهد سكندر	المومنين
شاه ابن الياس	خلد الله خلافة
شاه السلطان	

Margin, هذه السكه بحضرت فيروز اباد سنه سبعين و سبعماية

No. 23.

Fírúzábád, A. H. 769.

Silver. Size, vii. Weight, 166 grs. Very rare. Plate II. fig. 11.

Type No. 5. Similar design to type 1.

Obv.	Rev.
ابو المجاهد	الناصر
سكندر شاه	الدين الله
السلطان ابن	القاهر
السلطان	لاعدا الله

Margin,

ضرب هذ الفضه السكه في البلده فيروز اباد سنه تسع و ستين و * *

No. 24.

Satgaon, A.H. 780, 781, 782, 783, 784, 788. Plate II. fig. 13.

Type No. 6. *Obverse*, a quadrated scalloped shield, with open bosses on the margin containing the names of the "four friends," the intermediate spaces being filled in partially with the king's titles.

Reverse, hexagonal star-shaped lozenge, with exterior marginal legend.*

* The pattern legend of this mint-die seems to have been taken from oral data, as it is engraved as القاهرُ لاعدا الله instead of the more critical اعدا الله القاهرُ. The increased facilities of intercourse by sea probably aided the colloquial knowledge of Arabic in the estuaries of Bengal; while the learned of Dehli had to rely more upon books and occasional teachers. Ibn Batutah tells us, that Muhammad bin Tughlak, though pretending to speak Arabic, did not distinguish himself in the act, while *Hájí* Ilíás must himself have performed the pilgrimage to Mecca.

Obv.	Rev.
	یمین
سکندر شاه	خلیفه الله ناصر امیر
ابن الیاس شاه	المومنین خلد الله
السلطان	خلافة

Obverse Margin,

الامام العالم العادل ابو المجاهد —— ابوبکر عمر عثمان علي

Reverse Margin,

ضرب هذه السکه المبارکه في عرصه ستکانو سنه احد و ثمانین و سبعمایه

No. 25.

Shahr Nau, A. H. 781, 782, 783, 784, 785, 786 Plate II. fig. 14.

Type No. 7. *Obverse*, a simple octagon, with four circlets in the margin containing the names of the four friends of the Prophet, the rest of the exergue being filled in with the king's own titles.

Reverse, a diamond-shaped area with the crossed lines prolonged to the edge of the piece; the lines are slightly scalloped outwards to form an ornamental field.

Obv.	Rev.
سکندر شاه	یمین خلیفه
ابن الیاس شاه	الله ناصر امیر المومنین
السلطان	خلد خلافة

Obverse Margin,

الوثق بتایید الرحمن ابو المجاهد ابوبکر عمر عثمان علي

Reverse Margin,

ضرب هذه السکه المبارکه في عرصه شهر نو سنه اثني و ثمانین و سبعمایه

The name of the mint is imperfectly expressed on even the best specimens, and great latitude has been permitted in the omission or insertion of entire words in the reverse marginal legend.

Variety A. differs merely in the pattern of the reverse area, which is ornamented with double instead of single scallops.

No. 26.

Fírúzábád, A. H. 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792.

Type No. 8. *Obverse*, circular area, with a board margin divided by circlets enclosing the names of the four friends of the Prophet, the intermediate spaces being filled in with their titles.

Reverse, octagonal rose scalloped lozenge, with narrow margin.

Obverse,

الواثق بتائيد الرحمن ابو المجاهد سكندر شاه ابن الياس شاه السلطان

Margin,

ابوبكر الاعظم عمر ابوالخليفه عثمان المعظم علي الامام

Reverse,

يمين الخليفة ناصر امير المومنين عون * الاسلام و المسلمين خلد خلافته

Margin,

ضرب هذة السكة المبارکة في بلدة المحروسة فيروزاباد سنة ثمانين و سبعماية

No. 27.

Satgaon, A. H. 780.

Variety A. *Reverse* Margin,

ضرب هذه السکه المبارکه في عرصة المعمورة ستكانو etc.

No. 28.

Muazamábád (the great city), A.H. ?

Variety B. Mint, بلدة المعظم معظم اباد

No. 29.

Shahr Nau, A. H. 781.

Variety C. Mint, عرصة المعمورة شهر نو سنه احد و ثمانين

No. 30.

Col. Guthrie has a gold piece of type No. 8, size vii. and a half, weighing 158 grains. The coin is inferior in execution to the ordinary silver money. The letters are badly formed, and the marginal legend is altogether obliterated.†

No. 31.

Fírúzábád, A. H. 781, 782, 783, 784, 785, 786, 787.

Type No. 9. *Obverse*, circular area, with a broad margin, broken

* M. Reinaud interpreted the word as عون, *Defensor* (Journal Asiatique, 1823, p. 272), in which he is followed by Marsden (ii. p. 567). Sayud Ahmad again, in his transcript of 'Ala-ud-din's Inscription of 710 A. H., reproduces the title as غوث الاسلا و المسلين, which, in effect, carries a nearly identical meaning (Asar-ul-sunadid, p. 58).

† The only other Bengal gold coins I am at present able to refer to are a well-preserved piece of *Jálál-ud dín* Fatah Shah bin Mahmud (dated A. H. 890), now in the possession of Colonel Guthrie, weighing 161.4 grains, and a coin in the B.M. assigned to 'Ala-ud-dín Husain (A. H. 905-927) which weighs 159.5 grains.

by small shields containing the names of the four companions of the Prophet ; the intermediate spaces are filled in with titles which occasionally pertain to the king, but at times exclusively belong to the Imáms.*

Reverse, hexagonal field ; narrow margin.

Obv.	Rev.
	يمين خليفه
ابو المجاهد	الله ناصر اميرالمومنين
سكندر شاه ابن الياس	عون الاسلام والمسلم
شاه السلطان	خلد ملك

Obverse Margin,

الامام (ابوبكر) الاعظم (عمر) الواثق (عثمان) بتائيد الرحمن (علي)

Reverse Margin,

ضرب هذه السكه المباركه في بلده فيروزاباد سنه ست و ثمانين و سبعمايه

X.—A'AZAM SHÁH.

The accession of Ghíás-ud-dín Aazam Sháh was disgraced by rebellion against his own father and coincident open war, in the course of which Sikandar fell in a general action between his own and his son's troops. Native historians are more than ordinarily obscure in the narration of these incidents, and the dates relied upon are singularly untrustworthy, when brought to the test of numismatic facts. Aazam's initial revolt is admitted to have gained force chiefly in Eastern Bengal, where his coinage substantially proves his administrative supremacy, whether as nominally subordinate or covertly resistant to paternal authority, dating from 772 A. H.,—an increase of power seems to be associated with the mint record of a hold over Satgaon in 790 A. H., and a real or pretended occupancy of a portion of the territory of Pandua in 791, though the final eclipse of the royal titles of the father is delayed till 792 A. H.†

* الواثق in many instances is replaced by وابوالخليفه, while المعظم follows the name of عثمان .

† Stewart supposes that Sikandar met his death in 769 A. H (p. 89) ; and an even more patent error places the decease of A'azam in 775 A. H. (p. 93). The Tabakát-i-Akbari, which devotes a special section to the history of Bengal, implies an amiable and undisturbed succession in this instance.

Ghiás-ud-dín Aazam Sháh, *bin Sikandar Sháh.*

No. 32.

Muazamábád, A. H. 772, 775, 776.

Silver. Size, viii$\frac{1}{2}$. Weight, 166 grs. Plate II. fig. 16.

Type No. 1. *Obverse*, square area occupying nearly the whole surface of the coin, as in the old Dehli pattern.

Reverse, scalloped lozenge, forming an eight-pointed but contracted star.

Obv.	Rev.
المويد بتائيد الرحمن	ناصر الاسلام و
غياث الدنيا و الدين	المسلمين كين
ابو المظفر اعظم شاه	امير المومنين
السلطان	

Obverse Margin: On the upper edge, ابوبكر ; on the left, عمر ; in consecutive reading at the foot, عثمان ; and on the right, علي

Reverse Margin,

هذه السكة المباركة في بلدة معظماباد سنة ثمان و سبعين و سبعماية

Variety A. In one instance بحضرت جلال supplies the place of في بلدة .

There is a doubt about the reading of the word كين "being humble;" the عين "Oculus" of Marsden would certainly be preferable in point of sense, but the forms of the letters of the word scarcely justify such a rendering, unless we admit of an unusual degree of even Bengálí imperfection in the fashioning these dies.

On two examples of this mintage *in silver*, the marginal legend bears the words هذه الدينار in clearly cut letters; but I imagine this seeming anomaly to have arisen from a fortuitous use of the dies for gold coins, which, in device, were identical with those employed for the silver money.

No. 33.

Jannatábád, A. H. 790.

Variety A. Similar obverse with circular reverse.
Mint. جنتا باد سنة تسعين و

Rev. Obv.

No. 34.

Type No. 2. There is a subordinate class of coins, following the devices of Type No. 1 (in size vii. and upwards), struck from less expanded dies, and generally of very inferior execution in the outlining of the letters. These are also from the mint of Muazamábád, and are dated in bungled and almost illegible words سبعو سبعمایة وثمانو سعو, ثما ثما , احد و ثما ثما,—which may be designed to stand for 770 odd, 778, 780, and 781 respectively.

No. 35.

Fírúzábád, A. H. 791, 792, 793, 794, 795, 796, 797, 798, 799.

Type No. 3. Size, viii. to viii¼. Weight, 166 grs. Plate II. fig. 15.

Obverse, scalloped diamond field ; broad margin.

Reverse, circular area.

Obv.	Rev.
غياث الدنيا	ناصر امير
والدين ابو المظفر	المومنين عون الاسلام
اعظمشاه	و المسلمين
السلطان	خلد ملكه

Obverse Margin, السلطان الاعظم المويد بتائيد الملك الرحمن

Reverse Margin,

هذه السكة بقصبة فيروزاباد سنة ثلاث و تسعين و سبعماية

The Reverse marginal records vary in the prefix to the name of the mint from the Kasbah above given, في حضرة and في حضرة المباركه being occasionally used.

No. 36.

Satgáon, A. H. 795, 798.

Variety A.

No. 37.

Satgáon, A. H. 790, 795, 796.

Type No. 4. *Obverse*, area, a square, with a looped semicircle at each of the sides, forming a kind of amalgamation of the margin with the central device.

Reverse, area, a four-pointed star-shaped lozenge ; the outside spaces being filled in with the marginal legend.

Obv.	Rev.
ابوبكر	
المويد بتائيد الرحمن	ناصر الاسلام و
غياث الدنيا و الدين	
ابو المظفر اعظم	المسلمين كين
شاه السلطان	امير المومنين
[illegible]	

Reverse Margin,

ضرب هذ السكة • * في عرصة ستكانو سنة تسعين و سبعمايه

No. 38.

Type No. 5. Size, v. Weight, 166 grains.

Obverse, lettered surface.

Reverse, circular area ; narrow margin.

Obv.	Rev.
غياث الدنيا	ابد الله
و الدين ابو المظفر	خلد الله دولته
اعظمشاه	ملكه
السلطان	

Margin ? • معظماباد سنة احد

The singular orthography adopted in the rendering of the term *Abdallah*, and the substitution of an initial ا *alif* in lieu of the grammatical ع *ain*, affords another instance of the ignorance of the local mint officials, and their tendency to reproduce the approximate *sounds* of words, without regard to the true powers of the letters employed.

A vacant space in the final setting up of this article invites me to extend it so far as to notice a limited series of coins which have hitherto been erroneously associated with the mintages of Bengal proper,—I allude to the money of Táj-ud-dín Fírúz, whose date has, in like manner, been misapprehended by Marsden (p. 575), and by Mr. Laidlay, who follows his interpretation (J. A. S. B. xv. p. 330). The subjoined examples will show that the supposed date of 897 A. H. should be 807; and the consecutive numbers on the different coins now cited establish the fact that the potentate whose name they bear reigned at least from 804 to 823, having a capital entitled *Hájíábád*, which may with sufficient reason be identified with the *Hájípúr* of modern nomenclature. The introductory piece A. seems to have been issued by Táj-ud-dín's predecessor, and their several mintages alike depart from the ordinary style of Bengal coinages in the phraseology and finished execution of the Arabic legends, as well as in the weights of their currencies, which approximate closely to the full Dehli standard, in contrast to the reduced southern range of 166 grains.

A. Silver. Size, vii½. Weight, 165 grs. Unique. A. H. 797.

Obv.	Rev.
الناصرلدين	الواثق بتايد
لدنان الحامي	الرحمن ابو المظفر
الاهل الايمان	محمد شاه السلطان
	٧٩٧

B. Silver. Size from vi½ to viii½. Weight, 168 grs., the full and *sustained* weight of several specimens.

Obv.	Rev.
سلطان	تاج الدنيا
العهد و الزمان	والدين فيروز
الواثق بتائيد الرحمن	شاه السلطان
ابو المظفر	٨٠٤

Obverse, lettered surface.

Reverse, square area, with imperfect marginal records, usually consisting of ضرب بحضرت حاجيا باد with the figured dates *at the foot*, ranging onwards from 804 to 807 [Marsden], 810, 813, 814, 818, 819, 820, 822, and 823 A. H.

These coins are chiefly from the collection of the late Sir R. Jenkins, but have now passed into Colonel Guthrie's possession.

Among other rare and unpublished coins, having more or less connexion with the progress of events in Bengal, I may call attention to the subjoined piece of Shír Sháh (C.), which seems to mark his final triumph over Humáyún in 946 A. H. and his own assumption of imperial honours in Hindustán. The gold coin (D.) is of interest, as exhibiting the model from whence Akbar derived one of his types of money, which Oriental authors would have us believe were altogether of his special origination, even as they attribute so many of Shír Sháh's other admirable fiscal and revenue organizations to his Moghul successor. In coin E. we follow the spread of Shír Sháh's power northwards to the ancient capital of the Patháns, and the piece F. illustrates the retention of the family sway over the other extreme of the old dominion.

C. Silver. Size, vi$\frac{1}{4}$. Weight, 163 grs. A. H. 946. Well executed Western characters.

Obverse, السلطان العادل الموید بتائید الرحمن فرید الدنیا و الدین

Reverse, ابو المظفر شیر شاه سلطان خلد الله ملکه و سلطانه ۹۴۶

D. Gold. Square coin. Weight, 168$\frac{1}{2}$ grs Unique. (R. J. Brassey, Esq.).

Obverse, the Kalimah.

Reverse, شیر شاه سلطان خلد الله ملکه

At the foot, श्रीसेर साह.

E. Silver. Size, vii. Weight, 168 grs. Dehli. A. H. 948.

Obverse, Square area. لا اله الا الله محمد رسول الله

Margin, the names and titles of the four Imáms.

Reverse, Square area. ۹۴۸ السلطان شیر شاه خلد الله ملکه

At the foot, श्रीसेरी साह

Margin, ضرب بحضرت دهلي * * *

F. Silver. Size, viii. Weight, ? Satgáon, A. H. 951 (from the collection of the late G. H. Freeling, Bengal C. S.)

Circular area, اسلام شاه ابن شیر شاه سلطان خلد الله ملکه و
سلطانه و اعلي امره و شانه

Margin,

جلال الدنیا والدین ابو المظفر साह इसलाम श्री ضرب ستگانو ۹۵۱

BENGAL MINTS.

	1. Lakhnautí.	2. Fírúzábád.	3. Satgáon.	4. Shahr Nau.	5. Sonárgáon.	6. Muazamábád.
I. Kai Káús	A.H. 691.........695	... ...	... ...	... ...	... ...	— —
II. Shams-ud-dín	702.........722	... ...	... ...	... ...	*in possession.*	— —
III. Shaháb ud-dín.........	... ...	... ...	... ...	... ...	... ...	— —
IV. Bahádur Sháh	710,712.........720-722	... ...	... ..	... ...	IV. *Under Muhammad bin Tughlak,* 728	— —
Muhammad bin Tughlak (himself)	733	... ...	... ...	... ...	... ...	— —
V. Mubárak Sháh.........	... ...	... ...	... ...	... ...	737..... ... 741 to 750	— —
VI. 'Alí Sháh	... ...	742.........746	... ...	... ...	... ...	— —
VII. Ghází Sháh	... ...	... ...	... ...	... ...	751.........753	— —
VIII. Ilíás Sháh..............	... ...	740.........758	... ...	... ...	753.........758	— —
IX. Sikandar Sháh.........	... ...	750.........792	780......784	781—...786	756.........764	760——764
X. Aazam Sháh..........	... ...	791.........799	790 798	— —	... ...	772——781

Mint No. 7. Ghíáspúr........ IV. Bahádur Sháh, 730 A. H. Mint No. 8. Jannatábád:....... X. Aazam Sháh, 790 A. H.

Notes on the Jumma Masjid of Etawah.—*By* C. Horne, *Esq.*

[Received 5th April, 1866.]

Proceeding south from Humeganj at Etawah through the cutting leading to the Jumna, one observes on one's right hand (*i. e.* east), crowning an isolated mound, an old mosque. By those accustomed to the originally converted mosques of an early period, and as seen at Jaunpur and Benares, this may be at once recognized to have been altered from an ancient Hindu or a Buddhist structure by the process so well described by Fergusson in his Handbook of Architecture p. 81, vol. 1.—The style of the screen before the dome is the same as that at Jaunpur,* whilst the round buttresses at the back, and the coeval ornamentation, fix the period of its conversion.

On enquiring from some of the more intelligent, I found the age of the temple to be popularly reported to be coeval with that of Etawah city. Thus اتاوه $= 5 \times 6 \times 1 \times 400 \times 1 = 413$ which being deducted from 1282 Hijra (new expiring) leaves 809, which deducted from 1866 A. D. leaves 997 A. D. which may very probably represent the real date of the *Hindu* erection.

As is often the case, there may have been a former temple, but the material, black kunkur, does not shew age well; whilst the granite-pillars have been altered and partially carved at different periods.

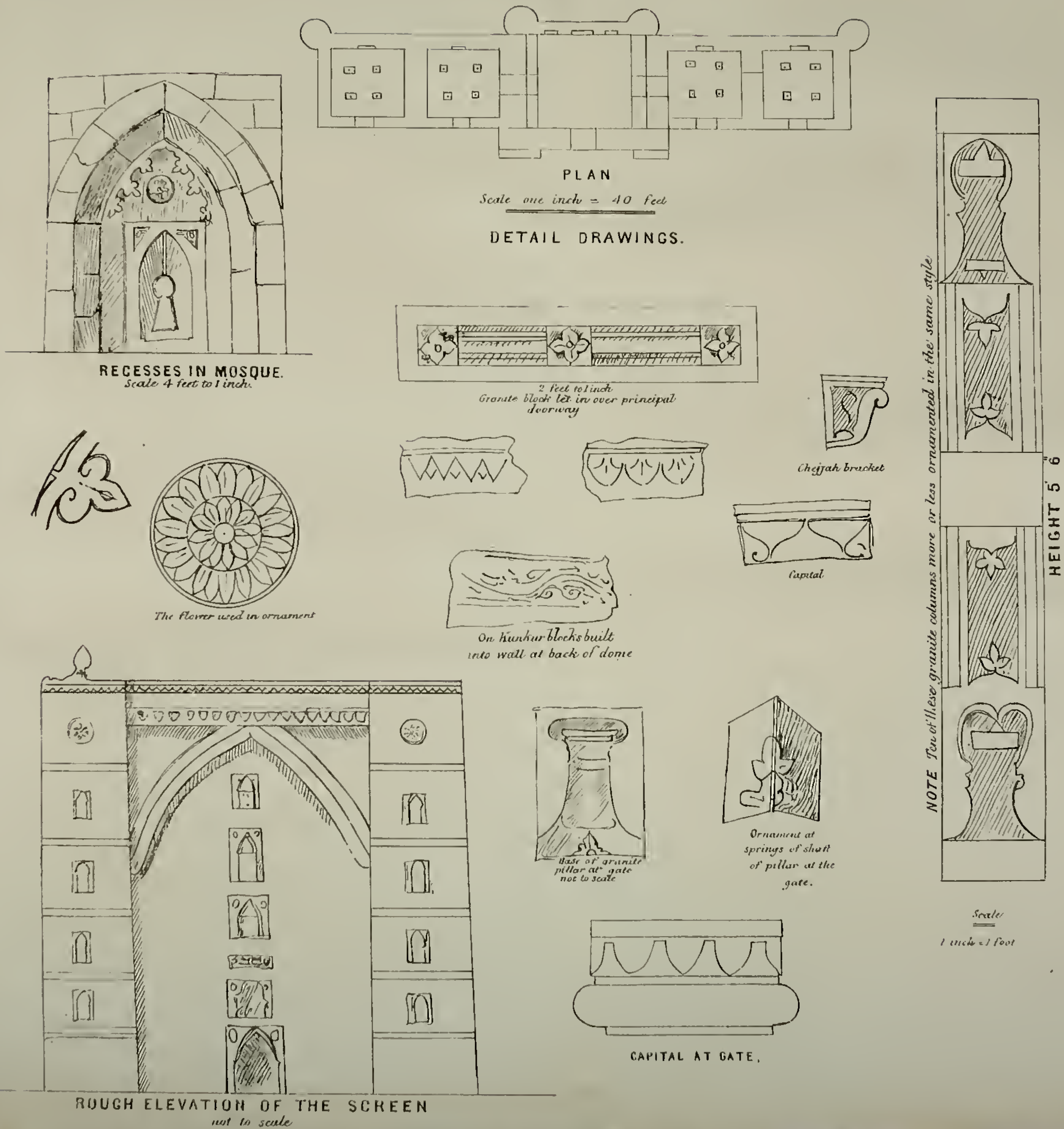
Mr. Hume of Etawah tells me he is about to publish a complete description of it with engravings; I therefore submit these notes merely as the means of drawing attention to the building, which, taken in connection with other ancient remains, is worthy of a visit.

The main portion of the building is of black kunkur; although there are fragments of blue granite boulders in the walls, and portions of at least 10 granite columns of varying lengths. The average length of them is 5-6 with a thickness of 8 inches; but one at the gate, where it is used as an architrave, exceeds 7 feet. There are also plain pillars of red and light coloured sandstone.

I could not, in my short visit, ascertain whence the granite columns had been brought. They have, many of them, been cut in half, so that they now stand about 8′-3″ in height; whilst one from which the carving

* Atallah, Jumma Masjid and other mosques.

JUMMA MUSJID
ETAWAH



T. Black & Co Lithrs Cal:

has been chiselled is used as an architrave in a rude chapel. Others are doubtless plaistered over in the walls.

The screen is 47 feet in height and a little less in width. The general depth of the building, of which a plan to scale is appended, (vide Plate III.) is 20 feet interiorly, the centre portion, on which the Mussulman dome is built, being a few feet more. The block of granite, perhaps 5 feet by $1\frac{1}{4}$, let into the front of the screen—and figured by me—is very curious. It is undoubtedly of great antiquity, and bears the usual Buddhist character of ornamentation as found in this neighbourhood. It at once attracts attention by being altogether out of place. Only one of the "Kangurá" or pinnacles remains in the building, but they doubtless extended across to the screen, the small portions of wall where the plaister has fallen, shew the well known scroll denticulated pattern.

Over the south chapel, right across the centre, has been constructed an arched chamber, 20 feet by 20, and perhaps 18 feet high. The roof of this has been moulded with pieces of nodular kunkur set in lime, which alone appears to keep it together. The effect is most singular; facing as it does to the East, it would seem that originally there had been a cloister, the four rude chapels consisting of 16 pillars each, with a larger chapel in the centre for the image. As, however, the whole was rebuilt by the Mussulmans some 430 to 450 years since, the only archæologcial interest which attaches to the spot is, that it was undoubtedly once a Buddhist site.

In the court-yard, now enclosed by a mean brick wall, is a small chaitya, 9 feet square, covering a Mussulman tomb, where four plain pillars support a flat roof with eave-stones of red sandstone projecting 2 feet on each side. The stones composing this evidently came from Agra from the same quarries* which furnished the Rajá's Secundra gardens. I have drawn one of the capitals which is of the old pattern, somewhat altered.

On the road between Etawah and Mynpoorie, several villages built on high "kheras" or mounds attracted my notice. I hope to explore them and send you the results, if any there be.

* Tautpur Village, Sahender Pergunnah, Agra Zillah.

Translation of an Inscription copied in the temple of Nakhon Vat or the City of Monasteries, near the capital of ancient Kambodia. —*By Dr.* A. BASTIAN.

[Received 16th January, 1867.]

The magnificent monuments of Kambodia give testimony of a bygone civilisation, whose origin remains shrouded in mystery. Their history will be read by the stone-sculptures which cover the walls and portray the nations anciently inhabiting the country, their costumes, manners and customs. There is, besides, scattered over the ruins, a not inconsiderable number of inscriptions to be found, which are written in an antiquated kind of Pali character, and, when deciphered, may assist to obtain the right clue. The following inscription is a more modern one in Kambodian letters, and was copied inside the great temple at Nakhon Vat.

Sapphamasadu: Glory to the holy ones. In the year, which counts 1623 in the era, the year of the dragon, the third month, on a Thursday, in concordance with the Gatha, which are written in Pali, in the metrum of Phrohma-Kit, on the Phra-Phuttha Rub (the statue of Buddha,) I humbly offer up flowers to Bhagavat, who sits in meditation to observe the precepts (Sila), in the reflecting posture and undisturbed by the attacks of man (Mara or Satan), on the handsome seat of the Lotus (Phuttang). I offer up to the Pharabat (the holy footstep) of highest excellence. I bend down and raise hands in supplication at the feet of the Lord. I worship in my mind the three jewels (Ratana-trai), laying down flowers and areca on the throne-seat (banlang), which, elegantly ornamented by sculptures, is overhung in fourteen folds with the Baldachin of four kinds of clothes, beautiful all over in perfection, and the whole shining in brilliant splendour, as a cover of Phra-Photisat (the holy Bodhisatwa), who sits motionless in the posture of continual meditation. I present offerings to Sakhya-Muni, the Lord of glory, who has preached the true law for guiding all beings on the heavenly road. I do homage under the holy footstep. I worship and adore, raising the hands in supplication before the Lords of religion, the five Buddhas, the three gems: in humble piety I invoke them, devoutly I pray. I offer myself in holy love, never forgetting. I fix my mind, the whole of my mind and soul, on the Phra-Chedi (the holy Chaitya or Pagoda) Chulamani* (the precious diadem of hair) in Traidungsa (Daodungsa or the heaven of setting stars), encircled by the shephada (Devada), whom I reverentially bear on my head. I offer up and bow down before (the figure of) Phra-Patima in his golden abode, the Lord of the three praises, the refuge of all beings. I present offerings to the Phra-Phuttha Rub in the Phra-Sathub (Dagoba) of the Phra-Chedi (Pagoda), the Prasat (palace) of the Vihan (monastery). I present myself in offerings of humble service,—I present myself wholly and entirely.

Having done worshipping, having finished the offerings, I pray to become perfect in wisdom, to know all kinds of sciences without error and mistake, after having been born in the next existence for seven years. When I shall have accomplished all knowledge of letters, I pray that I may become well versed in the Trai-Pidok, that I may be able to answer every one's questions, to solve all riddles proposed, that I may know the Trai-Phet (three Vedas) and the Sinlaprasta (the magic of the stones). May I be blessed to meet Pra Sijahn (Sri-Ariya or Arimathiya, the future Buddha) in the next existence. May I be surrounded by numberless attendants; if 11,110 follow, it will be enough. May I be so shiningly beautiful, as to move all hearts, like those women, who having taken holy orders, shall be reborn relucent of radiant beauty, in recompense for their pious deeds, and by virtue thereof. May I become great and mighty, of such power, that even Phra-Phrohm (Brahma) could never put any obstacles in my way. And when the circle of transmigrations leads me to be reborn again in a new existence, I pray, that I may become Buddha, and attain the holy law, pervading all existence,—that I may become equal to the perfected ones in the world.

Now in regard to these people here, who are called respectively Ming, Behn, Sok by their surnames, they desire to become handsome and delicate in figure, of such a shape, as it makes women beloved. This prayer I put in, on behalf of the aforesaid persons of the village Tabungkram. And two of them, Ming and Behn, have still another wish in their heart, namely: to become rich in honours and dignities, beautiful like painted pictures. May they, on leaving the present existence, which is an imperfect and unsatisfactory one to them, may

* Built by Indra over Gautama's hair, which he cut off with his sword.

they hereafter be reborn as brothers, and may the sinful consequences which have separated them, be exhausted, so that they will remain together and united always, and that ultimate death shall take them away simultaneously at one and the same day with their wives. May there be no grief, no sorrow then, as now oppresses them, now in the present existence, when the bones of mother and child are buried under a Phra-Chedi, which is erected above them, as a meritorious work. May mother and child remain united in the next existence.

And furthermore, there is a person here, called Im, who has restored a venerable Phra (idol), which had fallen in ruins, and lay there all cut to pieces. It had broken its neck; its hands and feet were lost. He built it up anew, he mended it, he made it handsome and pretty. It was covered with gold, it was surrounded by other Phra, 137 in number. All these figures, great and small, were clothed in a twofold set of garments; they had their praises written upon them. And after that, meritorious works were performed in the Phra-Chedi, which also had been rebuilt and embellished. For five ordinations the expenses were paid, and a Phra of gold was placed in remembrance. A great deal of money has been expended, the monks have been loaded with presents, a Vihan and a preaching-hall have been adorned, a priest was helped on in his consecrations, a slave was liberated, and all the other works of merits cannot be counted: they are too numerous. How often alms have been given is beyond recollection; times innumerable presents were brought to the priests. And these priests, after having received their presents, have vouchsafed pardon for all faults committed, have promised indemnity from all misfortunes. I pray to the Lord, that happiness may be in store for me, and that in the coming existence I may enjoy my blissful state, without being pestered by people who are envious of it. May I go through the future existences, free of calamities, full of wisdom and knowledge. May no sickness befall me. May I happily live, joined to my wife and my children, and attain a high and serene age, not knowing mishaps. May the evil consequences of former sins not reach me, may I never be oppressed by poverty. May I remain liberated from hell for ever. May my thoughts, now small and narrow, expand in the next existence, that I may understand the precepts (sila) well and thoroughly, that I may never break them, nor commit trespasses. May wisdom be with me always. May I never be in want of relations; nay, may I be blessed with many of them. May I possess plenty of servants. May no slanders pollute me. May I never do a stupid thing. May I speak kindly and softly to every one I chance to meet. May I be preserved from dealings with fools. May I never be born poor and indigent, but only in rich and noble families. May I well understand my business. May my memory be a good one. May nothing frightful happen to me. May nobody hate me. May the punishments, awaiting for sinful deeds of former vices, not hurt me. In speaking to nobles and monks, may my words be right and proper. Should animals be killed unknowingly, may I be pardoned. May there be an end of grief and sorrow. May I depart life, surrounded by my friends, not abandoned and alone. May the sins I might have committed in the present existence, not call for retribution in the next one. May I never be tempted to treat great men and learned teachers in an insolent and impudent manner. I beg pardon for all errors I might be guilty against the holy priesthood, Phra-Phuttha, Phra-Thamr (Dhamma). I beg pardon for all my faults. I beg pardon for any breach of the precepts. I beg pardon for rudeness and roughness of mind. I beg pardon, if ever I have fostered revenge. I beg pardon for lies I have spoken. May I be prosperous in every existence, and always meet with people of rank and dignity. I beg pardon for all errors, committed in words or in acts. May I be secured against evil and misfortunes in my next existences. May there be no terror, no fear and trembling. May never aristocratic tyrants bully me. May I never be threatened by enemies in any of the existences to come. May I not suffer complaints in the next existence, neither baldness nor elephantiasis. May no sores or ulcers disfigure my body. May I not be ugly. I beg pardon, if I have allowed to be tempted by bad inclinations. May evil never come upon me, neither now nor in future. May I always enjoy handsome women. May nothing bad cross my way. When this existence shall be finished, may there never be any more sorrow, may I roll in undisturbed bliss. May the sinful consequences of former deeds, may the torments threatening therefrom, be delayed and put off. May I be re-born handsome and fine. May I never be imprisoned, never be bound nor fettered. As it is said in the verses of Phromakut "Hao kha ti di," and in the Pali, raising my hands, I pray for wisdom. I, a person, to whom they have given the name Xai, I pray, that all evils of old and of the past may be finished, that I may be renewed to preach the words of the Lord in the next existence, to lead all beings on the road to Niphan. May I enjoy blessedness countless numbers of years in the existences to come, and then, performing works of merit with virtuous mind, may I attain to Phra-Sian-Metray (Arimathia). May I be pervaded by benevolence all over, may I show a charitable disposition continually, till the beating of the heart shall cease. As long as blood and eyes remain, may I accomplish good works. May I always be of a joyful mind, resembling Phra-Vixa-Thon* (Chea-tor) and always give alms to the Pret (Pretas), feeding them with blood and flesh. May the Shephada Kowand keep account of all the alms I give. May Phrohm likewise see them and be attentive to keep account. May I receive plenty of joy and felicity, in recompense for these alms. May it please one of the Shephadas to throw down a heavenly sword, because I ardently wish to cut my flesh and skin, to give it in alms piecemeal, to feed the Pret, that they may be satiated and get enough of it. May Phra-Phakava (Bhagavat) and Phra Thamr also know about all these virtuous deeds. May I become like Phra Siahn. I present flowers to Bhagavat and worship in offering them. May I know thoroughly all rules and precepts, like the Upaxa (the ordainer of novices). May I become guide to the beings, my contemporaries; may I be a leader to them in the Lord's religion, during my future existence. The present existence is an imperfect one, my frailties cause me to deviate from the road of truth; I pray for greater perfection in the next existence; I pray for wisdom, so as to penetrate all things, so as to surpass all other men; I pray for wisdom sufficient to solve all difficulties, for wisdom, equal to that of Neakkhasen (Nágasena or Nágárjuna), who with ease and without hesitation explained the questions and riddles put to him by Krom-Malin (Milinda). May the good works of former existences help me on to be re-born in a lucky state. May the Shephada come to my assistance and favour me. May I become benevolent, good-natured and liberal, free of avarice,

* Alchymists adore him, as the possessor of the magic stone, consisting of solid mercury, which is supposed to convert base metals into gold.

may I feel disposed to give alms, to do virtuous and meritorious works incessantly. And furthermore I pray particularly to possess that special wisdom vouchsafed to Taminsheah when still in the state of man, that wisdom which enabled him to solve all the problems invented by Nonthea-Sack in Nirupai, when, overcome by the prince of meritorious glory, he was made his slave and inspired by fear, and followed him as his servant. Thus he became the prince Apangtirat; and then a prince called on the Lord Viroxar, who at command received the name of Manang-Tack, because he used coarse and repulsive words, and did not know to speak properly by reason of his having been a garrulous and talkative fellow in one of his former existences. May I obtain a virtuous mind like Phra-Demiah (Temi),* who patiently bore all the trials his father put him to. I pray to obtain wisdom equal to that of Phra-Kala when born as Mahosot, whose wisdom, surpassing the wisdom of everybody else, being equalled by none, overcame Phra-Chulani. May I give alms, rich alms and freely, in the same spirit as Phra-Mund, as Phra Vetsandon and his lady (Nang) Matsi who faithfully followed him, equal to Nang Nontha, being born of the same mothers, children of the same parents in the course of different existences. And with great beauty were they gifted, and boundless knowledge was their share, till they entered heaven, in which I also pray to be received. Separated from my beloved ones in this sad existence, I hopefully wish to remain united to them, when reborn in my next existence, whether as animal or as man. May I always be surrounded by truthful friends. May I always possess my children and relations. May I always see before me those good women, Nang Pus and Nang Behn, and then these men here, Sues and Pho and Im and Png. I wish in my prayers to be endowed with mighty power and authority, to be learned in magic arts, well versed in them like unto Phra Isor, who called back to

* The Buddhists distinguish the lesser existences, 550 in number, from the greater ones, of which they count 50. The former contain the framework of those fables, which in various compilations have travelled far and wide through western nations. Of the greater existences, in which the Bodhisatwa has taken human form, the ten of the Thosse-Xat are especially venerated and the most holy one is the last Tataka, that of Phra Vetsandon, as immediately preceding the incarnation of the Buddha. These ten existences begin with the history of Temi, a pious child, who, when still in the cradle, imposed on himself ascetic penances.

life Nang Phakavadi, reviving her (by the ceremony of Xub).* May my fame spread about in eminent renown like that of Phra Noray (Nárâyana or Vishṇu), who, coming down from heaven (ravan), was born in the state of man as Phra-Ram (Ráma) and subjected the Sack (Rakshasa) of Langká, walking through the air like Phra Tsun in Kailása. And then I wish to become a king and to get crowned, and to have nine handsome ladies as queens on my side, and to reign one hundred thousand years. And furthermore I pray for great strength and for beauty like that possessed by Phra Chan (Chandra or the moon) in times of old. May I possess prowess and a valiant heart, like Phra-Ram, the celestial one. I pray for wisdom to understand the Sinlaprasat, to know the whole of the military arts and warlike exercises like the exalted Phra-Ram, to be expert like him in archery. When this existence will be finished, may I be re-born the son of a king. May I ascend to heaven like Phra Ketsamalea,† May I be favoured by Phra-Ta (Tadra). May he give orders to Phra-Phutsakam (Visvakarma) to build for me also a royal residence of unparalleled splendour on the edges of the forest. May my voice be a melodious one like that of the bird Karavek. May my wisdom expand. May I know all things and everything. May I become rich in silver and gold, in gems and precious stones. May I have abundance in clothes, in carpets, in pillows and dresses. May my retinue be formed by handsome ladies, graceful in figure and soft and delicate of colour, with legs of the shape of the Talaket flower. May I understand the whole sense of the Trai-Pidock.‡ May I, always revelling in favourable breezes, in the twinkling of the eye, hit the right to be safe. May I never lose my knowledge, should even my body shuddering tremble in fear. May my friends be one hundred one thousand in

* The magic art of Xub, which revives by sprinkling with enchanted water, is taught in the high academy of Takkasila (Taxasila) ; and it is an always recurring trait in the Indo-chinese romances, that young princes or the sons of wealthy Sethi travel to that famous city, to pass there some years as students. Another, but more dangerous method, in which fire takes the place of water, is known to the Rasi or Rischi, the hermits of the forest. The last king of Nokhon Tom, whom they offered to cure of leprosy, lost his life during the process.

† Phra-Ketsamalea (the head crowned with garlands) is the reputed founder of the splendid temple of Nakhon Vat. The legend makes him to be a son of Indra, and relates that his heavenly father sent Visacarma, the architect of the gods, to build on earth a palace after the model of that in which the angels pass their joyful lives.

‡ The Buddhistic Scriptures are contained in the three parts of the Pitaka, the Abhidhamma, the Vinaya and the Sútra.

number. May I remain undisturbed in unceasing bliss. May youths, male and female, of handsome appearance, attend on me, 100,000 in number, singing melodiously in sweet voices. May I possess wealth in elephants, horses, buffaloes and oxen of the best kind, elegant carriages and swift boats, to use them in going abroad. I would be pleased if each of my followers carried a glittering sword, and, when they close up in procession, they should solemnly walk like Putpala. Thus it is becoming. May I be favoured with magnificent palaces, nine of them, all covered with gold. Let them have high towering spires* rising above, glittering with jewels; let them be surrounded by colonnades, winding in three circles; let them be engraved everywhere with sculptures. On each gate have placed the Dragon king (Phaya Nokh),—place him on each step of the stairs to guard them. There must be adjoined three dwelling-houses, handsomely and finely got up. The roof must ascend in three terraces, above each other, and all embellished with splendid ornaments. The round houses also may shine in splendid ornaments. A stable for elephants has to be built, nice and clean. Let there be halls on both sides of the lake, one at the right, the other one at the left, and have them decorated with garlands of the Champa-flowers, exhaling a sweet perfume, like the scented powder of Kracheh. That is all.

Literary Intelligence.

Professor J. G. Bühler of the Elphinstone College, Bombay, and R. West, Esq. C. S. Acting Judge of Canara, have just brought out the First Book of "a Digest of Hindu Law," from the replies of the Çástris in the several courts of the Bombay Presidency. The volume before us contains a large mass of *responsa prudentum* in a variety of practical cases regarding the Hindu Law of inheritance as current in Bombay. It has been published under the auspices of the Bombay Government, and will prove a useful book of reference to lawyers. In the Introduction the editors have given an interesting account of the ancient Smṛitis.

The Government of Bombay has sanctioned the publication of an edition of the A'pastamba Dharma Sútra with the Tíká of Hara Datta. The work will be carried through the press under the editorship of Dr. G. Bühler.

* The description of the wished for palace is taken from the example of that one in which the inscription was hung up, viz. the temple of Nakhon Vat.

A new translation of the Sakuntalá of Kálídása, by Professor Foucaux of the French Academy, has just been published in Paris. The work has been got up in imitation of Professor Williams's excellent edition of the same work, and is intended to popularise among French readers that master-piece of the Indian Drama.

The publication of the Taittiríya Sañhitá of the Black Yajur Veda has once again been brought to a stop. Dr. Roer, who first undertook this work, left India on account of ill-health after publishing only five fasciculi. On his return to this country, press of official duties prevented his resuming the task, and it was therefore made over to Mr. E. B. Cowell. That gentleman succeeded in the course of three years to publish fourteen hundred pages, when ill health obliged him to retire from India. Paṉdita Rámanaráyana Vidyáratna, who succeeded him and brought out the first fasciculus of the 3rd volume, died in May last, after a protracted illness of six months. He was a Sanskrit scholar of a high order, and was earnestly devoted to the ancient literature of his country. He published several Bengali books, and edited, for the Bibliotheca Indica, the Vedánta Sútras with the Commentary of Sañkara, and the Srauta Stúra of A'swaláyana.

We have to record the death of another Sanskrit scholar of great eminence; Paṉdita Premachandra Tarkavágiça died at Benares on the 14th of April last. He was Professor of Rhetoric in the Sanskrit College of Calcutta for over thirty years, and was esteemed as the most profound scholar of his time. He was the only Bengali Paṉdita who had made the Prákrita language a subject of critical study. Among his works may be noticed the commentary on the great epic of Kaviràja, the *Rághava paṉdaviya*, every verse of which had to be explained so as to form once a history of the race of Raghu and once that of the Páṉdavas. His commentaries on the first half of the *Naishada Charita*, and those on the *Sakuntalá*, the *Uttararáma Charita*, the *Anargharághava*, the *Cháṭupushpánjali*, the *Mukunda-muktávali*, the *Saptasati-sára*, and the 8th chapter of the *Kumárasambhava* are well known. For the Bibliotheca Indica he edited the *Kávyádarça* of Çrí Ḍandin with an original commentary. He has left unpublished a Sanskrit Dictionary, and four Cantos of a poetical life of Sáliváhana, from whom dates the Çaka era of India.

JOURNAL

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PART I.—HISTORY, LITERATURE, &c.

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Notes on Sirájuddaulah and the town of Murshidábád, taken from a Persian Manuscript of the Táríkh i Mançúrí.—*By* H. BLOCHMANN, *Esq., M. A.*

[Received 21st December, 1866.]

About two months ago, a copy of the above work was forwarded to me for examination by the Philological Committee of our Society. The book had only lately been handed over to the Rev. James Long by the Nawáb Názir Sayyidí Dáráb 'Alí Khán Bahádur of Murshidábád, for transmission to the Asiatic Society in London. The author is a Shí'ah of the name of Sayyid 'Alí, a friend of the Nawáb Názir, and evidently a man of erudition. He seems also to have received some support and encouragement from Major G. Hall Macgrigor, C. B., political agent at Murshidábád in 1842.

The book is dedicated to the Nawáb Sayyid Mançúr 'Alí Khán Bahádur Nuçrat Jang with the following remark :

و این هدیهٔ محقّر که از قبیلِ هدیه آوردنِ مور است پای ملخی نزدِ سلیمان علیه السلام و تحفه آوردنِ سحاب است قطرهٔ را بسوی عمان لیکن توقّع کوچکانِ دل‌غمگین از زینت‌دهندگانِ تاج و نگین چنین بوده و می باشد که در معرضِ قبول درآورند * * شعر *

نملة جاءت برجْل من جراد   تو سلیمانی کن ای والا نژاد *

فانْ تشرّف بشرف القبول فهو غاية المنی و نهاية المامول * و این کتاب موسوم شد بتاریخِ منصوری *

" Although this contemptible gift resembles the present of the ant that brought the leg of a locust to Sulaiman (blessings be upon him !), or the drop of water which a cloud carried towards the ocean of 'Omán—yet insignificant people in their heart's anguish have hoped, and hope still, that it will find a place of acceptance with those who shed their lustre over sceptre and crown.

It's but a locust's leg which I can bring,
O act like Sulaiman, most noble king!
My only object and my highest aim
Is that this gift may your acceptance claim.

I have given to this book the title of *Táríkh i Mançúrí.*"

The book itself is a compilation made from Farishtah, the Siyar i Mutaakharín, the Riyász ussaláṭín, &c., but it contains also some original matter obtained from the inhabitants of Murshidábád. I have extracted the greater part, at least the more important items, of that which is new, and have added some extracts regarding the celebration of the Muharram in Murshidábád and a short description of the raft of Khiszr.

As the author has used Vansittart's memoirs for the events after the death of Sirájuddaulah, it would be useless to give extracts. Nor are the other chapters of the book of much interest. The author commences with Noah and the kings of the descendants of Hám, from whom the Hindoos originated, and then gives a short account of the kings of Delhi. A short geographical sketch of Bengal, Bahár and Orissa follows, as also a chronicle of Murshidábád. After mentioning the Hindoo princes who reigned in Bengal, he gives a brief history of the Governors and Nawábs of Bengal up to Sirájuddaulah. The last chapters contain a list of the Nawáb Názims from Mír Muhammad Ja'far to the present time, and of their children and servants; a description of their palace and the houses which they built, and of those which are now in ruins from want of repairs; and also some notes regarding their genealogy which is traced to Husain—subjects of interest for the Nawábs only.

Those who feel a particular interest in the following extracts, may compare them with Orme's History of the Military Transactions of the British, Vol. II, p. 139, Mill's British India (3rd edit.) Vol. III, p. 160, and Thornton's British India, Vol. I, p. 218.

In the beginning of 1757, Colonel Clive wrote a letter to Sirájuddaulah complaining of the Nawáb's duplicity in still favouring the French, intimating at the same time his design of attacking Chandernagore. On the 10th March, Sirájuddaulah sent an answer, stating that he was sorry to hear complaints. Without alluding to Clive's intention of attacking Chandernagore, he advised him to do whatever he thought best. The author says:

و کرنیل آنرا محمول بر صدورِ اِجازتِ محاربه با فرانسیسان کرده فوجِ خود براهِ خشکي بر چندن‌نگر مامور کرد و اَدمرل واتسن هم جهازاتِ خود را بر حَوالیِٔ قصبهٔ مذکور لنگر کرد * و اگرچه درین معرکه کرنیل کلیف کاري خالي از شجاعت نکرد لیکن چون تسخیرِ این قصبه بهمه جهت موقوف بر فوجِ بحري و جهازات بود گورنرِ چندن‌نگر راهِ آمد و رفتِ جهازات تا قصبهٔ مذکور بغرق نمودنِ مراکب بر سرِ راه مسدود نموده بود و فقط یك کوچهٔ تنگ گذاشته که بر هیچکس بجز بعضی از سردارانِ فرانسیس آن راه معلوم و منکشف نبود * ازین سبب تسخیرِ آن قصبه عسیر و متعذّر می نمود * چون درین عرصه کوکبِ طالعِ انگریزان رو بطلوع داشت و بختِ نارساي فرانسیسان بهبوط گرائید خود بخود عقدهٔ ما لا ینحلّ از دستِ تدبیرِ انگریزان کشوده شد و الّا درپیِٔ تسخیرِ این قصبه کرنیل کلیف را آنقدر کوشش و محنت در سر افتاده بود که از ابتداي اِقتدارِ انگریزان تا آن زمان هیچو صورت در هندوستان واقع نشده بود * مفصّلِ این مجمل آنکه مستر ترانیو نامی یکي از افسرانِ افواجِ فرانسیس که محرمِ این رازِ سربسته بود بسببی از اسبابِ ظاهري از مستر رناد گورنرِ چندن‌نگر ناراض گردید و پاسِ حقِّ نمك و حمیّتِ قومِ خود گذاشته نزدِ کرنیل کلیف رفت و ازین راز آگاه ساخت و کرنیل کلیف با اَدمرل واتسن جمعیّتِ جهازات بهمان راهِ مخفي زیرِ چندن‌نگر رسانید و در عرصهٔ نه روز محاربهٔ توپ و تفنگ داشته آنرا مسخّر کرد * و کوتهیِٔ فرانسیس را که در قاسم بازار بود انگریزان غارت کرده بتصرّفِ خود آوردند * و مستر ترانیو باین غدر و خیانت بدنام و روسیاه گردید و عوضِ این کورنمکی با ولیِٔ نعمت بمحاذاتِ خیرطلبیِٔ انگریزان تموّلِ کثیر حاصل نموده چیزي از زر که حاصل کرده براي پدرِ خود که پیرِ فرتوت و در وطنِ خودش مرده بنام زنده بود فرستاد * پدرش بر حرکتِ شنیعِ پسرِ ناخلف نفرین نموده نذرش قبول نکرد و واپس فرستاد *

مستر ترانيو ازين سخت متاثّر گرديده آنقدر شرم دامنش گرفت که بعد ازان
بکسی روي خود نه نمود * و بعد چند روز جسدِ او در پارچهٔ دستمالي
بر دروازهاش آويزان يافتند * معلوم شد که خود را خفه کرده هلاک ساخت *
القصّه چون فرانسيسان از چندن نگر اخراج يافتند باقي‌ماندگان که سرِ آنها
مستر لا مشتهر بموشير لاس بود بمرشدآباد آمده ملازم نوّاب سراج الدوله شد
و فوجي از پيادگانِ مشهور به تلنگه از طرفِ نوّاب آراسته وتيار کرده برين
معني انگريزان دَعوی کردند که حسبِ مصالحهٔ واقع مابينِ مايان و نوّاب
دوست و دشمنِ هريکي دوست و دشمنِ ديگری است *

"Col. Clive, taking this as a permission to attack the French, moved his land-army to Chandernagore, while Admiral Watson sailed with his ships to the same place. Col. Clive shewed great energy. But as the French Governor saw that the complete subjugation of the place would depend upon the operations of the navy, he caused a number of ships to be sunk in the river, with the view of impeding the progress of the Admiral, leaving a small passage only unobstructed. With the exception of a few French officers, no one knew that such a passage existed. But as the star of the English was in the ascendant, and the unavailing fortunes of the French were beginning to set, the complicated knot unravelled itself in the hands of the English. But if Fortune had not favoured the English, not even exertions such as had never been witnessed as yet in India, would have enabled Col. Clive to take possession of Chandernagore. A French officer, of the name of Terraneau, who knew the secret of the passage left in the river, was for some reasons dissatisfied with M. Renault, the then Governor of Chandernagore. Forgetting the obligations under which he lay to his own nation, he went to Col. Clive and informed him of the existence of the passage. Col. Clive and Admiral Watson were thus* enabled to bring the ships safely before Chandernagore, and took it after a bombardment of nine days.

* This would materially alter the eulogium of the following passage taken from Sir John Malcolm's Life of Clive, Vol. I, p. 192, "Few naval engagements have excited more admiration, and even at the present time, when the river is so much better known, the success with which the largest vessels of this fleet were navigated to Chandernagore, and laid alongside the batteries of that settlement, is a subject of *wonder.*"

" The French factory in Qásimbázár was, immediately after, taken and plundered.

" Mr. Terraneau, who in consequence of this treachery became infamous and ' blackfaced,' received from the English a large sum as a reward for his ingratitude. He sent a part of the money home to his old and infirm father, who however returned it, when he heard the disgraceful behaviour of his son. Mr. Terraneau felt much mortified at this. Shame ' seized the hem of his garment,' he shut himself up ; after a few days his body was found hanging, at the gate of his house, suspended by means of a towel. It was plain that he had committed suicide.

" The French being driven away from Chandernagore, took refuge in Murshidábád. Monsieur Las,* their leader, became an attendant at the Court of the Nawáb, for whom he fitted out a detachment known by the name of Telinga. To this the English objected, declaring that according to his agreement, the Nawáb was to consider their enemies as his."

A long correspondence ensued, as the Nawáb maintained, that there was no breach of faith in employing a few fugitives as attendants. At last some of the enemies of M. Las gained the day, and the Nawáb advised him to go to 'Azímábád and hold himself ready there, should he want him. M. Las objected to this, trying to convince the Nawáb, that after his departure certain false courtiers would call in the English ; but in vain. The Nawáb again promised to call him in case of need, hoping that he would be ready to come at his call. M. Las considering a future meeting impossible, went at last of his own free will to 'Azímábád. " Col. Clive was thus successful in this affair also."

It was at this time, says the author, that Col. Clive urged the Nawáb, to permit the English to build a Fort and to establish a mint, projects which they had desired to carry out for the last sixty years. Without recording a formal permission, he states, that the present Fort William was commenced by Clive in the course of the same year (1757), and that 20 millions of rupees were expended in its construction. The author says—

* In all English histories of India known to me, his name is misspelt Mr. Law. The transliteration of Monsieur, موشیر Moosheer, is characteristic.

کرنیل کلیف فورا بتعمیر فورت ولیم که الحال موجود است در شهور سنهٔ
یک هزار و هفصد و پنجاه و هفت شروع نمود و بصرف مبلغ بیست هزار هزار که
باصطلاح اهل هند دو کرور روپیه باشد این قلعه آنچنان تعمیر نمود که بدانست
این قوم تسخیر آن اگر تمام هندوستان یکجا شود محال است *

"Clive built Fort William in such a manner that, according to the opinion of the English, it would be impossible to take it, even if the whole of Hindústán united should fight against it." Regarding the mint, he says—

و اوّل سکّهٔ انگریزان در هندوستان بتاریخ نوزدهم آگشت سنهٔ يك هزار و هفصد
و پنجاه و هفت زده شد * و اگر این سکه بنام بادشاه هندوستان زدند لیکن
طرح جدید از تیاریٔ آن بر قالب یادگاري از انگریزان است * و شاید در ابتدا
حسب رواج هندوستان بدون قالب تیار کرده باشند مگر صورتهاي سکّه
به تمادئ ایّام انقلاب پذیرفت و حالا سکهٔ بادشاه خود ولیم چهارم بنقش
صورتش زدند * در دار الضرب آنها سکهٔ شاه عالم بادشاه بی دست و پاي
هندوستان جاري ماند *

"The first English coin was struck on the 19th August, 1757. Although the coins were struck in the name of the Emperor of Hindústán, a new method of preparing them, by means of a mould, reminded people of the English. It may be that the coins were at first struck without a mould, according to the custom of the land,* but a change took place in the course of time. Now they have struck coins with the likeness of their own King, William IV. But coins continued long to be issued at their mint in the name of Sháh 'Álam, the Indian Emperor 'without hand and foot.'"

The events before and after the battle of Plassey are described as follows:

A few letters written by Sirájuddaulah to M. Bussy, in the Dekhan, had been intercepted by the English, and Sirájuddaulah was openly accused of breach of faith. "The wrath of the Nawáb at the crooked dealings and slow but steady advance of these foreigners increased daily." Mr. Watts, the English resident at Murshidábád, was threatened. The Nawáb went so far, as to tear up before him

* V. Aín i Akbarí, the 8th Aín.

a letter, which Col. Clive had written to him. Soon after, however, from fear of his false courtiers and want of confidence in his own army, he tried to pacify Mr. Watts by a khil'at, and wrote an excuse to Clive. But the Colonel had already determined to commence hostilities, and readily joined a conspiracy headed by Mír Muhammad Ja'far to dethrone Sirájuddaulah. According to the author, the conspiracy was planned by Mír Muhammad Ja'far, Amín Chand Raura* and Khwájah Vazier, but according to the Siyar ul Mutaakharín by Mír Muhammad Ja'far, Rájah Dúlabh Rám and Jagat Séth, who had each their representatives in Calcutta, Amín Chand being merely Ja'far's vakeel. Khéthí Begum, a daughter of Mahábat Jang likewise assisted Mír Muhammad Ja'far. Clive treated with the conspirators through Mr. Watts.

The author then gives a description of Clive's double-dealings with Amín Chand, as given in all histories of Bengal.

Early in June 1757 Clive left Calcutta, reached on the 17th the small town of Katwa, south of Plassey, and took possession of the fort of that place. But neither did Mír Muhammad Ja'far join him, as he expected, nor did Clive receive even a line from the conspirators. Doubtful what to do, he wrote to the Council at Calcutta, who advised him to return. But Clive preferred to march on. On the 21st June, 4 o'clock P. M. he left Katwa, crossed the Hooghly and pitched his tents, on the morning of the 23rd, in the fields of Plassey. The Nawáb's army was now in sight. Mír Muhammad Ja'far still remained silent. A cannonade commenced. The English attacked the tents of Sirájuddaulah, but were vigorously opposed by Mír Madan,† one of the Nawáb's faithful amírs. About 12 o'clock Mír Madan was struck by a cannon ball and carried to Sirájuddaulah's tent, where he died. The fighting was however continued, Jarnélí‡ Mohun Lál having taken Mír Madan's place. But nothing decisive was done. Afraid of a conspiracy, Sirájuddaulah sent for Ja'far, who had not taken any part in the fight. After the most earnest solicitations on the part of the Nawáb, Ja'far promised to fight the next

* Generally called Omichund.

† Called Moodeem Khan in Thornton, Vol. I. p. 240 and Moodeen Khan at p. 242.

‡ Jarnélí (*i. e.* general) was a name given to him.

day, on condition that Mohun Lál should be at once ordered to withdraw from the fight. Sirájuddaulah agreed, and Mohun Lál returned to his tents. But no sooner did the troops see that their general had left the field, than they became hopeless and began to flee. Before evening the army of the Nawáb had dispersed. "This is the battle, in which India was lost for the Islám." Before the battle commenced, Amín Chand appears to have informed Clive, that there would be a show of resistance merely. Hence, when Clive saw the determined fighting under Mír Madan and Mohun Lál, he was annoyed and accused Amín Chand of treachery, but had to accept the excuse, that neither Mír Madan nor Mohun Lál belonged to the conspiracy. Sirájuddaulah seeing his army dispersed, mounted a swift camel (جمّازه), and after travelling the whole night, accompanied by 2000 horsemen, reached Murshidábád at 8 o'clock A. M. the next morning (24th June, 1757). He called his chief officers, but all refused to come, even his father-in-law. The state of things being altered, he did not think it advisable to remain in Murshidábád. Having placed a few faithful servants on carriages, he collected as much gold and as many jewels as he could, and left Murshidábád at 3 o'clock A. M. At Bhagwángólá he took boats and sailed up the river towards Rájmahal, where he was to meet M. Las. The meeting was, however, not to take place, for M. Las had been delayed through a want of punctuality on the part of his native servants, "a misfortune frequently experienced in Hindústán."

القصّه چون سراج الدوله از بهگوان گوله براهِ دریا روانه شده در راج محل
رسید آنجا بسبب اضطراب اطفال و زنِ خود که بسببِ جوع داشتند بذات
خود از کشتي فرود آمده بفکرِ بهم رسانیدنِ طعام افتاد و در تکیهٔ فقیري رسیده
ازو درین باب اعانت خواست * از اتفاقات این درویش را سراج الدوله درعهدِ
خود بجرمي آزاري رسانیده و ریش و بروتِ او را حلق ساخته باستخفاف او
کوشیده بود * او کینهٔ دیرینه در دل داشت * سراج الدوله را از وضع او شناخته
بظاهر تسلّي و استماله نمود و تیاريُ پختنِ کهچڑي کرده بسرعتِ تمام رفته
ازین حال بحاکم راجِ محل خبر داد * و درانجا میر محمّد قاسم خان خویشِ
میر محمّد جعفر خان در تلاشِ سراج الدوله رسیده بود ازین واقعه خبر یافته
فورا مع جمعیّتِ خود بر کشتیهای سراج الدوله رسیده او را با همراهیانش

گرفتار کرد * و آنچه نقد و جواهرات همراه داشت بقبضهٔ میر محمّد قاسم خان در آمد * و سراج الدوله با همچو مردمان که یك هفته پیش ازان بار سلامِ او نمی یافتند لجاج و سماج(۱) از حد گذرانید که آنچه همراه دارم گرفته از سرِ من بگذرید که بطرفی آواره شوم امّا سودی نه بخشید * و او را گرفته بمرشدآباد آوردند * میرن عرف صادق علي خان پسرِ میر محمّد جعفر خان خبرِ ورودِ سراج الدوله شنیده او را نزدِ خود طلبداشته و بجائي تنگ و تاریك مقیّد کرده و از رفقاي خود خواهانِ قتلِ او گردید * مگر کسی اقدام باین امرِ قبیح نکرد* آخر محمّدي بیگ نام شخصي که پروردهٔ نعمتِ مهابت جنگ جدّش بود وجدّه یا مادرش او را با دختري که پرورش کرده بود با او عقدِ مناکحت بسته و بآن سبب عزّتي و منزلتی دیگر داشت از کمالِ شقاوت مستعد باین امرِ شنیع شده نزدِ سراج الدوله آمد * و آن مقیّد بی دست و پا انواع معذرت کرده حقّ پرورش یاد داد * آن شقئ شدید ثانئ یزید مطلق نشنید و بضرب شمشیر کارش تمام ساخت * بعدِ قتل بحکم میرن نعشِ او را بر هودهٔ فیلي انداخته در تمام شهر تشهیر کردند * بعد ازان در خوش باغ که بمغرب از قلعهٔ مرشدآباد آن طرف دریا ست در مقبرهٔ مهابت جنگ مدفون ساختند * و بعد چندي میرزا مهدي علي خان برادر خوردِ سراج الدوله را بگیر آورده در شکنجه کشیده از جان کشتند و به پهلوي برادرش بخاک سپردند * نظامتِ سراج الدوله یك سال و چهار ماه بود و قتلِ او در آخرِ ماهِ شوّالِ سنهٔ یکهزار و یك صد و هفتاد واقع شد *

"When Sirájuddaulah had reached Rájmahal, he left the ship, as his wife and children were starving. With the view of procuring food, he entered the hut of a faqeer and asked him for assistance. It happened that Sirájuddaulah had inflicted some time ago a punishment upon this very dervish on account of some crime, and had besides disgraced him by having given the order to shave off his beard and mustachios. The dervish hated him still, and having recognized the Nawáb by his manners, feigned compassion and tried to soothe him. After making preparations to cook some khicharí

(۱) This should be سماجت. The writer wished, however, to have a rhyme for لجاج. The meaning of سماجت in *Hind.*, is adulation, humiliation.—The phrase میرن عرف الخ in the next sentence is not Persian either.

for him, the dervish ran to the Governor of Rajmahal and gave information. In the mean time Mír Muhammad Qásim Khán, a relation of Mír Muhammad Ja'far, had arrived in search of Sirájuddaulah, and having obtained the desired information, seized with the aid of his men the boats of the fugitive and captured Sirájuddaulah with his companions. All the jewels and the money fell into his hands. Thus was Sirájuddaulah in the power of men, to whom, a week ago, he might have refused admission. He conjured them to take all he had, but to spare his life and let him escape. But in vain. On his arrival as a prisoner in Murshidábád, Míran, known as Sádiq 'Alí Khán, the son of Mír Muhammad Ja'far, gave orders, that he should be brought before him, and confined him in a dark and narrow room of the palace. Míran desired his companions to kill him, but no one came forward to do the black deed. At last a man was found of the name of Muhammadí Bég, who had been under obligations to Mahábat Jang, the Nawáb's grandfather, and had married a woman, whom either the grandmother or the mother of Sirájuddaulah had brought up. In consequence of this marriage he held an honorable position. When this man came to Sirájuddaulah's room, the wretched prisoner made all sorts of excuses, and reminded him of the obligations under which he lay. But the cruel wretch, the second Yazíd, would not listen, struck him with the sword and killed him."

"By Míran's order the body was thrown on an elephant and carried about openly throughout the whole town, but was afterwards buried in the grave of Mahábat Jang in Khushbágh, west of the palace of Murshidábád, near the river. Some time afterwards Mahdí Alí Khán, Sirájuddaulah's younger brother, was captured and tortured to death. He lies buried by the side of his brother.

"Sirájuddaulah had reigned for one year and four months, and was killed in the end of the month of Shawwal 1170 A. H."

Regarding the installation of Mír Ja'far the author says—

و کرنیل کلیف مظفّر و منصور گردیده با میر محمّد جعفر ملاقات نمود
و از طرفین رسمِ مبارکباد ادا شد و با همدیگر روانه شده داخلِ مرشدآباد شد
و میر محمّد جعفر بقصرِ اِمارت رسیده جملهٔ سرداران شهر و اهلکاران ریاست
را جمع نموده درباری قرار داد و کرنیل کلیف درهمان دربار برخاسته و دستِ

میر محمّد جعفر گرفته بر مسندِ ریاست نشانید و شلك سلامیٔ اتواب بابتِ تعلّقِ صوبجاتِ ثلثهٔ بنگاله و بهار و اوڈیسه بمیر محمّدجعفر سر شد * بعد ازان خود میر محمّد جعفر بهمراهیٔ کرنیل کلیف و بعضي دیگر از انگریزان و رام چند دیوان و نب کشن منشیٔ کرنیل کلیف در خزانه رفته عرضِ خزانه گرفتند. مجموعِ زرِ نقد از اشرفي و روپیه چیزي زاید از دو کرور یافتند * و مشهور است که ورایِ این خزانهٔ دیگر در محل سراها بود که آنرا میر محمّد جعفر از کرنیل کلیف بسازشِ دیوان و منشیٔ او مخفي داشت و آنجا از جنسِ طلا و نقره آلات و جواهرات کم از هشت کرور نبود که آنرا میر محمّد جعفر و امیر بیگ و رام چند و نب کشن باهم تقسیم کردند * و این امر چندان بعید از قیاس نیست چراکه رام چند و نب کشن که دران زمانه زاید از شصت شصت روپیه ماهوار نمی یافتند رام چند که بعد از ده سال ازین معامله فوت کرد یک کرور و بیست و پنج لك روپیه نقد گذاشت و همچنین نب کشن در همان عرصه نه لك روپیه در مصارفِ موتِ مادرِ خود صرف نموده *

"After the victory Col. Clive met with Mír Muhammad Ja'far. They congratulated each other and went together to Murshidábád. On their arrival at the palace, the nobles of the city and the Government officials were called to a darbár. Col. Clive took Mír Ja'far's hand and led him to the Masnad. At the same time salutes were fired to indicate the transfer of the súbahs of Bengal, Bahár, and Orissa, to Mír Ja'far. After the darbár, the new Nawáb, Col. Clive with a few Englishmen, the Díwán Rám Chand, and Nab Kishn, the Colonel's munshí, inspected the treasury, where a sum of more than 20 millions of rupees, in silver and gold, was found.

"It is also well known that besides this treasury there existed another in the Harem, which fact Mír Muhammad Ja'far concealed from Col. Clive, at the instigation of the díwán and Clive's munshí. The value of the gold and silver articles and of the jewels found there was not less than 80 millions of rupees. The whole was divided among Mír Ja'far, Rám Chand, Amir Bég and Nab Kishn. This transaction is indeed very probable, as Rám Chand left a fortune of $12\frac{1}{2}$ millions of rupees at his death, ten years later; whilst Nab Kishn could afford to pay 900,000 rupees on the occasion of the death of his mother. Yet both men were in receipt of only 60 rupees per month at the time of the division."

Then follows an account of the money paid to the Company and the troops, as also of the "consideration" paid to the civil authorities and to Col. Clive. The author gives also the agreement made between the English and Mír Muhammad Ja'far, which he confesses to have taken from the memoirs of Nawáb Shams uddaulah, Anglicè Mr. Vansittart. The agreement* is the same as given in "The Treatises, Engagements, Sunnuds. Calcutta 1862, Vol. I, p. 11."

Notes on Murshidábád, &c.

The description given of the town of Murshidabad contains nothing new or interesting. The short history which the author gives, may be found in the Aráish i Mahfil (ed. Lees, p. 114) and in Thornton's Gazetteer of India. But the following extracts are perhaps of interest.

از ابنیهٔ قدیم امام‌بارة بودة است از بناهاي نوّاب سراج الدوله بن زین الدین احمد خانِ هیبت جنگ نوهٔ میرزا بندی علي وردي خانِ مهابت جنگ که باحتیاط و احترامِ تمام ساخته و مزدورانِ مسلمان دران کارخانه بودند وهنود دخل نیافتند * و اوّل روز نوّاب خود بدستِ مبارک خشت و گچ آورد و نهاد و بعد ازان معماران کار کردند * و در میانِ امام بارة که موسوم بمدینه بود قدّ آدم زمین حفر کردة از خاک پاک یعني خاکِ کربلا پر کردة بودند * صاحبِ ریاض السّلاطین مدّاحِ خوبئ این عمارت است و دیگران هم میگویند *

* Articles 6 and 7 mention compensations payable to Hindoos and 'Muhammadans.' The "*Treatises, Engagements, Sunnuds, Calcutta* 1862" has instead the reading "Gentoos and Musulmans." It appears that the English in India at the time of Sirájuddaulah, used the terms "Moors *and* Gentoos for Muhammadans and Hindus." Even Orme uses these terms, although he objects to them, on the score of their incorrectness, recommending *Musulmans* for *Moors*. Gentoos is Portuguese and the same as Gentiles, heathens. Perhaps it may be of interest to mention here a few other differences in usage. Thus the word *Súbah* was employed for Súbahdár. The word *Himalaya* was unknown and *Indian Caucasus* used instead of it. *Peon* had the meaning of *irregular infantry*. Murshidabad was spelt and pronounced *Muxadavád* (the vulgar still *pronounce it* Mukshidabad or Muksidabad); we find also *Orixa* for Orissa, *Mōrattoes* for Mahrattas, *Pitan* for Pathan, *phirmaund* for firmán, Scháh for Sháh, *Jehanguír* for Jehangir, *Industán* for Hindustán, *Helebás* for Ilahbás, now called Allahahad, &c. &c. I do not know, whether the word Muxadavad is a corruption of *Makhçúçábád*, the old name of Murshidábád.

هر چارطرف مکانات داشت طرفِ مشرق که دالان در دالانِ مغرب‌رویه بود
دران منبر و چندتا علم و همین مَکان براي مجلس مقرّر بود وطرفِ مغرب
دالان در دالانِ مشرق رویه دران ضرائحِ مقدّسه از اقسام یعنی نقرهٔ* و طلائي
و شیشهٔ و چوبی و علمهای متعدّد که نوَبت بصدها میرسید * قاریانِ کلام اللّه
در محرّم شب و روز در قرآن خواني مصروف و در غیر ایّام باوقاتِ معیّن *
و شمال و جنوبِ دالان در دالان براي کارخانجاتِ روشني و غیره که صدها
مزدور براي خبرگیریٔ روشني سامان در دست ایستاده * و بالاخانهٔ این
مکانات مملو از تتّیهاي ابرکي که در پسِ آن چراغان میشد و هزارها چراغ
می سوختند * در تتّي تصاویرِ گلهای اقسام و انسان و حیوان که در وقت
روشنی عجب نمودي † داشت * جهازِ شیشهٔ اقسام در هر دالان بافراط و
دیوارگیر و لاله و مردنگي بیرون از قیاس درهر مکان روشن * و در دالانهاي
شمالی وجنوبی دو دو تصویرِ براق که چهرهٔ انسان و دمِ طاؤس دارند و در
ارتفاع دم آنها بسقف میرسد و بجای خالهای دم سپرهای خوش روغن و
تشتریٔ چیني و نقرهٔ نصب کرده‌اند و صدها شمشیر و قرولی و پیش (۳) قبضِ
مصقّل بعجب نمود و ترکیب در اطرافِ سپرها نصب شده و صدها بتّیٔ موم
برای نمود دران تعبیه است *

"Among the old buildings was the Imámbárah built by Sirájuddaulah, the grandson of 'Alí Vardí Khán. It had been built with care and reverence, Muhammadan workmen alone having been employed in the work, and Hindoos excluded. The Nawáb laid the first brick with his own hand and put lime over it, after which the workmen commenced. In the midst of the Imámbárah, a piece of ground, called *Madínah*, was dug, to the depth of a man, which was filled with holy earth *i. e.* earth from Karbalá. The author of the Riyász

* An adjective of نقره Thus of سرمه چهره &c. the adjectives are written سرمهٔ چهرهٔ Vullers (Pers. Dict. I. p. 605) spells چهرهٔ without a hamzah, as he does not understand the words of the Bahár i 'Ajam.

† The word is نمود and the ي is the یاي وحدت. Johnson gives a word نمودی *namúdí* which Vullers adopts, p. 1352 of his Dictionary. There is, however, no such word. A similar mistake is the word مشتی given by Vullers, p. 1183. He says the ی is suffix, but it is the یای وحدت as in بعض and بعضي برخ and برخي

‡ The dictionaries give only پیش‌قبضه.

ussaláṭín and others have written encomiums on the beauty of this building. On all four sides were rooms. On the east were vestibules lying within other vestibules facing towards the west, with a pulpit, and a place set aside for an assembly room [wherein the elegies on Husain are read]. There were similar vestibules facing towards the east in the western part of the building, in which were nearly a hundred flags and the sacred coffins made of silver, gold, glass and wood. During the Muharram the Qorán was here chaunted day and night, and at fixed times during the other months. North and south of the building were vestibules of the same kind containing out-offices for the illuminations &c., where hundreds of workmen kept themselves in readiness [during the Muharram] to illuminate the place. The verandahs of the second story contained screens of mica, behind which the lamps hung. On the screens themselves were pictures of men and animals and flowers which looked wonderful when illuminated. All kinds of chandeliers, in large numbers, were in the vestibules, as also díwárgírs, lálahs and mardangís.* The whole building was illuminated. In the northern and southern vestibules were two representations of the Buráq [the horse on which the prophet ascended to heaven], each with a human face and a peacock's tail. The length of the tails reached to the roof of the house. Well polished shields and china or silver plates were fitted into the feathers of the tail, to represent the round spots in the feathers of a peacock. Polished swords, Karaulis [a kind of short swords] and daggers were placed round these shields wonderfully arranged, and hundreds of wax candles gave the whole a striking appearance."

This old Imámbárah was burnt to the ground in 1253 A. H. during a grand display of fireworks, "in the twinkling of an eye." A new one was built up, according to the plan of the former and at a cost of six lakhs of rupees, by the Nawáb Mançúr 'Alí. Its date (1264 A. H.) was expressed by the letters of the words روضۀ کربلا (the grove of Karbalá). Whilst the edifice was building, the workmen received

* Our Hindustání Dictionaries do not give these words. Díwárgír or Díwálgír is a lamp resembling our carriage lamps, three sides being made of glass, one of metal. Lálah (pr. tulip) is a lamp with one or more round shades. Mardángí is the Hindustani word for our Argand lamps.

their food in addition to their wages, and also, when the building was finished, a present of a double shawl and a handkerchief. "At that time you could see shawls in every lane of Murshidábád."

Regarding the Muharram festivities the author says :—

در شهرِ مرشدآباد بفضلِ الٰهی مذهبِ اثنا عشری رواج دارد و تعزیه‌داری را اهمِّ عبادت میدانند * هیچ خانهٔ نیست که خالي ازین سعادت باشد * اگر محتاج است یک مکان برای این کار علیحده کرده آنرا نذرخانه نام نهاده دو سه چراغ روشن و دو سه علم آراسته ایستاده میکنند * و بوقتِ معیّن مردمِ خانهٔ خودش دو سه بندِ مرثیه و نوحه خوانده و ذکری کرده شیون برپا میدارند * و اگر میانه وضع است دو سه کس از محلّه در خانه‌اش آمده شریک عزاداری مي شوند * و اگر صاحب استطاعت است تعزیه‌داری به نمود میکنند که دو يك مرثیه خوان هم مقرّر مینمایند * و اگر صاحب مقدور است ازین هم ترقّی‌میکنند یعنی تقسیمِ شیرینی و شربت و چیزهای دیگر مثل دهنیه و بن که قهوه و کشنیزِ بریان باشد * در هر محلّه همین حال است شب و روز جمیعِ مردمانِ این شهر مصروف باینِ کارِ خیر اند * و در ڈیوڑهیاتِ ناظم و اقارب مع شی زاید است که چند جورِ مرثیه‌خوان و روضه‌خوان و بندخوان وخطبه‌خوان و واقعه خوان ملازم اند *

"As in Murshidábád the Shí'ahs are, by the blessing of God, the reigning sect, the mourning for Husain and the making of ta'ziahs form a most important part of the divine worship. No house is destitute of this spiritual blessing. If a man is poor, he will put a few lamps in a separate part of his hut, called the place of vows, and put up some flags. At a fixed time the women and children of the house chaunt a few couplets of elegies and mourning hymns, say a prayer and then perform the *Shéwan* [*i. e.* they weep for Husain and beat their heads and breasts].

"If a man is of the middle class, he joins with two or three of his neighbours. They perform the ta'ziah in common. If a man is well to do, the mourning ceremonies are performed on a grander scale, and a few "reciters" are appointed. Very rich people go still further and distribute sweetmeats, sherbat, coffee berries and roasted coriander-seeds. So in every quarter of the town. Night and day people are engaged in these works of charity. At the "thresholds" of the Názim and his relations, there is something more. They have among their attendants reciters of elegies, describers of the grave of Husain, couplet singers, Khutbah readers and historians."

The imámbárah presents a grand spectacle during the Muharram. Food is daily distributed to the believers. In the evening there are fireworks and illuminations. On one day the Nawáb also comes. After alighting from his palki at the southern gate, he is conducted inside, and takes his seat on a black carpet, over which a white embroidered coverlet is spread; for a black carpet is used on this particular occasion instead of a bolster. Elegies are again recited, after which sherbat and spices are handed round. Thousands of people are admitted, but only such as come with either a turban or a pagrí.*

و علاوه برین مرثیه خوانانِ بنگالی که بهتّیال میخوانند و اینها جوق جوق وگروه گروه در امام بارّه و اطرافِ آن نشسته هر گروهي کم از پانزده بیست نفر نیستند * یکی ازانها که حروف آشنا میباشد مرثیه را در حروفِ بنگله نوشته در دست دارد * یك مصرع را میخواند و دیگران تبعیتِ او کرده درصدا شریك می‌شوند * و بعدِ اختتامِ هر مصرع لفظِ هی میگویند و هر دو دست بر سینه بعد ازان بر رانها و بعضی پا هم بر زمین میزنند که عجب صدایِ ملال‌انگیز ازان حرکت ظاهر مي شود * و در محلِّ بیگمات هم چند گروه ازینها مقرّر مي شوند و تا ده روزِ محرّم همین طور خوانندگي میکنند * وبروزِ برداشتنِ علم همین‌سان در راه خوانده میروند * و بتاریخ ششم محرّم که شبِ هفتم باشد مهدیِ † حضرتِ قاسم علیه‌السلام از نظامت وَ دیورهیات بر میدارند و در امام‌بارّهٔ کلان مي برند * آرایش و روشني علی الحساب و جلوس سپاهیان و ترگ سواران بتکلّفِ تمام پیش پیش مي باشد * و حضور با ملازمین مرثیه سماعت فرموده همراه تشریف مي برند * و بتاریخ هفتم امام بارّهٔ کلان زنانه مي شود و بیگمات تشریف مي آرند و نواب ناظم را زنجیر و طوق حسبِ معمول و مرسوم مي پوشانند * و باین تقریب زنانِ صدها شرفا و محتاجینَ بفیض

* In the original عمامه یا دستار

† So according to the MS. But the author means the Hindustani میندهي I may remark here that the Arabic مهدي [the name of the 12th imám] is pronounced میندهي all overBengal,especially in proper nouns as غلام مهدی &c.

میرسند که بیگمات هزارها روپیه بطریقِ نذر و نیاز عنایت مي فرمایند * و
بتاریخِ هشتم علم از ڈیوڑهیات بر داشته در امامبارہ مي آرند و جنابِ عالی
پا برهنه و پیاده همراهِ اعلام بتانّي و تامّل و اعزاز و احترام راه میروند و
مرثیه سماعت مي فرمایند و اشک علی التواتر از چشمِ مبارك جاریست * و
بتاریخِ دهم که یومِ عاشوراست قبل از برآمدنِ آفتاب علم و ضرائح را برمیدارند
و بامانيگنج که مدفن گاهِ ضرائح است و سمتِ جنوب بفاصلهٔ قریب دو کروه
یا کم ازان از قلعهٔ مبارك واقع است میروند * و حضورِ خداوندِ نعمت پا پیاده
همراهِ علم و ضرائح تشریف مي برند و مرثیه سماعت میفرمایند و درانجا رسیده
نمازِ عاشورا خوانده قریب بدو پهر بدولتخانه رجعت مي فرمایند * و دیگران تا
سه پهر و شام هم آیند * درین روز در اماني گنج هزارها مردم جمع مي شوند
و اقسامِ طعام از سرکارها بفقرا و مساکین تقسیم مي شود * و درینجا مکانِ شبیهِ
کربلا بنانهادهٔ نوّاب ناظر سیّدی داراب علی خان بهادر است که بکمالِ
خوش عتقادی آنرا ساخته و پنجشنبهِ دوم هرماه مجلس مقرّر است *

"Elegiac verses are also sung in Bengali by singers called *Bhathiyál*. They sit in the Imámbárah and round about the building, arranged in troops of 15 or 20. One of them who can read, has in his hand an elegy written in Bengali characters. He reads out a verse, which the others repeat with him in chorus. At the end of each verse they exclaim Hy ! strike their chests with both hands and then the thighs, Some strike also the ground with their feet at the same moment, the sound of which motion produces a most saddening effect.

"For the harem of the Begums likewise some reciters are appointed and the chaunting continues here also to the 10th day of the Muharram. Couplets are sung and flags carried about in procession.

"On the 6th day of the Muharram, *i. e.* the 7th night [as the Muhammadans like the Jews commence the day at 6 o'clock P. M.], the *Méhndí* of Haszrat Qásim* (blessings be upon him !) is brought from the Nizám's palace and carried in procession to the imámbárah

* The day before a marriage a plate full of méhndí or hená is carried in procession from the house of the bride to the house of the bridegroom who stains his hands with it. The carrying about of this red dye is called in Hind. *mehndí uṭhánā* and in Persian *hinábandí*. The Shí'ahs perform this ceremony during the Muharram also, in remembrance of Qásim, who the day after his marriage [*i. e.* when the méhndí procession had been performed] was slain at Karbalá with his father Husain.

with great pomp and illuminations. A body of infantry and cavalry march in procession before the mêhndí, the Nawáb and attendants follow, and elegies are chaunted.

"On the 7th day the Imámbárah is turned into a harem and the Begums attend. They put fetters on the Nawáb, according to custom, and a chain round his neck. Hundreds of women, high and low, receive presents on this occasion, as the Begums distribute thousands of rupees, in order to fulfil certain vows.

"On the 8th day the flags are carried from the palace. The Nawáb accompanies them, barefooted and walking slowly, with pensive mien and great dignity, whilst tears unceasingly flow from his august eye.

"On the 10th day, called 'Áshúrá, before sunrise, the flags and the coffins are carried to Amániganj, a place about 2 kós from the palace, where the coffins are buried. The Nawáb again walks barefooted in the procession, and, having arrived at the burial-place, orders elegies to be chaunted. The prayer appointed for this day is then read. About noon the Nawáb returns to his palace. The others do not return before the evening. The gathering of the people in Amániganj is very great; for all kinds of food are distributed there to the poor and the inhabitants in general. Besides there is in Amániganj a place resembling Kerbalá, laid out, from pious motives, by the Nawáb Názir Sayyidí Dáráb 'Alí. A meeting is held there on the 2nd Thursday of every month.

"As the relatives of a dead person prepare a dinner 40 days after his death, a large public dinner is also prepared in the Imámbárah, 40 days after the end of the Muharram festivities, *i. e.* on the 20th day of the month of Çafar."

I may remark that the above ceremonies are purely Shí'ah. Educated Sunnís abhor them, but low Sunnís take a part both in the Shí'ah, and also in Hindoo festivities, all over India. The Shí'ahs in Calcutta have a house near Manicktollah, where they celebrate the 10th day of the Muharram by carrying flags about. Elegies are also sung and the shéwan is performed. The house, which is called Karbalá, is let during the year, but the tenants have to leave it during the Muharram.

I take this opportunity to correct a prevalent error, which even many of our lexicographers have made, viz. that the ta'ziahs are carried about in remembrance of the death of Hasan and Husain. But it is in commemoration of the death in battle of Husain and his family only. Hasan had died a year before Husain of poisọn. Nor do the Shí'ahs exclaim in their lamentations "Hasan Husain!" but "Husain, Husain!" or "yá Husain! merely.

As a custom peculiar to Murshidábád, the author mentions a grand annual display of fireworks and a feast given by the Nawáb on the last Thursday of the month of Bhádón, to which the English gentry of Berhampore are generally invited.

A large raft of 100 cubits square is made of plantain trees and bamboos and covered with mud. In the midst of the raft a small fortress is built, to the walls of which all kinds of fireworks are attached. At the order of the Nawáb, the raft is launched (bhasáná) and steered to the other side of the river, when the fireworks are let off. The whole is done to the honour and glory of Haszrat Khwájah Khiszr, (may blessings be upon him).

Smaller rafts (hind. béṛá) are put on the tanks by Muhammadans of the lower classes all over Bengal on every Thursday during the month of Bhádón. The simplest ones consist of joined pieces of bamboos or plantain trees, with a few sweetmeats and a small lamp placed on them. They are made in order to discharge vows.

I do not know the origin of this custom, nor the area over which it extends. It is in all probability of Hindoo origin. But it reminds me of an attribute of Khiszr as the guide of wanderers, who loose their way in the darkness of the night. Indeed one must have seen the darkness of a night in Bengal during the month of Bhádón, to know what darkness really is.

Notes on the style of the book.

The writer succeeds in expressing his ideas clearly; awkward sentences occur seldom.

The style of the book is Hindustani-Persian, *i. e.* Persian words arranged according to the genius of the Hindustani language. The general failings of all Indian writers in Persian, from Abulfaszl downwards, appear also here. A preference is given to long periods with participial constructions corresponding to Hindustani forms as, کرکر

کرکے &c. The apodosis (جزاء) is generally introduced by words like بریں معنی, نظربران, دریں‌وقت &c., which corresponds to Hindustani correlative adverbs as جب and تب, جو and تو &c. Many phrases are purely Hindustani, e. g. بنا عجیب و غریب است که تعلق بدیدن دارد "the building is remarkable, so that it has a connection with seeing," i. e. "you must see the building to comprehend its beauty," or as one would say in Hindustani دیکھنے سے علاقه رکھتاھی you must see it, in order to judge. نماز خواندن for the Persian نماز کردن is the Hindustani نماز پڑھنا. The phrase مینهدی برداشتن for حنا بستن is Hindustani for مینهدی اٹھانا. The phrase میرن عرف صادق علی is Hind. for میرن معروف بصادق. The author uses also many Hindustani words quite needlessly, *e. g.* دوسه‌جفت مرثیه خوان for دوسه جوڑ مرثیه‌خوان. I was astonished to find the following monstrosity in the chapter on Murshidábád و نیز معمول ناظمانِ سلف بوده که درماه بهادون که کشتی‌های نواڑهٔ سرکاری که در ڈھاکه بود طلب میداشتند

"It was also the custom of the former Nawábs to send in the month of August for those government boats which were at Dacca." The most learned Persian scholar, unacquainted with Hindustani, would not know what to make of the که before کشتی. It is very good Hindustani* and stands for جو. کشتی ها is Indian usage for کشتیها. Hindustani authors also insist upon writing بادشاه for پادشاه, as پاد has an obscene meaning (V. Bahár i 'Ajam). اتواب is a curious Arabic plural of the Persian توپ, "The phrase" اشیای مغروته "plundered things" is a serious blunder. It looks as if the author had made a participle of the noun غارت mistaking the ت for a radical.

The handwriting of the MS. is a bad *Shikastah.*

* بهادون مهینے میں جو کشتیاں ڈھاکه میں تهیں الخ.

Notes on Buddhist Remains near Mynpoorie.—By C. Horne, *Esq. B. C. S.*

[Received, October 30th, 1866.]

At a distance of from 10 to 25 miles to the south of Mynpoorie extends of line of high Kheras, distant 3 or 4 miles apart.

On each of these, in ancient time, was some large building, but owing to their general transformation, some hundred years since, at a time of anarchy, into square mud forts, traces of these ancient buildings are hard to find.

In my former notes relative to Kerouli, Maloun and Kánemganj, I recorded evident traces of Buddhist buildings of probably the 3rd or 4th century A. D., but in the mounds recently visited, I have not been so successful.

Leaving Bújániganj canal station, opposite to which is a village perched on a high mound with its usual jheel around, created by the excavation of earth to form the said mound which I could not visit, I proceeded to Tukrow (canal station), nearly west for $6\frac{1}{2}$ miles. Three miles from there, still going west, I arrived at Bhawanti, a village similar to that just spoken of and probably worthy of a visit—but the sun forbad my examining it, and I pushed on to Kúrhat—which is a mound of great extent, with a very large jheel almost enclosing it.

Here the fort arrangement had been carried out, as shewn in Fig. 1; but I was fortunate in finding some very ancient solid brick blocks cut into ornamental patterns with a tool. (Fig. 2.) This block was burnt in one piece and was of very fine texture.

Fig. 1.

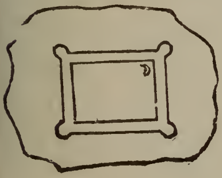


Fig. 2.
14 inch.

Fig. 3.

7½″

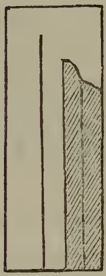
9″

The next illustration was a finial corner ornament. (Fig. 3.) The cutting was very sharply done, and I found fragments of many other such bricks.

10″

Fig. 4.

3′



7½″ thick.

Fine kunkur blocks are rare here, and stone is quite unknown, hence the use of brick. There was, however, one small column shaft in fine kunkur (Fig. 4) which shewed the trace of a small building, probably early Hindoo.

There were also heaps of fragments of small kinriaros or cherubs, such as are seen around later statues of Buddha, as well as 2 pairs of feet, with one or two round faces with very large ear-rings, so that I think that this village would repay a careful search.

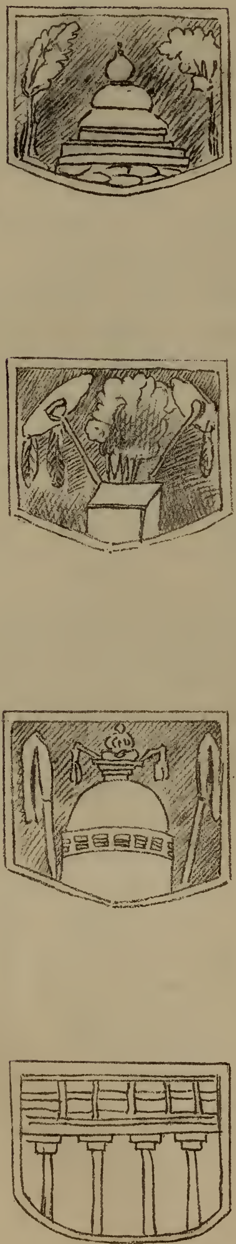
From Khurrah to Soj is only 2 or 3 miles. *Soj* is a mound of vast extent with a very large square mud fort rising 40 feet on its crest, and an immense jheel stretching away from its base. Near the jheel is an arrangement of old kunkur blocks 16′ × 10′—being 5 courses 4′—9″ in height, with many blocks lying around, amongst which I identified the centre block of a Jain ceiling as per fig. 5 in the margin.

2′-8″

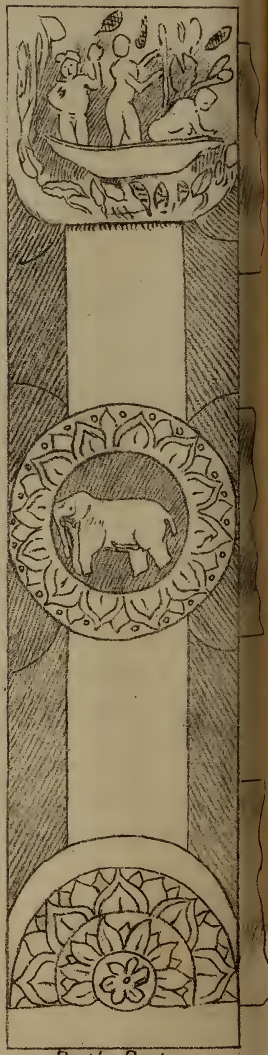
Fig. 5.

This from its size would indicate a building of small size; but kunkur is a formation which does not readily indicate age.

I also noticed, set up as a sacred post, a kunkur ornament being a large finial, the same as found at Maloun. A portion of a statue of Buddha, being from the waist to the feet, also occurred, but I was much disappointed at finding so little that was really ancient.



Carvings on tops of rail posts at Buddha Gayá.



Rail Post

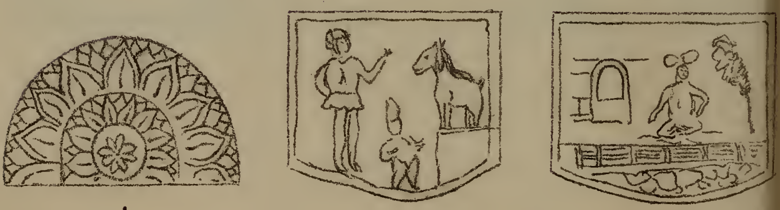
Lithographed at the Govt. School of Art Calcutta by Kamakhya Churn Ghose Student

T. Black & Co. Lithrs: Cal:

Carvings on Rail Posts at Buddha Gayá

Middle ornaments

Bottom ornaments



Top ornaments.

Drawn on Stone at the Govt School of Art Calcutta by Kamakhya Churun Ghose Student

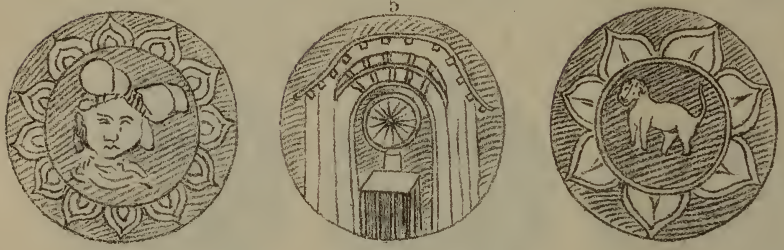
T. Black & Co. Lith.

Carvings on rail posts at Buddha Gayá

2

Middle ornaments

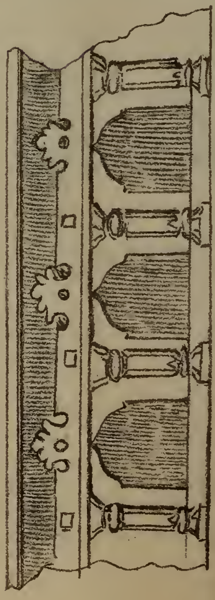
5



Middle ornaments

Top ornaments

Demon face



[illegible]

Lithographed at the Govt. School of Art Calcutta by [illegible] Ghose. Student

T. Black & Co. Lithographers Cal:

Saman is about $2\frac{1}{2}$ miles west of Soj, on a mound, with a jheel, and is entirely built in the said mound. It is the residence of Kullyan Sing, agent for the Rajah of Mynpoorie, and might repay a visit.

Proceeding still further west, we came to Kishní, on the metalled road from Futtyghur to Etawah. Here was one large mound covered with buildings in occupation, and so nearly inaccessible archæologically; and a smaller mound from which I was told large square bricks were excavated. I found here a heap of broken Hindoo deities, but not a trace of Buddhist remains.

Near Kúrhul I also saw a round mound from which they said large bricks were taken, but neither at Kishní nor at Kúrhal did I see an ancient brick either lying about or built into any structure.

The oldest coins I could get were some copper ones of the Delhi kings, but I have no doubt but that Hindoo punch coins are sometimes found. This line of country is worth carefully exploring, and as a road from Kurhal to Kishní is in course of construction, others will find it an easier matter than I did.

Notes on the Carvings on the Buddhist Rail-posts at Budh Gayá.

By C. Horne, *Esq. C. S.*

In submitting to the Society the accompanying drawings of the more remarkable of the carvings on the Buddhist rail-posts at Budh Gayá, some from the court-yard of the mahant, but chiefly from the little temple by the tower, I would beg to draw attention to some of them—

Plate, No. IV. *Firstly.*—The boat scene, almost identical with the one figured by Cunningham in the Bhilsa Topes.

Secondly.—The rest of the upper portion is of the same sheet, all of them copies, doubtless of Buddhist rails, pillars, and buildings. Here we find the round and pointed arch, but this argues nothing, when we remember that there were imitations of wood work and of thatch and bamboos as in the cave of the rock temples of Barabur close by.

Thirdly.—The central compartments are curious, but need little remark. At first I took them for astronomical emblems as signs of the zodiac, but I do not think they are.

Fourthly.—The lower ornament is nearly the same in all.

Memo.—Although drawn one over the other—it does not follow that the identical three were upon one and the same rail-post.

Plate No. V.—The figure shewn as No. 2, to the left, is rather unusual. It wants all the refinement of Buddha, and does *not*, I think, represent him.—There is another such figure let into the wall, as you enter the lower room in the great tower on the right hand, inside the doorway. The fifth sketch puzzled me. It is perhaps intended to represent a good trick. To the extreme left is, what I believe to be, the only remnant yet found in Benares of a Buddhist rail. It is much defaced, and obliterated with dirt and ghee, and stands nearly opposite to the door of the golden temple on the left hand of the street.

The demon face to the extreme left of the centre one much resembles the Sarnath demon face; whilst the cornice is very bold, free, and handsome. The single demon face inside the brick tower, left, above the floor of the highest chamber, must have been built in, when the tower was built, and I should not assign any great age to it.

The portion of the Singhásan or idol shrine drawn nearly to scale, and which shews the holes into which were set the fastenings of the metal covering, is very curious. It exactly corresponds in style to the whole of the exterior plaistering of the great tower, and in the event of the arches having been declared to be coeval with the tower, I must amend my former opinion, and would hold that the tower was rebuilt, interiorly arched, and wholly plaistered at or about 500 A. D.—the date of Amara Sinha, when the original Buddhist railing included both the Bo tree and the tower.

In conclusion, I may remark, that although my drawings are very defective, yet the original carvings are very rude, and clearly betoken their early execution.

The Pegu Pagoda.—By Capt. H. A. Browne, *Deputy Commissioner of Rangoon.*

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Every ancient Pagoda in Burmah has its *Thamaing* or "sacred chronicle," giving an account of the relics or quasi-relics which it was built to enshrine, the names of the kings, rulers or other distinguished personages by whom it was erected or has since been repaired or embellished, in short its history from its foundation down to a recent time.. The commencement of those chronicles is of a more or less mythical character; the founding of each particular pagoda being connected, if possible, by its historian with some event in the life of Gaudama, who is fabled to have visited these regions after he became a Buddha. Some gleams of real history may be detected even in the mythical portions of the narratives, but later on the chronicles are truthful contributions to the history of the period. To disunite some of these from the obscurity of the Hpoongyee's book-chests, and give a compendious description of their contents, will not be an uninteresting task, and the results may be useful to the author who will some day write "The History of Burmah," as well as interesting to the general reader.

One of the most ancient and famous among the Pagodas of Burmah is the graceful structure known as the Shwé Hmawdaw ရွှေမှော်တော် at the town called, by Europeans, Pegu, and by Burmans, Pago ပကိုး or Paigoo ပဲကူး*, but formerly known as Hanthawadie ပံသာဝတီ, which, since the decline of Thatoon သထုံ twelve centuries ago, has been the capital of the Talaing nationality.

Hanthawadie is derived from the "Hantha" (Goose or Brahminee Duck), the national bird of the Talaings. Concerning the manner in which this bird came to be selected by the Talaings as their emblem,

* The name "Pago" appears to be of Burmese not Talaing derivation. It is said to be a corruption of "Paikho" ပဲခိုး or Beau-thief, from some old legend connected with the place.

The name of the pagoda "Hmawdaw" is a corruption of the Talaing Hpot-daw which is interpreted in Burmese as "Bhoorabyan," a "winged" or flying Bhoora.

the following fable is narrated. When Gaudama, in the eighth year after he became a Buddha, was on a preaching tour in these parts, he passed by the hill on which Hanthawadie was afterwards built, and there seeing two "Hanthas," which with joined wings paid him obeisance, he foretold that 1116 years after his death, there would be built on that spot a town which would become the capital of a race of monarchs and an important city. As he foretold, so it came to pass. On this site, which is just outside the eastern wall of the present town, the original founders of the Talaing kingdom of Pegu, Thamala and Wiemala, built the old city of Hanthawadie, about 573 A. D. The district, which took its name from the capital town, contained at its most floursihing period 32 cities or townships, and included the eastern half of the present district of Rangoon, with parts of Toungoo and Shwegyeen. The following are the names of the thirty-two cities.

1. Dengmai; 2. Zarayboon; 3. Hmawbyo; 4. Lagwonbyeng; 5. Akharaing; 6. Ma-oo; 7. Ramanago; 8. Ramawatie; 9. Hmawbee; 10. Hlaing; 11. Hpoungleng; 12. Htandawgyee; 13. Deedwot; 14. Zeta; 15. Zoungdoo; 16. Hpa-aing; 17. Merengzaya 18. Tagnabhoung; 19. Meng-raihla; 20. Kawlieya; 21. Zainganaing.

The whole of these twenty-one townships are within the limits of the present district of Rangoon, and the names may all, with the exception of Nos. 1, 2, 3, 6, 7, 8, 13, 14, 16, 18 and 19, be found in the Map of Pegu. Those which are not now traceable among the existing towns or divisions of the district, were situated as follows: No. 1. Dengmai, on the bank of the Sittang river, south east from Pegu. No. 2. Zarayboon, now known as Zwaiboon, in the same neighbourhood. No. 3. Hmawbyo, doubtful. No. 6. Ma-oo, part of Akharaing. No. 7. Ramanago, the present town of Rangoon. No. 8. Ramawatie, the country round the present town of Rangoon. No. 13, Deedwot, north of Pegu. No. 14, Zeta, north of Pegu. No 16, Hpa-aing, on the bank of the Irrawady, opposite to Danoobyoo. This division existed up to the annexation of Pegu, when the circle of Hpa-aing was amalgamated with that of Tagay. No. 18, Tagnabhoung, between Hmawbee and Hlaing. No. 19, Mengrai-hla, next to Tagnabhoung.

The following are the cities which lie within the limits of the present district of Shwegyeen. No. 22, Koukmaw; No. 23, Ban-myo; No. 24, Doontsaran; No. 25, Kyeekya; No. 26, Tsittoung (Sittang); No. 27, Atha; No. 28, Ywongzaleng; and the remainder which are in the district of Toungoo, are—No. 29, Toonkhan, No. 30, Rainwari, No. 31, Baingta, No. 32, Wenghpyaing.

Below is a table shewing the names of the kings by whom these towns were founded and the dates assigned to the reigns of the kings.

Name of City.	*Name of King.*	*Date of Reign.*	
		B. E.	A. D.
Koukmow.	Thamala.	514	1152
Banmyo.	Ditto.		
Doontsaran.	Ditto.		
Kyeekya.	Ditto.		
Tsittoung.	Wiemala.	526	1164
Dengmai.	Ditto.		
Zarayboon.	Ditto.		
Atha.	Ditto.		
Hmawbyo.	Mahiemoora Ariendaraza.	550	1188
Lagwonbyeng.	Ditto.		
Akharaing.	Hientharaza	557	1195
Ma-oo.	Ditto.		
Ramanago.	Poonnarickha.	697	1335
Ramawatie.	Ditto.		
Hmawbee.	Ditto.		
Hlaing.	Ditto.		
Hpoungleng.	Tietharaza	712	1350
Htandawgyee.	Byeenya-oo.	731	1369
Deedwot	Ditto.		
Zeta	Ditto.		
Zoungdoo.	Ditto.		
Hpa-aing.	Ditto.		
Doonkhan.	Ditto.		
Rainwai.	Ditto.		
Merengzaya.	Ditto.		
Tagnabhoung.	Ditto.		

Mengraihla.	Ditto.		
Kawlieya.	Razadhicrit.	743	1381
Baingta.	Ditto.		
Wenghpyaing.	Queen Beenya daw San Shang tsaw-boo.	850	1488
Gwon-zaleng.	Dhammatsedee.	864	1502
Zainganaing.	Thoo-sheng-taga Riwot pie	901	1539*

The dates in the above table are those given in the "Thamaing" of the Shwé Hmawdaw, but it is clear that in this particular, *i. e.* as regards dates, the chronicle is altogether wrong. The year 1116 of the religious era, in which year Pegu is said to have been founded, corresponds with the year 493 of king Thamoondarie's Era (573 A. D.) but the chronicle gives the year 514 of the present secular era as the date of this occurrence A. D. 1152. This makes a difference of 579 years in the date of Thamala's reign.

The Shwe-Hmawdaw, like many other pagodas, is said to have been built in order to enshrine two of Gaudama's hairs. The legend relates that in the sixth year after Gaudama had obtained omniscience

* There are five different eras known in Burmese Chronology. They are as follows:—

1st.—The Kawza era which, after lasting 8650 years, was abolished by Bhodaw Eentsana, grandfather of Gaudama, in B. C. 691.

2nd.—Bhodaw Eentsana's era, which lasted 148 years only, until Gaudama's death, B. C. 543.

3rd.—King Ayatathat's or the Religious era. This lasted 624 years, until A. D.. 82.

4th.—King Thamoondarie's era. In 82 A. D. Thamoondarie, king of Prome, superseded the Religious era, as far as secular purposes were concerned, by his own era which he established from the 622nd year of the Religious era, A. D. 80. This era lasted 562 years, until 643 A. D.

5th.—Pagantsaw Rahan's or Pooppatsaw Rahan's era. In 642 A. D. this king of Pegu abolished the Prome era and established his own, making it commence from the year 560 of the former era. This era has now reached its 1228th year.

Another era, but little used, known as Gnyoung Mangtara's era, which lasted 798 years, was synchronous with a portion of the present era.

According to Burmese computation, therefore, the following number of years have elapsed since the death of Gaudama:—

Ayatathat's Era, years	622
Thoomoondarie's Era,	560
Pooppatsaw Rahan's Era,	1227
Total	2,409

Which fixes the date of that occurrence, viz. the death of Gaudama, in 543 B.C.

(about 582 B. C.) whilst he was tarrying in the Makkoola Hill near the source of the Thalwon (Gwon-zaleng) river, he was visited by two pilgrims from Zoungdoo* named Mahathala and Tsoolathala, the sons of Pientaka, a wealthy merchant of that town. The brothers made many offerings. Gaudama, being desirous of requiting them, and at the same time of establishing his religion in their country, shook his head, and presented to the brothers two hairs which adhered to his hands, directing them to enshrine the same on the Thoodathana-Myeng-theeta Hill which lay to the west of the Hanthawadie Hill. The two brothers being ignorant of the locality of these hills, Gaudama described them as surrounded by the sea, from which they had but lately emerged, and promised that they should be pointed out by the Nats and Brahmas. Gaudama then prophesied that in the 1116th year of his religion, and the year 514 of the secular era, two brothers, named Thamala and Wiemala, would found the city of Hanthawadie to the east of the Thoodathana-Myeng-theeta Hill, and that his religion would flourish there.

The two brothers, Mahathala and Tsoolathala, then took ship and conveyed the sacred relics, enclosed in a casket provided for the purpose by the Thagya king of their native town, where they were received with great rejoicing. After holding high festival for seven months and seven days, they proceeded to obey the instructions they had received, by enshrining the relics on the Thoodathana Hill. Guided by the miraculous power of the Nats and Brahmas, they speedily arrived at the spot, and then they prayed that an omen might be given if that was indeed the very place. In answer to their prayers, the great earth shook. This not only supplied the desired information, but called down a host of Nats and Brahmas from the upper regions to take part in the enshrinement of the relics. By them the shrine was thus prepared. At the bottom of a pit ten cubits square was laid a slab of pearly white marble, set with diamonds. A similar slab, set with emeralds, was prepared to cover the mouth of the pit. In the centre of the bottom slab the Thagya king placed a golden cradle, round which were ranged images of the chief disciples of Gaudama, each holding a golden bouquet. These disciples were Thaicapootra, Mawgalan, Theeree Maha Maya, Theeree Thoodaw-

* A place which still exists upon the Pegu river, about 20 miles above Pegu.

dana, Gathawdara, Khema, Oopawon, Rahoola and Ananda. The sacred relics were then conducted with great pomp from Zoungdoo to the Hill, the distance, two Yooyanas (24 miles), being travelled in fourteen days. The casket containing the hairs was then placed on the cradle, and high festival was held around the shrine. Besides the images of the chief disciples, those of the following persons also were placed in the shine; Mahathala and Tsoolathala, the disciples Anooroodha, Mahakathapa, Ooroowelakathapa, Oopalie-pagnya, Isaweggie, the king of the Brahmas and his four wives. The several positions occupied by these images are all carefully described in the legend. Countless offerings were then made, the Thagya king giving ten billions of gold, each of his four queens forty thousand of silver, Pientaka one thousand of gold, Mahathala and Tsoolathala one thousand and eighty of silver, and so on. The Thagya king then placed certain Nats to guard the shrine, and a structure of stone and brick, 50 cubits high and 250 cubits in circumference, was erected over it. This took place in the year 119, Bhodaw Eentsana'a era, 572 B. C., on Saturday the 1st of the waxing of the month of Tagoo.

Then follows a list of the people dedicated by the Rulers of Zoungdoo, Thamandaraya and his queen Thoobhattadewee, to the service of the Shwe Hmawdaw, and the extent of the land which was declared to belong to the shrine. The land was as follows,—to a distance of 100 "Tas" (1,050 feet) to the east of the Pagoda, 100 "Tas" to the north, 100 "Tas" to the west, and 50 "Tas" to the south. This would comprise an area of about 310 acres.

Here ends the first chapter of the mythical portion of the legend, from which no real information can be gleaned, except perhaps that there was a town at Zoungdoo before Hanthawadie was founded.

We have not yet, however, got out of the mythical period. Our chronicler next attempts to connect the Pagoda with the celebrated revival of religion which took place in the reign of the great Athawka of Patalipoot in the commencement of the 3rd century of the Christian era. The legend states that in the 218th year of the religious and the 327th of the secular era* there was not a single worshipper of Pagodas or relics in the country. Cities had declined from their

* Another mistake in chronology. There is no secular era known, the 327th year of which corresponds with 218 of the religious era.

former greatness, and the temples had fallen into ruins, when the king of the great country of Patalipoot named Athawka Dhamma Raja invited the Rahandas Mawgaliopootta, Fictha and Oobhara to the third council, and under their guidance searched for sacred relics wherever they were to be found. The Rahandas pointed out the places where the holy hairs and other relics were reposing in the country of Hanthawadie; seven Tsedees were cleared of the trees and weeds, with which they were overgrown, and were ornamented with golden Htees by the piously disposed monarch. These Tsedees were the Dagoon, the Kyaik-dewa, the Kyaik-thamwonhan, the Shwe Hmawdaw, the Makaw, the Kyaik-Khouk and the Kyaik-tanoo. All these, with the exception of the Shwe Dagoon (Rangoon), are in the neighhourhood of the town of Pegu.

A number of persons were also devoted by king Athawka to be the attendants or servitors of these Pagodas.

A complete list of them is given—ninety men were assigned to the Shwe Hmawdaw and twenty-five to the Shwe Dagoon. Altogether five hundred men were devoted to the seven Pagodas. Of these two hundred were from the west of the Sittang river, and the remainder were Mogoung Shens. Lands also were dedicated to the use of these Pagodas.

The extent of the lands is carefully described in the legend. The land which was assigned to the Shwe Hmawdaw was the same which had been given before by king Thamandaraza of Zoungdoo. The lands assigned to the Shwe Dagoon were more extensive. Their boundaries are thus described. On the east the Thabyoo Khyoung, on the north the Zoung-Khyoung, on the west the Myoung Mya Pagoda, on the south the river.

King Athawka then returned to Patalipoot.* After the episode of king Athawka, there is a hiatus of nearly 900 years in the chronicle, and we arrive then at the historical period.

* The first introduction of Buddhism into India extra Gangem dates from the time of Athawka. After the 3rd council had completed their labors and reduced Buddhism to its present form by the compilation of the Beetagat or scriptures, missionaries were deputed to all the neighbouring countries to spread the knowledge of the faith. Two of them, Potera and Thawna, arrived in the Talaing country of Thatoon, whence their religion spread over Burmah. It is doubtful whether, at the time of their arrival, the Talaings had yet occupied the country to the west of the Sittang River.

In the year 1116 of the religious and 514 of the 3rd era* the Thagya king established the brothers Thamala and Wiemala as rulers over the country of Hanthawadie. They found the Shwe Hmawdaw still in existence. In 523 king Thamala, perceiving that the "Htee" (chatta or canopy) of the Pagoda was bent and inclining towards the south-west, was filled with religious fear, and raised the Pagoda from its original height of 50 to 54 cubits, crowned it with a new golden Htee, and dedicated 25 families of Engdaret to its service.

In 526 Thamala died, and his brother Wiemāla Koomma reigned alone. He added 5 cubits to the height of Shwe Hmawdaw, making it 59 cubits in all, gilded it, and gave it a new golden Htee. He also erected nine others Tsedees, the names of which are given, and dedicated five families of Tadaugyan to the perpetual service of the Shwe Hmawdaw.

Wiemala reigned alone 17 years and died in 543. He was succeeded by his nephew, Thamala's son, named Athakoommȧ. He also was a pious prince, and being desirous of surpassing the meritorious works performed by his uncle, added 6 cubits more to the height of the Shwe Hmawdaw, and built seven other Tsedees, the names of which are given, all of which he gilded, and crowned with golden Htees. After reigning seven years, he died in 550.

He was succeeded by his son Ariendaraza or Arienda koomma. Seven months after this prince came to the throne, he observed that the Htee of the Shwe Hmawdaw was inclining towards the north-west. On this he ordered his chief noble Thoorathiedie at once to repair and embellish the holy structure. This was done, and seven more cubits were added to the height of the Pagoda, making it 73 cubits high. Thoorathiedhia's son erected another Pagoda, also 73 cubits high, to the north of the Shwe Hmawdaw, which Pagoda is still known by the name of the "Nobleman's Son's Pagoda." Ariendaraza, who was well versed in the laws of kings and replete with the eighteen kinds of knowledge, was desirous of emulating the

* By the 3rd era the writer means the 3rd era after Gaudama. *i. e.* the present one. As before remarked, there is no secular era of which the 514th year corresponds with the 1116th year of the religious era. As far as the chronicle shews, therefore, it is doubtful whether Pegu was founded by Thamala and Wiemala in 573, A. D. or in 1152, A. D. In the text, to avoid confusion, the dates only of the secular era mentioned by the chronicler, will be given.

meritorious works of his predecessors, and therefore having associated with himself his queen Kethanee and his chief noble and ministers, erected the Pagoda called Kyaik-depazan, to the service of which they dedicated Gua Tsaukha and seven families. The king also dedicated forty-seven families to the service of the Shwe Hmawdaw.

Ariendaraza reigned seven years, and died in 557. His son Hientharaza or Mahiengtharaza succeeded him. During his reign a particular storm occurred, which blew off the Htee of Shwe Hmawdaw, as well as the upper portion of the Pagoda itself. All were seized with fear. The king had the damages repaired and a new jewelled Htee constructed. The Pagoda was raised three cubits more, making its height 75 cubits. Four families of Htwonkalaing were dedicated to the Pagoda, and the village of Htwonkalaing given to them for their subsistence.

Hientharaza reigned 17 years, and died in 573. On his death there was an interregnum of 17 days, during which time the chief Hpoongyee managed the temporal affairs of the kingdom, until Giendraza ascended the throne. The chronicle does not state what relation this king bore to his predecessors. Three months after his accession to the throne, he repaired the west face surrounding wall of the Shwe Hmawdaw. This king was wise and powerful, well versed in the ten laws of kings, was possessed of the three kinds of strength, knew the four stratagems, and was full of the four laws of charity. He erected the Kyaikpadaing Pagoda, an elegant structure on the top of an eminence about 8 miles south of Pegu. Concerning the erection of this Pagoda the chronicle relates that when the king was making a progress through the country, he learnt from ancient records that three holy hairs had been deposited by the Hermit Gandawadee in the Thoowonna Hill, and a cairn of stones was placed over them. Finding a heap of stones on the south-west extremity of this Hill, he concluded that this must be the very spot where the three hairs had been deposited, and accordingly he erected over it a Tsedee 87 cubits high, gilded the structure, and crowned it with a golden Htee. He appointed nine families of Htwonmâi to be its servitors, and dedicated to it the land immediately around, within the following limits: on the east 400 "Tas," on the north 200 "Tas," on the west 300

" Tas," on the south 400 " Tas." After this the king raised the Shwe Hmawdaw 5 cubits more, making it 80 cubits high, and dedicated to it three more famalies of Moonetkarie. The Pagodas, monasteries and other religious works erected by this monarch are innumerable, and all men are exhorted to follow his example.

In this style the chronicler goes on, giving a minute history of the additions to the repairs and embellishments of the Shwe Hmawdaw under each succeeding monarch, down to Badoon Meng, the Burman king who built the city of Amarapoora, 1143 B. E.=1781 A. D. He gives, likewise, a complete list of the other meritorious works, building of Pagodas, monasteries, &c. by which the reigns of these kings were distinguished.

As the recital of these works, however veracious it may be, is somewhat tedious and uninteresting, except to a pious Boodhist, it will be omitted in the present narrative. The names of the kings with the dates of their accession will be given in a tabular form, and the more remarkable events only, which are mentioned in the Thamaing, will be noticed in the text.

The ninth monarch, Kawarieka, is said to have been a more powerful monarch than his predecessors, and to have received on this account *tribute*, which may be interpreted presents, from the kings of Siam, Thatoon, Ceylon, China and Pagaw. The same is related of his son Pecutsalaraza. This king, Pecutsalaraza, established the Karanee monastery, about two miles west of Pegu, where there is still a " Thein" or Buddhist consistory built of masonry, some wooden monasteries, and a small stone-henge, an interesting relic of the original establishment. This consists of a number of granite pillars about eight feet high, planted on the ground, and covered with inscriptions in the square Pali character. Many of them, thick and massive as they are, have been broken and thrown down, and the inscription partially effaced. The copy of what remains, fills a small closely written volume, the contents of which I have not yet been able to go through. The 12th king, Anooramaraza, signalized his reign by procuring a holy tooth-relic from Theeree-dhamma-thawka, the prince of Thatoon. This he enshrined in the Shwe Hmawdaw.

The 17th king, Tietha, is notorious in Talaing history as having for a time abjured the Buddhist faith, and made great havoc among its temples. The pious chronicler, however, says nothing about this, but enumerates the good works which he performed after his reconversion.

With this king, the chronicle states, "the race of Hanthawadie kings became extinct, and the king of Pagan appointed Akhamamwon to rule over Pegu. Three months after his arrival at Pegu, this Viceroy attempted to shake off the yoke of the Pagan king, and a general named Narapadie was sent to subdue him. In this he succeeded, and Akhamamwon was killed. Lekhaya was then appointed Governor of Pegu, but was recalled three months after his arrival. Talabya was appointed to succeed him. A month after his arrival in Pegu this Governor also revolted, and sent to ask assistance from Waroorec, the powerful king of Martaban. Warooree came to assist him with an army of 40,000 men. The Pagan king sent down a General named Theehapade with an army of 50,000 men, 1,000 war boats, 1,000 elephants and 5,000 horses. A great battle was fought at Ma-oo in which the Pagan army was worsted, and fled back to Pagan. Talabya professed the utmost gratitude to his ally, but was secretly jealous of, and laid a plan to destroy, him. He invited Warooree to tarry for a few days at Pegu. Warooree's army dispersed to seek their subsistence in the neighbourhood, and Talabya was proceeding to carry out his nefarious design, when Warooree became acquainted with the danger of his position. Having prayed that the ten modes of punishment might fall on the head of the violator of the ten laws of friendship, Warooree mounted his elephant, and with 20 followers prepared to meet Talabya. The two monarchs attacked each other on their elephants. Warooree ran his spear through Talabya, who fell dead from his seat. Thus Hanthawadie became a conquered province of Martaban, and paid tribute to Warooree.*

* In the A. S. Journal No. 76, April, 1838, I find a copy of an inscription on a bell found at Arakan (the translation by the way which is given in the Journal is very incorrect) which inscription appears to relate to the story of Warooree and Talabya, though their names are not mentioned. In this the date of Warooree's victory over the Pagan king is given as 1913 of the religious era,=1370 A. D., i. e. 16 years later than the date given in the Shwe Hmawdaw Thamaing. The translator in the Journal has cut off the first figure in the date, adding "we suppose the 1 to be an accidental stroke," and has taken it to mean 913 of the present era A. D. 1645, which is a mistake. The inscription states that this bell was cast in 984 of the present era A. D. 1622, long after Warooree's time. The bell was probably cast in Arakan, and not brought thither from Pegu.

Warooree was succeeded by Pagnya-Oo, who transferred the seat of government from Martaban to Pegu. The chronicler has here again been guilty of a chronological mistake. He states that Pagnya-Oo reigned 16 years in Martaban and 19 in Pegu, altogether 35 years, and yet he makes the date of his accession 731 and of his death 743 ; thus allowing a period of 12 years only for his reign. This king appears to have done more to extend his dominions than any of his predecessors on the throne of Hanthawadie—vide the list of cities founded, already given.

Pagnya-Oo was succeeded by his son Razadhicrit who was one of the most powerful monarchs who ever reigned in Pegu ; Arakan and China are said to have paid him tribute, and the chronicle gives an interesting account of his relations with Ceylon.

Pandooya,* the king of that island, sent him his daughter Thamoottadewee, with a fleet of seven ships and a holy tooth-relic. This was enshrined in the Shwe Hmawdaw.

King Razadhicrit reigned 40 years.

In the reign of Byeenya-rau-khaik, who flourished A. D. 1427 about, the Shwe Dagoon Pagoda of Rangoon is mentioned for the first time in the historical period by the chronicler of the Shwe Hmawdaw. It is said that having been damaged by a storm, the Pagoda was

* This name cannot be identified with any of the names of the kings of Ceylon as given in Turnour's Mahawanso. The only name at all like it is that of the 139th king, Pandita Prakrama, who flourished about 1319 A. D. In Turnour's Epitome, the following instances of communication between Burmah and Ceylon are mentioned. A. D. 1071, Anurudha, king of Arakan, sent learned priests to Ceylon. A. D. 1592, Wemala Dharm, king of Ceylon, brought learned priests from Arakan. In 1153 A. D. the Ceylon king is said to have sent an expedition to "Arramana" to chastise the king of that country for having committed acts of violence on Singhalese subjects, and having intercepted ships conveying some princesses from Ceylon to the continent. In 1186 also a Pali letter was written to the king of Arramana soliciting him to send learned priests to Ceylon. Is not this Arramana the same as Ramagnya, the Pali name of a portion of Pegu? In Tennent's Ceylon it is stated that when the Holy Tooth Relic of Ceylon was seized by the Portuguese, in 1560, "the sovereign of Pegu, who had previously "dispatched annual embassies to offer homage at its shrine, sent in anxious "haste to redeem it by exchange of treasures and political services," an offer which, through the influence of the priests, was declined. Again in 1566, the king of Pegu having been told by the astronomers that he was to wed a Singhalese princess, sent to demand her. The king unfortunately happened to have no daughter, but the daughter of one of his ministers was palmed off upon the Pegu monarch as a princess, and at the same time a *counterfeit* tooth was sent to Pegu as the genuine tooth-relic, which had in fact been destroyed by the Portuguese.

repaired by king Byeenya-rau-khaik. This king reigned 30 years.*

His son and successor Byeenya-kharo is said to have been a very just monarch, and several instances are given of the inflexibly strict manner in which he administered justice. In A. D. 1388 a female sovereign, queen Beengnya-daw or Byeengnya-daw Shengtsawboo reigned in Pegu. She was 58 years old when she came to the throne. After residing seven years in Hanthawadie, she left her son in charge of that town, and removed her court to Dagoon (Rangoon). She built a place to the south-west of the Shwe Tshaudaw (Shwe Dagoon), and dedicated lands within the following limits to the service of the Pagoda. On the east Kyaik-kanet, on the south Kyaik-kanoot, on the west Kyaik-myoungmya, and on the north Kyaik-mo-rap.†

The queen was succeeded by her son-in-law Dhamma-tsedee who built another capital to the west of the original town of Hanthawadie. This king received a present of 100,000 paving-stones from Ceylon. With half of these he paved the court of the Shwe Dagoon, and used the other half for a similar purpose at the Shwe Hmawdaw.

The twelfth king of the Martaban dynasty was conquered by the great Toungnoo king Tabeng-shwe-htee, of whom the chronicler records nothing, except that he kept the Shwe Hmawdaw in good order, and performed other meritorious works.

He was succeeded by Thamaing-daw-rwot-kalie whose lineage is not specified, but he was probably a descendant of the Martaban race of kings. His reign is memorable, from his having been the last monarch who added to the height of the Shwe Hmawdaw. Subsequent monarchs repaired it and gave new Htees, but none of them added to the building itself. Thamangdaw raised it six cubits, making its height altogether 205 cubits=324 feet about. At this height it has remained ever since, being a few feet higher than the Shwe Dagoon of Rangoon.

Thamangdaw was dethroned by another celebrated Toungnoo monarch, known as Tsheng-hbyoo-mya-sheng (Lord of many white elephants). This king removed his capital to Pegu, and built the

* In the A. S. Journal No. 5 of 1859, Col. A. P. Phayre, in his account of the Shwe Dagoon Pagoda, states: "It was not until the reign af Ban-gya-rau, in 808, that anything was done to restore the Shwe Dagoon." "Ban-gya" should have been written Bangya or Bangnya, pronounced "Beenga."

† Kyaik is the Burmanized form of a Talaing word "kyat," meaning a Pagoda.

present walled city of Pegu, to the west of the former town of Hanthawadie, and nearer the river. The power of this king was great. Ceylon paid him tribute and Siam sent princesses. He built the Maha-tsedee Pagoda, a huge pile of brick and laterite, about two miles to the west of Pegu, near the Karanee monastery. This, if completed, would have rivalled the Shwe Hmawdaw in size, but it appears never to have been finished, though the king dedicated 31 families from Twante in Dallah to its service. This is the first occasion on which the Dallah division of the present Rangoon district, which lies to the west of the Rangoon river, is mentioned by the chronicler.

This part of the country appears to have been colonised by an independent race of Talaings, and not to have formed part of the original country of Hanthawadie.

After the death of Nau-kya-bhooreng, in A.D. 1624, a "Koola Pathee kappeetan" (literally a western foreigner Musalman captain) ruled Pegu from Thanlyeng or Syriam. He, no doubt, was a Portuguese. The chronicle states "he was a heretic, and for 12 years searched for "Pagodas to destroy them. Religion perished in Ramangnya, and "good works were no longer performed. The Htee and the Tshap-"thwa-hpoo* of the Shwe Hmawdaw were pulled down and taken to "Syriam. But the people of Hanthawadie, at the instigation of the "Rahans Telatseng and Engamoot, made a new Tshap-thwa-hpoo of "150 viss of gold of the Pagoda."

When the Ava king heard of the conduct of the Kappeetan, he sent an army of 10,000 men under Meng-rai-kyaw-tswa against him; the Kappeetan fled, and was drowned when crossing the river to Dallah. The Ava king, whose name is not given, then ruled in Hanthawadie. He appears to have resided in Hanthawadie.

The fifth king of this dynasty, Meng-rai-kyaw-goung, dedicated 190 families of Pada in Syriam, who had rebelled against his authority, to the service of the Shwe Hmawdaw, and assigned three villages for their support.

The seventh king reigned in Ava, and made Hanthawadie over to a governor Guatha Oung, who oppressed the people and was killed in a rebellion. The next governor also was killed by a rebel named

* The spike above the Htee, so called from its resemblance to the flower of the screw-pine.

Tsheng-kya-sheng of Tharet-oke, who set himself up as king with the title of Boodha-kethee Tsheng-kya-sheng. In this king's reign, it is recorded the white foreigners appeared in Pegu.

This king is said to have removed to Laboon in Zimmay, and to have been succeeded by Gui-khaing who was deposed by his minister Kanaikhaing, who was anointed king with the title of Bya-maing-dee-razadie-patie. This king's son, Byeeaguyadalla, appears hardly to have commenced his reign when the Talaings were finally subjugated by the great Burman conquerer Aloung Bhoora—whose approach, the chronicler says, was heralded by a violent storm and earthquake, by which the upper part of the Shwe Hmawdaw was thrown down. After subduing the provinces of Dhaway (Tavoy), Byiet (Mergui), Taneng-tharee (Tenasserim), Taraw Byat-bhic and Dwarawadee, Aloung Bhoora died on the 13th increase of Nayoon 1122 (A. D. 1760) at the village of Lawa-mye-byahma.

With the seventh king of this dynasty, Bhadoon-meng, who ascended the throne A. D. 1771, the Thamaing of the Shwe Hmawdaw concludes. The Bhadoon-meng built a new capital, Amarapura, and was anointed in 1773, with the lengthy title of Theeree-pawara-wiezara-nanda-rathtarie-bhawana-tietya-tiepatie-pandita-maha-Dhamma-razadhieraza. In his reign the shwe Hmawdaw was repaired, and a new Htee made under the supervision of the Governor of Hanthawadie. Here ends the chronicle of the Shwe Hmawdaw.

Kings and Governors of Hanthawdie according to the Hmawdaw Thamaing.

	Names.	*Dates of Accession.* B. E.	A. D.
1	Thamala, ...	514	1152
2	Wiemala, or Wiemala Koomma,...	526	1164
3	Athakoomma, ...	543	1181
4	Ariendaraza or Mahiemoorarien-daraza, ...	550	1188
5	Hientharaza, ...	557	1195
6	Giendaraza, ...	574	1212
7	Mieggadiepa, ...	586	1224
8	Giezzawievararaza, ...	601	1239
9	Kawarieka, ...	611	1249

10	Peentsalaraza, ...	623	1261	
11	Attatharaza, ...	636	1274	
12	Anooramaraza, ...	651	1289	
13	Mieggadiepagnay, ...	663	1301	
14	Eggathamandaraza, ...	673	1311	
15	Oopalaraza, ...	685	1323	
16	Poonnarieka, ...	697	1335	
17	Tietharaza, ...	712	1350	

Governors appointed from Pagan.

1	Akhamamwon, ...	716	1354	
2	Narapadie, ...	,,	,,	
3	Lekhaya, ...	,,	,,	
4	Talabya, ...	,,	,,	

The Martaban Dynasty.

1	Waroorce, ...	716	1354	
2	Pagnya-Oo, ...	731	1369	
3	Razadhicrit,*	743	1381	
4	Dhammaraza or Pagnya-dhamma-raza, ...	783	1421	
5	Byeenya-ran-khaik, ...	789	1427	
6	Byeenya-kharo, ...	821	1459	
7	Byeen-kyan-daw,...	847	1485	
8	Tamawadaw or Liet-mwot-daw-ta-mawdaw, ...	850	1488	
9	Beenyadaw or Byeenyadaw Sheng-tsaw-boo, ...	850	1488	a female sovereign.
10	Dhammatsedee or Dhamma-tsekya-tsedee, ...	864	1502	
11	Hattiraza or Byeenya-ran bhiethieta	878	1516	
12	Atie-raw-raza or Taga-rwot-pie,...	901	1539	

Toungoo king.

1	Tabengshwe-htee...	923	1561	

* If Pagnya-Oo reigned 35 years, Razadhicrit's accession will be 766 B. E. or 1404 A .D.

Dynasty not specified.

1	Thamamgdaw-rwot kalie,	...	930	1568
2	Tsheng-hbyoo-mya-sheng, ...	...	942	1580
3	Nan-kya-bhooreng, ...	...	971	1609
4	A Koola Pathee Kappeetan,	...	986	1624

Ava Dynasty.

1	A king, name not given, ...	...	998	1636
2	Meng-Rai-dieppa, ...	...	1013	1651
3	Thato-maha-dhamma-raza, ...	...	1013	1651
4	Nankya Engwa Bhooreng,	...	1033	1671
5	Meng-Rai-kyaw Goung, ...	...	1055	1693
6	Engwa-Bhooreng, ...	...	1070	1708

Governors appointed by Ava kings.

1	Gna-Tha-Oung, ...	...	1099	1737
2	Meng-Rai-Oung, ...	...	"	"

Talaing kings.

1	Boodha-kethee–tsheng–kya-sheng,		1102	1740 (?)
2	Gnakhaing, ...	...	1108	1746
3	Bya-maingdee-razadie-patie,	...	1108	1746
4	Byeengnya Dalla, ...	...	1119	1757

Burman Dgnasty.

1	Aloung Bhoora, ...	...	1120	1758
2	His son's name not given,	...	1122	1760
3	Tsaleng-myo-tsa-meng,	...	1125	1763
4	Tshengoo-tsa, ...	...	1138	1766
5	Hpoung-ga-tsa, ...	...	1143	1771
6	Bhadoon meng, ...	...	1143	1771

On the Antiquities of Bágerhát.—By Bábu Gourdass Bysack, *Deputy Magistrate and Deputy Collector, Manbhoom.*

[Received 29th March, 1867, Read 1st May, 1867.]

The Delta of the Ganges offers few localities of interest to the antiquarian. An alluvial plain, intersected by a number of mighty and ever-shifting rivers, there is not a spot on it, which can arrest the attention of the traveller by ever so poor a display of the remains of human art of a former age ; no hoary temple of the ancient Hindu rajas,—no majestic palace buried under the dust and vegetation of centuries,—no baronial castle where the Aryan held revelry, when the Moslem had not yet set his feet on this land,—rewards the search of the inquirer. Nothing meets his eyes that proclaims of ancient civilization, and well may he question if ever any scion of the solar or the lunar race dwelt amid the people of Bengal. Even history does not afford many names of places in lower Bengal of truly ancient times. Ságar Island, it is true, was known some two thousand years ago, but not as a royal city or a flourishing port, but only as the abode of a hermit. Nuddea was the capital of the Sena Rájás when Bakhtiár Khiliji invaded this country, but the Bhágirathí has since so often shifted her course, and so completely washed away every vestige of the lofty halls and the proud battlements which owned the descendants of Ádis′úra for their lords, that it is impossible now to determine its exact locale. Of other places in the Delta, the history is equally uncertain and unsatisfactory.

But if we know not enough and have no relic of ancient Hindu cities in the Gangetic Delta, there are not wanting in it nooks and corners which, without pretending to any time-honored antiquity, may afford materials not altogether uninteresting. The little town of Bágerhát is one of them ; and to a few remains of its former greatness I wish to draw the attention of the readers of the Journal, in the following pages.

The town of Bágerhát is situated on the bank of the Bhairab, a sluggish stream, 50 miles, as the crow flies, to the south east of Jessore. According to the Revenue Survey maps, the latitude of the place is 22° 40′ 10″ N., longitude 89° 49′ 50″ E. When it was first founded, it is impossible now to tell, but it was a place of some note more than four hundred years ago; for I find that about that time one Khán Jahán *alias* Khánjá Ally, a chief of great piety and liberality, who was rusticated from the court of Delhi, was sent to this place to hold the post of a tehsildar. Many fine buildings and stately mosques were erected under his auspices, and the place was in every respect greatly improved. What was its name then, I cannot now ascertain; the inscriptions that I have examined to find it out, being altogether silent on the subject. Its present name is but of yesterday. It was given to it long after its glories had passed away, and its history forgotten. A deserted village on the outskirts of the Sunderbunds, its humble inhabitants needed but the aid of a poor bi-weekly fair to supply their wants; that fair was, and is still, held on a raised spot on the river-bank where once stood the pleasure ground of Khán Jahán. The illiterate dealers and pedlars who frequented it to sell their goods called it the 'garden fair,' *Bágar hát*, and the name was adopted by Government when, in May, 1863, it was made the head quarters of a magisterial sub-division.

From the few traces still visible I believe the garden must have, at one time, included an area of about 200 biggahs. On one side of it there was, until recently, a dirty putrifying tank overgrown with jungle, which in olden times must have been a pleasant sheet of water; and on the other a mound, probably the debris of what once was a summer house. Traces of metalled footpaths are met with at different places, as also the remains of a high road, 30 feet broad, made of well-burnt bricks placed on edge, which, it is said, formerly extended from this place to Chittagong.

Three miles to the west of the garden, there is a large tank, over a hundred biggahs square, noted for its sweet water and a number of tame crocodiles. I had no opportunity to ascertain its size, but judging from the impression its sight produced on me and from memory, I believe it is fully as large as the Pála Diggi near Murshidábád, and nearly as large as the Mahipál Diggi in Dinagepur. Bábu Guru Churn Doss, Deputy Magistrate of Jangipur, in a letter published in the Society's Proceedings for October 1862, says that "it must be in size equal to, if not larger than, that in the Dilkosh Baug of the Raja of Burdwan." But as the tank under notice has silted up and its water has receded much from the original banks, it is not easy to ascertain its original size. In the height of the dry season in April last the sheet of water measured 1,560 feet square. Its excavation is popularly ascribed to Khánjá Ally. It is said that that chief, being very much troubled from want of good potable water, obtained the sanction of the king of Gour, and caused this tank to be excavated ; and that when he found its water to be brackish, improved it considerably by pouring in it a large quantity of mercury, which, it is said, is a most efficacious antidote to brackishness. This story, however, is not sufficiently romantic to please the simple people of the district, and a sheet of sweet water in a place noted for its saline soil being an uncommon wonder, another has been set in currency for their edification. According to it, when the tank had been dug to a great depth, the workmen came to a perfect temple, with its doors closed from within, which no efforts of theirs could unlock. Message was therefore sent to Khánjá Ally, who, mounted on a swift horse, approached the temple, and struck it with his wand. Anon flew open the doors, and he beheld, within, a Fakir seated at his ease before a lively fire, and smoking his hukka. Khánjá Ally saluted him and asked his blessing, to secure a tank full of good water. The Fakir said that he had built the temple on the banks of the Bhairab as a place of retirement, and had just roused himself from a protracted meditation to collect food for a meal. He little thought that during his state of abstraction so much earth had accumulated over his temple as to admit of a deep tank being excavated. However since it was so, good water would immediately be produced, but Khánjá Ally should fly for life, or the rising spring would drown him. Nor was the latter unprovided for such a contingency. His horse was the swiftest on earth, and it bore him through the water to dry land in a twinkling. This story suggests the idea, that when the tank was excavated, traces of a building were found in its bed ; and considering the frequency with which old bricks and broken pottery are met with in the Sunderbunds, such an idea would be by no means unreasonable.

I have said above that the tank is noted for its tame crocodiles, and well it may be, for nowhere else have I met with a more wonderful instance of the influence which the human mind can exert over the saurian. Upwards of twenty monsters, from 10 to 20 feet long, may here be seen rising and sinking in the water with the docility of a child, at the beck of a puny miserable-looking Fakir who could not resist a rap from the tail of the smallest of them. They are fed with live fowls and kids, and they unhesitatingly come close by dry land to receive them. Meat is offered to them on the palm of the hand, which they quietly take away, without ever snapping at the hands themselves. Little children play about on the bank without any risk; and men, women and children bathe in the tank without ever having to repent of their temerity.

Some time ago a rumour was brought to the notice of Government that infanticide was committed in this part of the Sunderbunds, and I was directed to make an inquiry. But I found it was unfounded; the fact appeared to be that the simple people of the district believe that these crocodiles can bless young ladies to come into an interesting condition, and their blessings are sure to bear fruit. Accordingly many young women repair to this place to bathe in the sacred water of the tank, and implore the blessing of the saurian monsters. They offer them fowls and kids; then paint a human figure with red lead on a stone pillar in the neighbourhood, and, embracing it, vow to give away to the crocodiles the first fruit of their blessings. This vow is never broken, the firstborn is invariably brought to the tank, and when, at the call of the Fakirs, the crocodiles rise to the surface, the child is thrown on the water's edge with words implying a presentation. But it is taken up immediately after, and borne home amid the rejoicings of the family. I could find no proof to shew that any child had ever suffered from this exposure.

Parents whose children die early also often seek the blessings of these crocodiles, by exposing their infants on the bank of the lake.

There is another source whence has arisen the notoriety of Bágerhát as a place for infanticide. The Fakírs and Sanyásis who live in the adjacent part of the Sunderbunds, have a high reputation for supernatural powers in healing the sick; hence, whenever a child is afflicted with any uncommon or mortal malady, or born with any permanent infirmity,. such as dumbness, deafness, or blindness, and frequently when medicines have failed (and the pharmacopœia of an ordinary native village, which embraces only a few simples, is soon exhausted) the superhuman aid of those worthies is sought with all the blind faith of veneration which characterises an ignorant and superstitious race. Parents from different parts of Jessore, Pubna, Farrídpur and Backerganj repair to this place, and occasionally leave their children with the Fakirs, in the hope of their taking pity on the sufferers, and curing their afflictions. This is generally a temporary arrangement, and the little ones are taken home as soon as they are cured, and often long before, if the hope of recovery become faint or fail. Rarely one out of several sons is, in fulfilment of a vow, dedicated to the service of religion, to be brought up amongst the Fakírs; but never is a child abandoned in the tank, or in the neighbouring jungle, with a view to destruction.

Close by and to the north of the tank there is a large tomb which holds in its centre the mortal remains of Khán Jahán. It is built of remarkably well-burnt bricks of a large size, and strengthened by stone boulders in some of the piers. In style it differs little from similar structures in other parts of Bengal—a square of 45 feet, having a central hall along the whole length, and connected with two side aisles by open archways. The exterior has an arched doorway on each side, the north being closed. The height is 47 feet to the top of the dome, which is a well proportioned structure, somewhat pointed at the top, and seated on a collar high enough to raise it above the line of the cornice without itself being offensively prominent.

The plastering of the building has peeled off in many places, but from what remains it is evident that the builder was perfectly familiar with the art by which the masons of Delhi of that time gave a marble-like smoothness and polish to chunam work. The steps round the grave are inlaid with encaustic tiles of various colours, the richness of which has withstood the wear and tear of four hundred years without any serious damage. Some of the tiles are hexagons 4 inches across, while others are squares of 6½ inches each side. The substance of the latter is a white stone ware, and the enamelling on it is of a character which makes me suspect these tiles to have been imported from China. The former are of red earth, and the glazing and designs on them are of inferior execution. Their counterparts are commonly met with in Pathan buildings in Gour and elsewhere. The art of making these tiles has now been lost to the natives; the only remains of it are to be met with among the potters of Murshidábád and Bírbhúm, who apply a glazing of some consistency in blue, green and white, on the kalkis or tobacco-bowls of ordinary Mahomedan hukkas, as also on a common musical instrument called the báyáñ.

The grave of Khán Jahán is placed in the middle of the hall, and is covered by a large slab of pure white Jeypur marble, raised on three masonry steps inlaid with encaustic tiles. It was erected in the year of Hijira 863 = A. D. 1458,—just 409 years ago. According to popular belief, the tomb was built in the lifetime and at the expense of the Khán, who departed this life on the night of Wednesday the 26th of Jilhijja *i. e.* about the end of March or the beginning of April. The epitaph is in Arabic, inscribed in golden letters, and, like most epitaphs, is brimful of nauseating praise (vide Appendix A), but the Khán in popular estimation was not unworthy of it. In his lifetime he was reckoned a saint, and to this day he is worshipped as such by Hindus and Mahomedans alike. Flowers are strewn over his grave every day by the attendant Fakirs, and pilgrims from various parts of eastern Bengal come all round the year to offer to it their salutations. On the full moon of Chaitra, supposed to be the anniversary of the Khán's death, a grand mela is held near the tomb, when over ten thousand people assemble to commemorate his piety and sanctity.

On the sides of the grave-stone, there are four different inscriptions, copies of which I also annex (Appendixes B to E). Three quotations from the Koran are also given, but these I did not deem worth copying. The only available article of interest in the building was an old curiously-carved Koran-stand, which I brought away for deposit in the museum of the Asiatic Society; as the stand was never used by anybody, the sacrilegious hands I put on it, will, I fancy, cause no inconvenience to the faithful.

In the side-aisles there are three or four graves, but without inscriptions, and the attendants could give no reliable account of the people whose bodies rest in them.

The tomb is situated in a large quadrangle surrounded by a masonry wall. Within this enclosure there are several graves, but of no historical or artistic importance. There is, however, a small cenotaph on the north side which is worthy of a short notice. If is of modest size and no architectural pretension; but it was built by a zealot, one Mohammed Taer *alias* Pír Ally by name, whose religious fervour forced the conversion of many a Hindu to the Mahomedan faith. Himself a renegade from the religion of his Hindu forefathers, he acquired a high reputation for sanctity, and maintained it by a strict observance of the ordinances of his adopted religion.

According to tradition he was sent for to Delhi, and for some reason or other, there beheaded by order of the emperor. He is said to have once heard from a Brahmin of high caste and great influence, one Naranáráyana Ráya, that "smelling was half eating," whereupon he caused some cooked meat to be brought to his presence. The Brahman by his side perceived the smell, and immediately covered his nose with his cloth; but it was too late, the wily Mahomedan urged that by his own shewing he had "half eaten," and must therefore cease to be of the orthodox creed. He was accordingly outcasted, and his descendants to this day are known as Pirális or Pir Ally Brahmans. Puerile as the story is, it is worthy of note that all the Piralis of Bengal trace their original seat to Jessore, and no Piráli is to be met with in the eastern or the northern districts. One of the ancestors of the present Tagore family of Calcutta first associated with Naranáráyana, and he and his descendants have ever since been called Pirális. Such Káyasthas as associated with these degraded and proscribed Brahmans, were subjected to the same penalty, and are to this day known by the name of the wicked Pír. Their number, however, is very limited, and they are met with in no other district except in Jessore.

Three miles to the south-west of this tomb, there is a magnificent mosque, commonly known by the name of *Sáṭgumbaz*, or the mosque of 60 domes. It is an open arcaded structure, formed of massive walls six feet thick, and having on the top 77 small domes supported on sixty pillars. The ground plan is an oblong of 144 feet by 96, divided into seven aisles by six rows of pillars. The foundation and the domes are of brick; while of the pillars some are of brick, and others of stone. Like all other Mahomedan mosques in India, the *Sáṭgumbaz* has its front to the east, thereby enabling the faithful to pray with their faces towards the K'ábá at Mecca. The number of archways on this side is 11, of which the second and the tenth are closed with masonry, the same arrangement obtains on the opposite wall, the Mulla's pulpit being placed by the side of the central archway. On the north and the south façades there are 14 arches, 7 on each side, the height being 15 feet to the point of the arch. The building is flanked by four massive towers which rise above the line of the domes. Two of them enclose winding staircases ; that to the south-east being very dark and steep, while the one on the north-east is well lighted and easy of ascent. The people call the former *Andhár Mánik* and the latter *Raushan Mánik.* Altogether the building has a grand and imposing appearance, and even in a more favoured locality than Bágerhát would command admiration, and be reckoned as an object worthy of notice. It was evidenly intended for a jummah masjid or Friday mosque.

The only other object which has been associated with the memory of Khánjá Ally and which demands a passing notice, is a physical phenomenon of some interest. It is a dull roaring sound, as of the booming of distant cannonade, which is said to be fired by aerial hands in honour of Khánjá Ally. At Bágerhát, those sounds are heard at all times of the year ; particularly when the weather is calm and the sky clear. It is most distinct during a lull after a storm or a heavy shower of rain. At Burrisal they are equally prominent, and noticed with great curiosity. Various theories have been hazarded to account for the phenomenon. Mr. Pellew, the superintendent of survey at Burrisal, in a letter to me, says—

"What you allude to must be the 'Burrisal guns,' which are heard all over south Jessore and Backerganj, at least in the neighbourhood of the Baleswar. They are distinctly heard at Burrisal. I have never heard them myself west of Morellganj. My own idea is, that they are perhaps the sound of heavy surf. My reasons for supposing this (of course I am by no means certain) are as follows. The noise exactly resembles the sound of surf as heard often by me at Pooree under certain circumstances, viz. when, on account of a cessation of the south-west monsoon, the swell rises to an unusual height before breaking, and then breaks simultaneously for perhaps a length of three miles of coast. I have often been woke from my sleep by the thunder of these waves, when breaking in this manner. As regards the succession of 10 or 11 reports, we all know that waves generally break successively along a beach, and at the distance the listener is from the sea these would appear equally loud.

"2nd. Reason. The further south I go, the louder the reports are, and the more unequal in power (this I have not tested quite sufficiently).

"3rd. There is a story (to which you allude) of a Collector sending down people in a boat to find out about its whereabouts, who heard the noise always to their south, till they reached the Hurungotta, and were compelled by the weather and sea to return.

"4th. The general belief in natives that they are not marriage guns.

"5th. The dissimilarity between the sound and that of marriage guns, noticed by all who hear them.

"6th. The fact that sound would be conveyed very far by the south-west monsoon along the surface of the large rivers of Backerganj. They are generally heard in a lull after a squall, at least I think so, just when the surf breaks most regularly and simultaneously. I am sorry I have no more certainty to give you."

The cause above assigned to the sounds by Mr. Pellew may be the right one, but the reasons he has adduced, plausible as they are, do not seem to be conclusive. It may fairly be argued that had the sound been produced by the surf, they would have been noticed near the seashore, wherever there is a low beach. Such, however, is not the case. I have nowhere read of such sounds in books, and never heard them anywhere beyond the mouths of the Ganges.

At Balasore, which is only seven miles from the Bay, they are never noticed. Mr. Pellew says that a sound similar to the "marriage guns" of Burrisal is heard at Pooree, which is occasioned by the breaking of the swell on the beach, during a certain time; but it is not a constant occurrence. During my stay for more than two months at Basdebpur, a village five miles from the sea between Bhadrak and Soroh, I never heard a report of the kind, though the surf rises and breaks on the beach with equal or perhaps more violence, during all seasons. Even at places near to Bágerhát, or in other parts of the Sunderbuns equally distant from the shore of the bay, the noise is not audible; and the only tract which enjoys the honour of these salutes is that which extends from the eastern border, from the river Baleswar to the foot of the Chittagong hills.

I had an opportunity of going down as far as "Tiger's Point," and I carefully watched the phenomenon, but I did not notice that the sounds became louder and louder as my boat drifted down from Morellganj to the mouth of the Huranghátá. This would lead to the inference that the swell of the sea was not the cause of the sounds, and it is possible that they may be due to some subterranean or volcanic agency, the nature of which we have not the means now to ascertain. It is one, however, which is well worthy the attention of scientific men.

APPENDICES.

A.

اِنتقلَ العَبْدُ الضَّعِيفُ الْمُحتَاجُ اِلَى رَحْمَةِ رَبِّ العَالَمِيْنَ اَلْمُحِبُّ لِاَوْلَادِ سَيِّدِ *
الْمُرْسَلِيْنَ الْمخلص للعلماء الراشدين المبغض للكفار و المشركين * المعين *
للاسلام و المسلمين الغ خان جهان عليه الرحمة و الغفران من دارالدنيا الى
دارالبقا ليلة الاربعاوى ستة و عشرين من ذى الحجة ودفن يوم الخميس في سبع
و عشرين منه سنة ثلث و ستين و ثمانماية *

B.

مَنْ مَاتَ غَرِيْبًا فَقَدْ مَاتَ شَهِيْدًا *

C.

الدنيا اولها بكاءٌ واوسطها عناءٌ و اخرها فناءٌ

D.

هذه روضة مباركة من رياض الجنة لخان الاعظم خان جهان عليه الرحمة
والرضوان تحريرًا في * ست و عشرين من ذى الحجة سنة ثلث وستين و
ثمانمائة *

E.

ياد آوريد اى دوستان الموت حق الموت حق
خار است اندر بوستان الموت حق الموت حق
مرگست خصمى محكمى بر جمله جانان زو يقين
نے هيچو ديگر دشمنان الموت حق الموت حق *

On the Transliteration of Indian Alphabets in the Roman Character.

—*By* F. S. Growse, *M. A.* Oxon, *B. C. S.*

[Received 5th January, 1867.]

The question of transliteration has been so fully discussed at recent meetings of this Society, that a paper which attempted to revive the subject would probably meet with scant consideration. I am also myself of opinion that the theory has been discussed more than enough, and only wish on the present occasion to state briefly a plain matter of fact, and make a practical suggestion.

It is impossible for any one, however imbued with phonetic prejudices, to deny that all European philologists and oriental scholars have, by mutual consent, adopted a uniform system of representing Indian alphabets in Roman characters, which varies only in some few and unimportant particulars. As to the vowels, there is at the present day no dispute at all; for that intensely insular peculiarity of denoting the simple sounds of *i* and *u* by the awkward combinations of double *e* and double *o* is now quite obsolete in the literary world. I have not seen any recent oriental work from the French press, and therefore cannot tell whether their practice of representing *u* by *ou* has been abandoned or not; but this at all events is a feature which is not likely to be imitated by English writers. As to the consonants, there are some few, but very few, points which are still left open: thus the palatal sibilant is generally denoted in England by *s* with a stroke over or dot below it, while continental scholars prefer the symbol *ç*; again the compound which English scholars represent by *ksh* is on the continent represented occasionally by *x*, more frequently by *csch*, which latter is not likely to find many advocates out of Germany. Thus too in the Persian alphabet, the Arabic *káf* is sometimes denoted by *q*, but more usually by *k* with a dot under it; and the final consonant *he* is sometimes expressed by the vowel *a* alone, sometimes by *ah*. But it is really unnecessary for us to regard these minor discrepancies, since they do not appear in what may be called our natural authorities. For I suppose it will be admitted that Forbes's is the standard dictionary for modern Hindustani; while the last complete Sanskrit dictionary is Prof. Benfey's, published in London during the year 1866, and the greatest work ever yet undertaken for the elucidation of that language is the gigantic cyclopædia of Dr. Goldstücker, which, if ever completed, will most assuredly be universally accepted as the standard authority on all points of Sanskrit learning. In these three works, by three different authors, we find one uniform system of transliteration without a single point of difference, except as regards one solitary letter, viz. the palatal sibilant. This, Forbes, in accordance with modern pronunciation, represents by *sh*, while Benfey denotes it by *ç* and Goldstücker by *s′*. It appears to me that since we have such authorities as these, our course is plain; for who is to establish rules of orthography, if lexicographers are not? I therefore think that the recent discussions on the subject by this Society are to be regretted,* since they had a tendency to re-open a question which had virtually been long settled, and, by ignoring an established fact, to throw a check in the way of educational progress.

That many and serious inconveniences result from the want of system that now prevails in India on this matter is undeniable, and a remedy is daily becoming more urgently required. For many registers of native names have now to be kept in Roman characters, and the whole object of alphabetical arrangement is frustrated so long as it remains uncertain whether *amrit* is to be looked for under letter *a* or letter *u*, and whether a person spells his name as *Devi-dín* or *Dabi-deen*. And this difficulty is one entirely of our own creation; for although in English, where the orthography of proper names is altogether arbitrary, it is quite possible for a highly educated man, in writing down a list of persons from dictation, to mis-spell every word, in a catalogue of Hindu names there is no such danger. Every personal appellation is also a literary term, with a definite meaning and invariable form; and therefore any one, having a very moderate acquaintance with Indian history and mythology, would be competent to write a long list of names with unerring precision; and there is no excuse for the carelessness which makes an array of the names and titles of native gentlemen in the Government Gazette look like a roll-call of South Sea savages. It will be found that almost all names resolve themselves into one of the following categories: 1st, and most common of all, the name of some popular hero or divinity standing

* The object of the discussions here referred to, was to determine whether European technical terms should be translated or transliterated into the Indian vernaculars.—Ed.

simply by itself, as Lakshman, Baladeva; 2nd, a similar name with the addition of some word denoting 'disciple' or 'by the favour of,' as Bhagawán-dás, Rám-saháy, Hanumán-Prasád, Gauri-datt; 3rd, some one of the thousand epithets appropriated to the leading characters of the Hindu Pantheon, as Niranjan, the unimpassioned; Chakrapáṇi, the discus-holder; Bansi-dhar, the flute-player, *i. e.* Kṛishṇa; 4th, the name of some one of the appliances of ritual worship, as Tulsi, Sálagrám, Vibhúti; 5th, some word expressing beauty or other excellent quality, as Nawal, Sundar, Kirat; 6th, some heroic or honorific title as Randhír, "the staunch in fight," corresponding to the Homeric "meneptolemus;" Khaṛagjít, the conquering swordsman; Mahábali, the greatly valiant; Anúp, the incomparable; 7th, the name of some precious material, as Híra, a diamond; Moti, a pearl; Kánchan, gold; 8th and strangest of all, some affectionate diminutive, as Nek Rám, a little Rám; Chhote Lál, a little dear, Nanku, a darling. In the village patois, it is true, many of these names ordinarily appear in a very corrupt form, but even these corruptions are reducible to the following simple rule, viz. that the first syllable of the word only be retained unimpaired, and an open vowel substituted for the whole of the termination; thus Kalyán becomes Kalu, Bhagiratha, Bhagi, and Nayanasukh, Nainu. But these diminutives correspond simply to our English Bob, Dick and Tom, and have no right to be included in a formal catalogue of names. The enforcement of a correct system of transliteration would naturally be opposed by all who are too indolent to acquire a rational knowledge of the language, or who choose to diversify their style by the simple expedient of spelling the same word two or three different ways in one paragraph; but the present slovenly system, or want of system, is not only a practical inconvenience, but is also a disgrace to an educated government.

But, it may be urged, perfect precision is no doubt desirable in scientific treatises, but would be pedantic in ordinary writing. Now can any parallel be found to such a state of things as this argument supposes? Every language has recognized laws of spelling, which the uneducated classes in practice frequently transgress; but has any government on that account determined to class itself amongst the illiterate, and to relegate orthography to the professedly learned?

The Government of India stands alone in this extraordinary patronage of a barbarous nomenclature which excites the ridicule of every European scholar.

In one of the recent discussions on the subject, I remember that Dr. Lees gave a very good illustration of the results of this lax mode of spelling, quoting several Indian words from a 17th century traveller, which were so much disguised by their Roman garb, that identification was impossible. But by a curious perversion of logic, the speaker proceeded to argue the inexpediency of transliteration at all; whereas the illustration only showed the evil of not having a definite standard: for if each Indian letter had its acknowledged Roman equivalent, every word would be as intelligible in its Roman as in its Indian form. I would therefore suggest that the Asiatic Society should print in a tabular form the Roman, Nágari and Persian alphabets* as arranged by the eminent lexicographers abovenamed and approved by Prof. Max Müller, the greatest of modern philologists; and that this table should be occasionally appended to the Nos. of the Society's Proceedings, and every writer expected to modify his phonetic vagaries accordingly. It certainly does not appear unreasonable to require that the contributors to a scientific and literary journal should master the first rudiments of orthography, before they proceed to discuss abstruse questions of philosophy and literary history; and a writer who appears in print under the auspices of a learned Society should feel it as strange to put down *chatta poker* for *chhatra pokhar* as to spell "umbrella," *umbreller*. I think too that, if a more frequent reference to a Dictionary were rendered necessary, articles would not be forwarded for publication in such a very crude state as is now sometimes the case. Thus in the last No. of the Philological Journal, the same distinguished officer, who writes *chatta poker* and *Machowa* and *Cuchowa* for Matsya and Kachchhapa, begins his paper with a lengthy speculation about "a race called variously Serap, Serab, Serak, Sráwaka, who were probably the earliest Aryan colonists," and another race called Bhumij, without apparently any idea, at the time of writing, that Sráwaka is the ordinary Sanskrit name for a Jain or Buddhist, and that the literal meaning of Bhumij is the earth-born, Autochthones, Aborigines. The identity of the Jain and

* This has already been done.—Ed.

Sráwaka is in a confused manner indicated before the conclusion of the article, but without recognizing the fact that the name (literally "a hearer") indicates a purely religious distinction, and that it does not imply a difference of race any more than the term "Roman Catholic" implies an Italian by descent.

I may here incidentally observe that in this district (Mainpuri) the Jains, who form a considerable item in the population, are known popularly only by the name of Saráugis, which also is clearly a corruption of the same word Sráwaka. Their habits and customs are of course the same as those described by Col. Dalton.

If my suggestion as above were adopted by the Society, the same principle would be consistently carried out in compiling the list of members with their places of residence, where we should no longer see Bábu alternating with Baboo (the latter invariably suggesting the loss of a final *n*) and the first step might be taken towards the correction of our present barbarous local nomenclature. Our maps are no doubt admirable as results of engineering skill, but in a literary point of view, they are ridiculous,—a large proportion of local names, especially Hindi words, being utterly distorted from the original form. Thus for instance, I have never yet seen a map where the common village name Kushalpur was not spelt with an initial Persian *kh*, as if it were a derivative of *khush ;* and yet it might be supposed that if any Hindi word were to be allowed to retain its identity, it would be the name of a district so famous in ancient legend as Kos′ala, which had Ayodhyá for its capital, and gave a name to the mother of the national hero Ráma. Upon this point I cannot do better than quote the words of the late Prof. Wilson, who, describing Indian maps as miserably defective in their nomenclature, says, "None of our surveyors or geographers have been oriental scholars. It may be doubted if any of them have been conversant with the spoken language of the country. They have consequently put down names at random, according to their own inaccurate appreciation of sounds, carelessly, vulgarly and corruptly uttered ; and their maps of India are crowded with appellations which bear no similitude either to past or present denominations. There is scarcely a name in our maps, that does not afford proof of extreme indifference to accuracy, and of an incorrectness in estimating sounds which is in some degree perhaps a national defect." It may be necessary to take with some modification, at the present day, the above severe reflections on the ignorance of our surveying officers; but whatever their knowledge, it is evident that they have not had sufficient courage to deviate from the traditional groove of barbarism. To initiate a reform in this direction, is an undertaking well worthy the highest efforts of the Asiatic Society. But the whole question has been treated so often, that there is no occasion for further words; it only remains for some definite action to be taken.

On the other hand, equal carelessness and neglect of philological principles are displayed in the ordinary modes of representing English words in Nágari characters: thus the names of the four months September, October, November, and December are frequently so spelt in Hindi translations, as quite to obscure the fact that they are identically the same as the vernacular Saptami, Ashtami, Navami, Dasami. It has also become a uniform practice to represent the English *t* on all occasions by the letter ट; thus ignoring the fact that in the English alphabet the one symbol does double duty, and our pronunciation of it varies, though perhaps unconsciously, in different words, accordingly as it has a *murdhanya* or simply dental power. For instance, the name Victoria is, so far as my experience goes, invariably written with the ट, though most incorrectly so; for both in meaning and derivation, it corresponds precisely to the common appellation Vijay, the *j* by an invariable rule becoming *k* before dental *t*; while *k* with murdhanya *t* is an impossible compound, and a short vowel would have to be introduced between the two consonants, before they could be pronounced. Indeed Her Majesty may reasonably complain of the injurious treatment she receives here in India: for not only is her name misspelt, but her royal title also is most grossly misrepresented. The crafty Musalman, whoever he was, who first suggested the preposterous expression *málika mu'ázzam*, must, when he found it adopted, have chuckled immensely over the indignity he was passing on the Queen of the unbelievers. Fortunately, the phrase is so thoroughly outlandish, that it practically conveys no meaning in this country; though any Arab chief who heard it would derive from it a strangely derogatory idea of the Empress of India. I remember reading an article, which appeared in England about a year ago, taking this phrase as an illustration of our special linguistic clumsiness, as contrasted with Russian tact, and pointing out the considerable advantage which they thus enjoyed over us in impressing the oriental imagination. For my own part, I am quite unable to see any valid reason why the well-known and dignified word *pádsháh* should not be used, at least on all ordinary occasions, where no reference is made to the sex of the sovereign, as in the superscripture of service letters, or the wording of legal documents.

As change of circumstances, or the development of European ideas, involves an occasional necessity for enlarging the vernacular nomenclature, I would suggest that this coinage of words, hitherto characterised by the most signal failures, should be transferred from the Government mint to the care of the Asiatic Society, and that a Philological Committee should be allowed to express their opinion before any new issue was definitely stamped and authoritatively circulated. The last new word that has been forced down the throats of the people is *numáish-gah*, the principal result at present of the fashionable exhibition epidemic. It is a compound, for which it would be perfectly useless to look in any Hindustani Dictionary, and in fact has never had any existence in the country. As yet its use is exclusively confined to the Munshi class, who, in order to define its meaning, invariably prefix the word *mela*, and I believe consider it only the Government synonym for a *tamásha* of any kind, in the same way as *sirika* is the Government expression for what every one in his senses calls *chori*. Thus, during the grand Darbár at Agra, I had petitions from *mukhtárs*, explaining their clients' absence on the ground that they had gone to the "Agra numaish-gáh." With the people at large the word *melá* appears to answer every necessary purpose; or if greater precision is desired, *sarkâri melá* is employed. And although some more adequate expression might no doubt be evolved by a due exercise of the critical faculty, I consider this indigenous product is at all events better than the official exotic. Several other subjects suggest themselves for animadversion, but my remarks have extended far beyond the limit I originally intended, and some of the points already noticed may appear too minute to deserve serious attention. Yet, if philology is worth studying at all, it is certainly worth while to recognize its rules in practice.

Literary and Miscellaneous Intelligence.

A catalogue of the Vernacular Publications of the Bombay Presidency has just been brought out by Sir Alexander Grant, Director of Public Instruction, Bombay. It embraces the names of 1679 books of which 175 are in Sanscrit, 660 in Marhatti, 628 in Guzrati, 49 in Canarese, and 43 in Sindhi. Of Zend books there are 4, and of Pehlevi 1, being the Pehlevi version of the Zendavesta. Prefixed to the catalogue are two interesting essays by Professor F. Kielhorn and Mr. M. G. Ránáde, on its Sanskrit and Marathi portions.

Mr. J. Beames has just published a short introduction to the study of Indian Philology, with a map shewing the distritution of Indian languages. It is intended to be a guide to those "who, having no knowledge of Linguistic Science, wish to record and preserve dialects of obscure and uncivilised tribes with whom they may come into contact; or any of the countless local peculiarities of the leading Indian languages which may be spoken in their neighbourhood."

The following is an Extract from a letter from Major General A. Cunningham to Colonel C. S. Guthrie, on a large gold Eucratides lately brought to England.

"But what is a double gold-mohur compared to the great gold Eucratides which has just been brought from Bokhara by Aga Zebalun Bokhâri? It is $2\frac{1}{2}$ inches in diameter, and weighs *ten staters*, or *eleven guineas?* It has the usual helmeted head on one side, with the horsemen and inscription on the reverse. The owner has refused 700£ for it. It is genuine—and beats all the Greek coins hitherto discovered.

"I have three specimens of a new Greek King, Apollophanes, and some rude coins of Strato with the title of Philopator, which is translated *priyapitá*, lover of his father. Please tell Grote of these Bactrian novelties."

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On the Arabic Element in Official Hindustani.—No. 2. *By* J. BEAMES, *Esq., B. C. S.*

[Received 23rd July, 1866.]

"If Hindustani, adopted by us as the future general language of India, is to be a language and not a jargon, it must become so by means of its alliance with Persian, the speech which all Indian Mahomedans have at their heart, and use as the feeder, or channel of other feeders, for all their abstract thought, their politics, science, and poetry."*

This extract serves as a fitting text to the subject which it is my aim to illustrate. In a former paper I gave an outline of some arguments in favour of the present Arabicized dialect of our courts, and as the little literature which the language possesses is written in the same style, the following remarks may be considered as applicable to the literary style also. In the present I propose to review the assertions of the upholders of the opposite opinion, which may briefly, and I trust fairly, be stated thus :—In writing or

* Quarterly Review No. 234, page 517 on "Vámbéry's Travels in Central Asia."

speaking Hindustani, if you have two words to choose between, one Hindi or Sanskrit, and the other Persian or Arabic, it is better and less artificial to use the former; and the Arabic and Persian words already in use in Urdu are for the most part wrongly used, and are often very corrupt forms of the genuine words. There are thus two arguments: the first, a political; the second, scientific. I will examine the political or historical argument first. But I must premise that I consider the whole question as one for the student rather than the statesman. Dr. Fallon, a vigorous partizan of the Hindi school, writes, somewhat complacently, thus:* "The Urdu language needs direction; but the natives have neither taste nor learning for such a work. The task must be performed by European scholars, and the Government of the country." I would ask the author whether, in all the range of his comprehensive reading, he has ever met with an instance of a language having been created or guided by foreign scholars, or licked into shape by a Government. Is language, like law, a political creation? Does it not rather grow up in the homes of the people? Is it not hewn out of their rough untutored conceptions? Does not its value consist in its spontaneous and unconscious growth? Are not its very irregularities and errors, proofs of the want of design that attends its formation?

Or again, can a stranger guide the native mother in choosing how to talk to her child? If it be difficult for foreigners to influence a language in a country where women enjoy the same freedom as men, how much more hopeless is the task in a country like this, where the mothers of the people are inaccessible and invisible?

No, we cannot influence the speech of this people; they have formed it for themselves; they have, before we came on the scene, chosen Arabic and rejected Hindi. It is not true to say that they prefer Hindi, and that we have forced on them Arabic. It is not correct to say that pedantic munshis have created for the use of the European officer a dialect unknown to the majority of the people, and the use of which severs him from them, and gives the keys of communication into the hands of a single class. The use of Arabic and Persian words pervades every class. I, and many other officers, know that

* English-Hindustani Law and Commercial Dictionary by S. W. Fallon, Introductory Dissertation, p. xviii. ad fin.

when we go alone and unattended into a native village, we can converse readily with the commonest people; and I have found the Arabicized style, which I, from deliberate preference, always employ, quite intelligible to the ryot and the bunnia. This people formed their own language, and we may rest assured they will continue to develop it in that direction which they feel to be best. It is true that Hindi is the speech of the lower classes, but how many Arabic words have invaded even the lowest Hindi, because the national feeling has adopted Arabic as a sign of cultivation. The scholar may lament that it is so, just as some scholars lament the disuse of Saxon words in English, but the lamentations of the scholar do not hinder the progress of the language.

" Hindi is more native to the soil, and lies closer to the hearts of the people than Arabic or Persian, and its use is therefore preferable to that of the last named languages." This is the *political* argument of the Hindi school. Dr. Fallon* puts it thus: " Hosts of Persian and Arabic words have been introduced *by natives of the country* (the italics are mine) who affect a foreign tongue, and make transfers in the mass out of worthless books imperfectly understood. The true vernacular is overwhelmed, thrust aside, and scornfully ignored." And again, " The vocabulary of the Indian Courts of Judicature is not absolutely without a few Hindi phrases. Still, a very large proportion of good Hindi is systematically excluded by ignorance or bad taste, or, worse still, from corrupt design. Words which are continually in the mouths of the people, the current speech in which men in town and country buy and sell and transact business, the mother-tongue of the peasantry and indeed of the great bulk of the nation is repudiated for a foreign, high-sounding phraseology. But a people's vocabulary is not so to be set aside. The few have seldom yet succeeded in substituting their language for the language of the many. Beaten off from the courts and public offices, native Hindi still lives in the busy mart, and in the familiarities of social and domestic life. In the pithy sayings, proverbs, and national songs of the country, dwells a spirit and an influence beside which the foreign and less familiar speech seems feeble and flat. These Hindi phrases have deep roots in the habits and associations of the people. They come

* Dissertation pp. xii. xiii.

home to the feelings and the understanding of the highest and the lowest. They possess a living power, universality and force of expression, which can never belong to the Arabic and Persian platitudes that are thrust in their place."

Now all this is very good and very eloquent, but it rests on false assumptions. It assumes that what is true of some classes of the population is true of the whole. It puts aside entirely all the rank and education of the country—it puts the peasant on a pedestal, and requests us to accept the barbarous and antiquated jargon that falls from his lips as the model of our speech, and as the vehicle for the expression of intricate philosophical argument, close legal reasoning, delicate and refined discussion on art, science and politics.

A second erroneous assumption is, that we have to thank our law courts for the abundance of Persian and Arabic terms in use in Hindustani. The fact, however is, that our native clerks use nine-tenths of these words, simply because they have been used for five centuries past as legal terms, and use has conferred on them a conventional meaning, which no other words possess. The native press, in discussing matters of a purely unofficial character, uses the same phraseology. The style of Abul Fazl and the Sih Nasr-i Zahúri is the model of all native composition. And this arises not from pedantry or affectation; the reasons of it are to be sought, first, in the circumstances in which the early Musulman invaders found themselves; and, secondly, in the constitution of native society from those times to this.

Who, then, were the founders of the Urdu language? They were a mass of Turks, Tartars, Persians, Arabs, and Syrians; with whom were amalgamated many of the middle and lower classes of Hindus; principally, perhaps, the adventurous trader, who goes anywhere to gain money, and the idle scum who are always attracted by an army. If we further ask what were the materials from which this heterogeneous mass could compound a *lingua franca*, we find, of indigenous dialects, Sanskrit and Hindi; of extraneous ones, Arabic and Persian, and various Turkish dialects. They had to introduce a new religion, a new government; systems of policy and organization new to India; rules of etiquette; the social habits and refinements of a town life; new articles of clothing, furniture and luxury; philosophical terms; terms to express new processes in the mechanical arts.

To what source should they turn for words to express these ideas? The Brahmin and the Rájput stood aloof from the casteless strangers. Sanskrit therefore was probably very little heard in the camps of the Ghori or the Khilji, and still less in those of Timur or Baber.

Words of Sanskrit origin, but more or less mutilated, were heard from the lips of the lower classes, who also used a vast number of Hindi words, *i. e.* words either of Sanskrit origin or not, but so far altered from their original as to become new words.*

Let us now go through some of the words which we may suppose offered themselves to the invaders as native terms to express their new ideas, and I think it will be seen that none of these words were really available.

In the first place the new religion was Islám. To express the religious duties of that pugnacious creed in anything but Arabic was profanation not to be thought of. Hence the introduction of *masjid*, *namáz*, *rozá*, *kitáb*, *íd*, and the words of this class were unavailable, for even putting aside the profanation, words of Sanskrit origin could not express, because they did not contain, the requisite ideas. If any one doubts this, let him think how far the Sanskrit and Hindi words written below represent the Arabic or Persian.

Masjid	Sanskrit—*mandiram*, *deválayam*;
	Hindi—*dewála*, *maṭh*, *mandar*, *shiwála*, *ṭhákurbári.*
Namáz	S. *prárthaná*, *nivedanam*;
	H. *pújá*, *páṭh*.
Rozá	S. *upavása*, *upásanam*, *abhojanam*, *langhanam*;
	H. *upás*, *langhan*.
Kitáb	S. *pustakam*, *grantham*;
	H. *pothi*, *pustak*.
'Id	S. *parvva*, *utsava*, *yátrá*;
	H. *parab*, *tyohár* or *tehwár*.

Now it is at once evident that the adoption of any of these words, deeply tinctured with the hues of the Brahminical creed, would at once have been fatal to the genius of Mahomedanism. These Sanskrit words therefore retained their place in the language with reference to

* An example will make the distinction clearer: *Rájá* I should call a Sanskrit word, because it retains its form unaltered; *bilmháná* I call a Hindi word because its connection with the Sanskrit *avilamba* is, though undoubted, yet not at first sight apparent.

the belief of the Hindu, while for the new Muslim population, the purely Muslim words were retained; and as nothing was displaced to make way for them, they were a clear gain to the language, enabling it to keep pace with the new religious development of the nation at large. Secondly, words relating to the government of the country. The mass of little kingdoms each headed by its petty *rájá*, a puppet whose strings were pulled by his Brahmin ministers, was to give way to the rule of one supreme "father-king," *padsháh*;* who should parcel out his dominions into satrapies or *subás*; and these powerful satraps again would divide their provinces into districts; and the rulers of districts would portion them out into counties, and so on. Divisions of caste were to be ignored, all men were free and equal, on condition of paying their taxes duly. The sovereign acknowledged himself to be under no obligation towards his subjects. He was an absolute despot whose business was to rule, as his people's was to obey. He was, however, expected to be accessible to the meanest of his subjects at certain times, and on the whole to do justice, though after a somewhat random fashion. How utterly inapplicable to such a system and to such a ruler would be the Sanskrit title of *rájá*; what a crowd of ideas and memories of another order of things would such a title bring with it. Would it not lower the great "father-king" to the level of the petty knights he had just destroyed? But the word *rájá*, though inapplicable to the sovereign, was not discarded; it remained as the title of a high order of nobility, as it is to this day, and the Persian terms indicative of sovereignty are therefore positive additions to the language.

It is unnecessary to go in detail through the long list of words relating to government introduced by the invaders. It is evident that a people's language can have no words for ideas or things which do not exist in the country. Especially was this the case in India. Excluded from all but the scantiest commerce with the outer world, India had long believed herself to contain the whole of the inhabited earth, or at least to be the centre and greatest part of it. Like China in the present day, India thought herself "the central flowery land," and had but dim notions of certain "outside barbarians" who led a miserable life on the confines of space. When the new era of a vigor-

* I assume *Padsháh to be "pidr-shah,"* father-king, like *Atabeg* or *Abimelech.*

ous civilization and progress dawned on her, she was unprepared to meet it. Her religion, laws, customs and language shrivelled up at once, and slunk into holes and corners, and the statues of her gods which had loomed grand and terrible in the twilight of Brahminism, looked poor, feeble scarecrows in the full blaze of el Islam. The conquerors were but little disposed to adopt the language of the conquered race, but even had they been so, that language afforded them no materials in which to clothe their ideas. Necessity stept in to aid inclination, and the result was a language full of imported words.

"But," it may be urged, "no one objects to a certain number of Arabic and Persian words; many of them are necessary, some even indispensable, to the people: all we object to is the indiscriminate introduction of words which are not necessary, and for which the early Mahomedan invaders are not responsible." I might answer this, by asking the Hindi school to tell me how they know at what date any given word first made its appearance in India? On what grounds do they assert that the simpler and shorter Arabic words were introduced first, and the longer and more complicated ones later? There exists no regular Urdu literature by which we can, as in English, mark the exact epoch of the introduction of a word. And this brings me to my second argument, that, namely, derived from the constitution of native society, during all the years in which the Urdu language has been growing, up to the present time.

The conquerors were essentially one nation, though composed of very mixed elements. If they had adopted the language of the conquered, in a few generations they would have become scarcely intelligible to one another. In the present day an inhabitant of the Punjab just manages to make himself intelligible to a man of Patna by virtue of those few words which are now common to all Indian dialects, namely those of Persian origin, and the Hindi verbs and particles which have, thanks to the Mahomedans, become familiar all over the country. At the time of the first invasions *honá* was not used over a wider area than *bhá*, *pás* than *bhíre*, *uská* than *okerá* or *wáká*. As the country was split up into a number of petty kingdoms, so was the language into a mass of dialects. Hindi was not one but many, and so it is to this day. The service which the Mahomedans rendered to India, consisted in their taking one of these many dialects and making it the vehicle of their Persian and Arabic, and thus distributing it all over India. The Hindustani or Urdu language is therefore, from one point of view, not Persian grafted on Indian, but Indian inserted into Persian. The movement began from above and was imitated by the lower classes.

At an early period of the invasion, large tracts of country were converted to the Muslim faith. All the Punjab west of the Chinab, and a great deal east of that river; all the chief towns in the valley of the Ganges, and many villages in all parts of the country were largely converted; and the conversion went on for centuries, and has not yet ceased. To all these converts Arabic became a sacred tongue, and as such lay and lies as near the hearts of this section of the people as Hindi. Speak to a Mahomedan rustic in Hindi, he understands you and talks to you in the same; but speak to him in Urdu, and he will press into his service every word he knows of Arabic and Persian, to show you that though, through accident of birth, he can only speak a few words of those honored and sacred tongues, he is yet not quite without knowledge of them. The rustic father sends his son to school to the village pedagogue, to learn what? not Hindi, but Arabic and Persian. And then we are told that these languages do not lie near the hearts of the people! Why, I believe if the votes of the whole Mahomedan population could be taken, an overwhelming majority of them would prefer to abandon Hindustani altogether and make Persian the language of the land.

Among the higher classes in towns, who form the most intelligent and cultivated portion of the population, there can be no question whether Urdu or Hindi is most popular. It is in the towns that we find the stronghold of the Musulman, and consequently of Arabicized Urdu. But on what grounds we are asked to set aside the townspeople and all the Mahomedan rural population, together with all cultivated Hindus who try to talk as much Urdu as possible, I do not see. Native society has been for five centuries so thoroughly leavened with the language of the Mogul invader, and the invader has so thoroughly made himself at home in India, and has so successfully maintained the claim of his composite dialect to express the progress and intelligence of the country, that all classes aspire to use it as a sign of good breeding and cultivation.

The language, to quote Dr. Fallon once more, "in which men buy and sell and transact business" is *not* Hindi; it is Urdu. If *man* and *ser* and *chitánk* are Hindi, *kímat* and *nirakh*, *mál*, *saudá*, and *saudágar*, *jins*, *rakm*, *bazár*, and *dukán* are Persian. If *hâṭ* is Hindi, *ganj* is Persian. *Saṛak*, *bail*, and *gáṛi* are Hindi, but *pul*, *sarái* and *manzil* are Persian. And so it runs through all the scenes of common Indian life; you hear everywhere simple Persian words as frequently as Hindi in the mouths of all classes of the people. I appeal to the experience of all who know well the rural districts of this country for confirmation of this assertion.

We may then safely state that to the higher classes throughout the country, to the Mahomedan rustic, to the townsmen in all districts, Urdu is as familiar and as well known; nay, more familiar, than pure unadulterated Hindi. It remains only to discuss the question as regards the *Hindu* peasant. And it is in this connection that the want of uniformity between the various Hindi dialects requires to be brought out in a stronger light. Hindi is not one, but many. If we follow the advice of our purists, and try to talk and write only pure Hindi, we abandon the possibility of retaining one universally intelligible language and fall back into a chaos of a dozen or more different dialects. In advocating the use of Hindi in preference to Arabicized Urdu, Dr. Fallon's school mean by Hindi those portions of Urdu which are of Indian origin; they mean the dialect which uses *wuh*, *yih*, *iská*, *uská;* which says *honá*, *hotá*, *huá*, *karná*, *kiyá;* that dialect which has been incorporated into Urdu: the Hindi, in short, of Delhi and Muttra. But ten miles from Delhi itself I have heard *wáká* for *uská*, *yáká* for *iská*. If we are to reject such forms as these and use only the Delhi Hindi, we are quite as far from reaching the heads and hearts of the mass of the population as ever. The great Bhojpuri dialect, for instance, is spoken throghout eastern Oudh, Gorackpur, Benares, Shahábád, Sarun and Tirhút, and is more unlike the Delhi Hindi than Dutch is unlike English. I would ask a Delhi or upper Doab rustic to interpret the following from the evidence given in court in a dacoity case by a peasant of Champáran. "*Okerá dwáre gárdhá sunilin, sagare log dháwalan, tán̲ dúi sau jana jamilan, ghare samágelan, sagará dhan, chípá, loṭa, dhán, cháwal sáthi lúṭ lelan, dheri toralan, phin niksalan, áru mushál bhig delan, te bhágalan, t'hom a' P'shádwa chahet gelin, t'ekho chor pakaráil gel.*"

This is pretty simple, especially when written down clearly on paper, but when heard from the mouth of the witness, mumbled and half pronounced and spoken with the rapidity of a steam-engine, it is not so easily caught. It means: "We heard a noise at his house. Every one ran [there]. There two hundred men were collected. They entered the house. They looted all the property, platters, loṭás, rice [of three sorts]; *dhán*, [unhusked]; *cháwul*, [husked]; *sáthi* [a species of Bhadai rice]. They broke the granary; then they came out, threw away their torches and fled. Then I and Parshád pursued, and one thief was caught."

Does Dr. Fallon wish us to fall back on this dialect, for instance, with the certainty that by using it we render ourselves unintelligible to one-half of India? or are we to use some other dialect, unintelligible to this half? Or again is each Englishman to use the dialect of the district where he finds himself, and have to learn a new dialect at each change of station?

If in reply I am told that the language meant by Hindi is the dialect of *hai* and *huá*, *kartá* and *kiyá;* and not that of *bhá* and *bháil*, *karat* and *karalan*,* nor that of *che* and *chilá;*† nor that of *húndá* and *hoyá;*‡ nor that of *cho*, *chá* and *chi;*§ and that a certain amount of necessary Persian words is allowable, I would ask where are we to draw the line in Hindi between what is classical and what is provincial, and in Urdu between what Arabic words are allowable and what are not?

Remarks on some ancient Hindu Ruins in the Garhwál Bhátur.—By Lieutenant Ayrton Pullan, *Assistant Surveyor, Great Trigonometrical Survey.*

[Received 6th June, 1867.]

While engaged in surveying a portion of the dense forest that skirts the foot of the Himalayas between Garhwal and Rohilcund, I discovered a very remarkable temple and a number of carved slabs scattered through the jungle. These ruins have hitherto escaped notice, owing to the dense jungle in which they lie hidden. The

* Bhojpuri. † Tirhút. ‡ Panjábi.
§ Rájputaṇá and Harrowti.

admirable preservation in which the temple still is, and the beauty of the carving on it, and the surrounding fragments, have induced me to make sketches of the most remarkable portions. I send herewith zincographs* from my sketches, trusting that with the following brief account, they may prove interesting to the Asiatic Society.

In January last, while in the Chandipáhár Seváliks and near the site of an ancient but now ruined village called Mandhal, almost six miles east of Hurdwar, I found among the grass the carved figure of a Bull; following up my discovery I came upon a small temple of exquisite carving and design, the figures on the frieze in fine alto-relievo and the whole arrangement of the façade perfect.

Round the temple, which was eight feet in height and six or eight feet square, were scattered a number of carved slabs, a group of wrestlers, Ganesh with his elephant head, and some gods under canopies so very Buddhist, as to remind me of "Sákya Thubhá" on the drawings of the monks of Zauskar and Ladakh.

The temple itself stands on a platform or "chabutará," twenty feet square, and at each side is a trench or drain which was probably intended to carry off the water, and leave the flat square dry for worshippers. Beautifully executed heads terminate the trench at the four corners: on the south a woman's head and bust, at the west a lion, at the north a ram; the east corner is broken and defaced. These heads in form and execution brought to my mind most vividly "the Gargoyles" on the gothic Cathedrals of Europe.

Scattered about were two or three large capitals and shafts of pillars, evidently belonging to a building of far larger dimensions than the small one now standing. The frieze and doorway faces the south; the northern door is much plainer, but I would draw attention to one of the pillars shewing *a stag under a tree* which is identical with the stag and tree on a silver coin found by me two years ago near Betrut in the Sahàranpur district, and attributed to the Mahárájá *Amojdha;* the coin is now in the possession of Bábu Rájendralála Mitra of Calcutta. Inside the temple lies a square carved slab, cracked by a fall, bearing a fine three-headed deity. This three-headed god occurs on most of the slabs throughout the Terai, and is conspicuous on the lingam found near Lál Dháng.

* These zincographs may be seen in the Library of the Asiatic Society. Ed.

Whether the stag and tree, common alike to temple and coin, gives a clue to the builders; whether it suggests a stream of Hindu civilization driven by persecution into the untrodden forests of the Terai, like "the pilgrim fathers," seeking in the wilderness quiet to worship God after the fashion of their ancestors; or whether it may perhaps go to prove that in time past the deadly fever-smitten Terai was not deadly, but a cultivated country filled with villages and inhabitants;—these points I leave for antiquarians to decide.

About eight miles further east in the Lúní Sot, a narrow stony ravine running down from the Himalayas, I found some more slabs, one with a beautiful female head, and two or three large pillar shafts and cornice-mouldings, similar to those at Mandhal. After a long search I could find nothing further; but an old Brahmin who had a cattle "got" in the ravine, told me that twenty years ago several fine figures, slabs, &c. were carried away to Jayapur and Gwalior by wood-cutters from Central India.

Four miles further east, I came on the ruins or rather indications of a city (the place is now known as Pánduwálá) near the police jungle chauki of Láll Dháng. Here after an hour's search I at length lighted on the object of my visit; I found the ground beneath the tall tiger grass and tangled bamboos covered for a couple of square miles with heaps of small oblong red bricks, interspersed with carved slabs of stone; but the most singular and beautiful relic was the last to reward my search; this was a stone "lingam" of most exquisite work, half buried in the ground, but when excavated, standing three feet high and carved on three sides.

Forty or fifty small chirágs were turned up by my servants, while excavating the "lingam." The people at Láll Dháng told a similar story to the Brahmin at Lúní of figures and slabs that had been carted away to the plains at different times. At Pánduwálá I observed three or four evident indications of foundations of houses, and in one place a half-choked canal of good stone work, which had brought water doubtless to the people of the buried city from the cool hollows of the Bijinagar "Sot." A large stone, six feet in circumference by three in diameter, also lay near the foundation of one of the houses of bygone Pánduwálá. At Mawakot, a Boksar village in the Terai, eighteen miles east of

Pánduwálá, I found some more slabs, some of the three-headed divinity and one bearing a very curious figure. An old Brahmin, a resident of the village, told me that it represented "Jangdeo Kumár." The mailed figure with his armed supporters seemed almost an ancient gothic knight, but the curious tracery of fishes surrounding the warrior, somewhat destroyed the illusion. I found nothing more worth recording during my stay in the Terai, but I came on continued indications of what once had been: here a chipped and broken cornice near a cattle "Got." stuck up on end by the ignorant Paharis as a "Deotá," there a great slab of hewn stone lying alone among a clump of bamboos in the middle of the forest. That these remains extend through the whole length of the Rohilcund and Kumaon Terai, I should think there is little doubt. I was told that at Rámnagar in the Kumaon Terai, there were some very fine slabs and carved stones, but I was unable to make my way there.

My remarks on these interesting relics are of necessity meagre, but I hope that my drawings may induce some of the antiquarians of the Society to throw some light on these ruins in the wilderness. I can find no mention of these ruins in Batten's work on Gurhwál and Kumaon, although that writer mentions the Dwáráháth frieze and carvings in Kumaon. I believe I am the first European who has seen the Mandhal temple, or indeed any of these ruins, as none of the district or forest officers had ever heard of their existence, until I mentioned them.

Notes on ancient Remains in the Mainpuri District.—*By* C. Horne, *Esq. B. C. S.*

[Received 8th June, 1867.]

Asauli.—This large village is within two miles of Mainpuri to the north east and can be best approached by the old cemetery, from which it is perhaps three-fourths of a mile distant.

Crossing an "úsar" plain, and passing through the village of Sikandarpur, you see the village of Asauli picturesquely perched on its mound, which rises some forty feet from the level of the plain. At one end is a large native brick house used by the Rájá of Mainpuri during the mutiny, whilst at the other (the east) are swelling mounds covered with trees. But ere you can reach the said village, you have to go a long way round to avoid the extensive sheets of water which environ it on three sides, and which have been caused by the earth excavated therefrom to raise the mound.

Entering by the east, one at once notices a large heap of stones, &c. on a small mound, and here one naturally looks for the Buddhist temple or "chaitya" which certainly faced the rising sun.

Nor is one disappointed, for amidst the mass stands a stone with a deity thereon carved, now called by the villagers "Gúlpib-Debí." This is represented in the rough sketch given below; it is held by

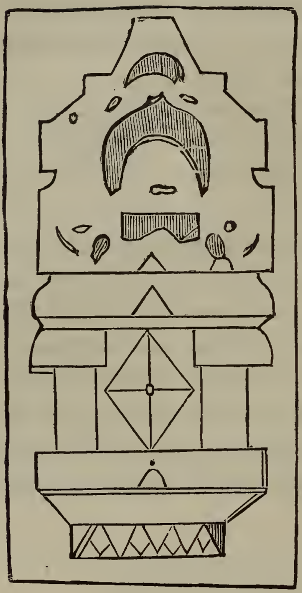
me to represent "Vishṇu," the supplanter of Buddh in this instance. This slab may, however, have formed part of the temple, and have been placed to the right or left of the entrance, as in the later Buddhist temple many Hindu deities were admitted. The carving about the figure is very rich and characteristic of the period I would assign to it, viz. circa 500 A. D.

The large squared blocks of kankar forming the original foundation are, many of them, still in situ—and the building will appear to have been of some size and of the usual crucial form. The length of the cross is not easily ascertained. A single cornice block will, however, give some clue to the size of the structure as it measured 34″ deep by 20″ wide.

Several heads of Buddh, carved in the conventional style, were lying about; whilst two niche ornaments revealed him sitting in contemplation, and several lintel stones two feet ten inches in length, shewed that the sanctuary had been richly carved. There were remains of sundry cruciform capitals, and of single and double bases for pillars as well as of the pillars themselves, but the most curious piece of carving to be seen there was a long slab of kankar, a basement moulding which I have figured below. It will be observed that it consists

entirely of elephants seen fronting one. It measured eight feet one inch, and in this space there were five elephants. Another portion of the same basement moulding was found in the village, as also that of a frieze of demon faces which may possibly have formed part of another building.

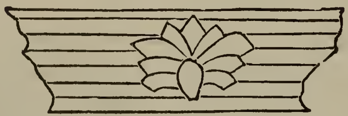
Amongst the ornamental carvings were several settings of "viráj"



or jewel shewn in the margin; whilst the over-branching vase does not fail to assert its prominent place.

There were also remains of statues of both male and female figures nearly nude, with elaborate waist-belts; but these appeared to me to belong to a time when the sensuous Jains were supplanting the Buddhists.

It is very curious to trace on these stones records how the purer faith of S'ákya Muni mingled and became incorporated with and debased by the grosser superstitions of S'iva and Vishṇu —to see how the pure and, so to speak, classical severity of rendering of the human form gave way to the sensuality of engrafted creeds—how S'ákya himself became adorned, needed clothing to cover him, instead of that wondrous veil of drapery generally indicated by merely the faintest waist-line or mark across the thigh, and required "tíká" marks and tiara, how the forms of his attendant female devotees bent and twisted themselves with their distended busts, and how, in truth, the small spark of light S'ákya had revived died out. Again, wandering about the village, one finds everywhere traces of carvings on blocks of stone built into walls. See below. These much resemble those at Malaun which I have before described.



Some are like the figures at Mathurá and Bhilsa; whilst I could not find that any Hindu temple had ever taken the place of the original Buddhist or Jain structure, in which, as afore-noted, it is probable that some of the Hindu Pantheon had found a place.

The mound is of great extent, running nearly east and west. It is perhaps half a mile long and of about the same width, and in former times there probably stood a large Vihar or convent on its western end, where it is highest.

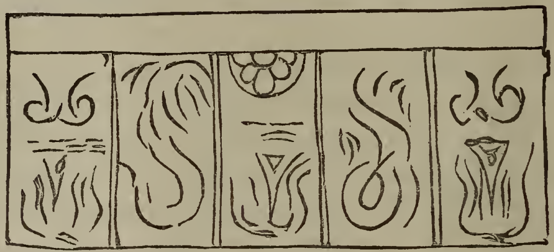
Near this were lying six large stones very richly carved and in good preservation. The carvings upon them appeared to be metaphorical representations of the seasons. They are said to have been dug out from near where they are now lying some years since, and the stones (sandstone) appear quite fresh.

On one, five feet in length, S'ákya is seated on a tortoise. Two

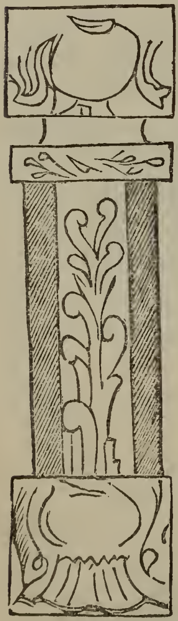
devotees kneeling, hand or offer vessels; whilst from his head springs a tree, going off into scrolls in the bends of which are lotus blossoms. On two or three stand little elephants, and on the others there are "chakwá chakwi" or Brahmani ducks billing and cooing, or sitting alone preening their feathers.

On either side is a panel, much defaced, but upon which "kinnars" or cherubs may yet be seen, and again beyond these on either side are

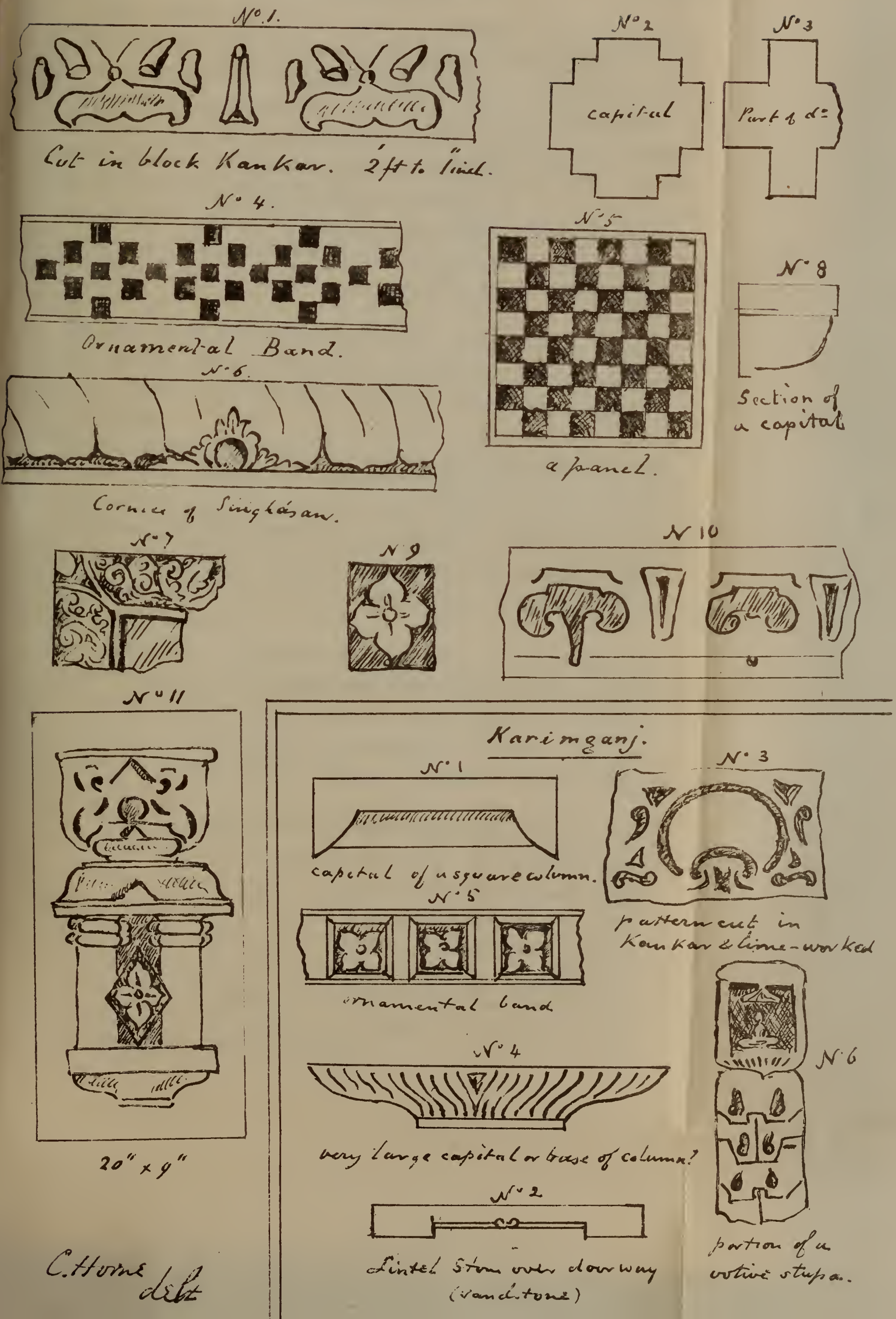
amatory groups—very Jain—viz. to the left a man playing a tom-tom with a woman holding her hands over his head; to the right a man's hand on his heart vowing devotion, whilst the woman is scorning him. On another large stone, half of which is wanting, is Buddha rested in the middle, the "Navagraha" or nine planets right and left, with the sun and moon on either hand closing the series. This stone is clearly early Hindu.



I append an outline of a portion of another carving which appears allegorical, although I am unable to make it out. I also send an outline of a pilaster found by me at Bíchaman on the Grand Trunk Road about six miles distant. Besides being of unusual design, it is pierced with a large round hole, and may possibly have formed part of a railing like that found at Mathurá.



The bricks about the village were not large, and I imagine that in early times, the use of squared kankar blocks for religious edifices was universal in places where stone is not found. The carvings above described were on sandstone which may have been brought from Agra or elsewhere. It is, however, clear from what I have above noted that Asauli is worthy of a visit by any passing Archæologist.


No. 1.
Cut in block Kankar. 2 ft to 1 inch.
No. 2
capital
No. 3
Part of do.
No. 4.
Ornamental Band.
No. 5
a panel.
No. 8
Section of a capital
No. 6.
Cornice of Singhásan.
No. 7
No. 9
No. 10
No. 11
20" x 9"
Karimganj.
No. 1
capital of a square column.
No. 3
pattern cut in Kankar & lime-worked
No. 5
ornamental band
No. 4
very large capital or base of column?
No. 6
No. 2
Lintel Stone over doorway (sandstone)
portion of a votive stupa.
C. Horne delt

Anjani. About three miles north of Mainpuri in the cross-road eading to Eta lies this village, and the road to it is cut through the base of the large khera or mound which attracts the attention of the Archæologist. To the left (in west) for a very large extent is low marshy land caused by the extensive scooping off of the surface earth or the purpose of raising the mound to the right, on which, in very early times, stood Buddhist or Hindu buildings.

At present the summit is occupied by a small mud fort surrounded by a trench, which I was told was thrown up in Lord Lake's time by the Nawáb of Lucknow, whose authority was acknowledged here.

Close by and still upon the crest of the mound which is of great extent, appears a heap of stones, and this upon closer examination, proves to have been a Buddhist "chaitya" or outlying chapel to a large building.

The basement would appear to be in sitû, and stands in the middle of what was once an enclosure of 24 by 18 paces in extent, its longest face being toward the south. The foundation of the enclosure wall has been dug out to the extent of several feet, which reveals the fact that the whole of this part of the mound consists of brickwork laid in mud and the bricks being from 14″ to 15″ × 10″ × $2\frac{3}{4}$″ in size.

The "chaitya" was constructed of kankar blocks; although some small portions were of Delhi sandstone. The remains, however, scattered through the village, shew that there must once have been a very large building here with columns of considerable diameter; and from their character, I am inclined to assign a date coeval with the decline of Buddhism.

The sheet of illustrations herewith sent, (Plate VII.) shews that the line of Rakshas' or demon heads, bears the character of the Buddh Gaya restorations and of many found at Benares and Jaunpur (figured in the Journal) presumed by me to belong to the same period (Fig. 1). The original cruciform capitals (Figs. 2 and 3) and chessboard ("diaper" of Col. Yule) pattern, Fig. 4, betoken great antiquity, whilst the finding in one place of the eight feet of cornice would seem to indicate a larger "Siñhásan" or idol throne for the figure of Buddha than could have been placed in the little "chaitya."

The Hindus would seem to have adopted the said chaitya, for I found three broken "nandies" or bulls and three slabs covered with Kṛishṇas in relief. The carved stone corner of a lintel, Fig. 7, might have belonged to the chapel, and a small clasped hand found in the spot was probably that of one of the " Kinnaras" or angelic cherubs, such as are generally placed around the figure of Buddha. Very many stones were found covered with, what I believe to be, early Hindu cutting, (Fig. 10,) whilst the band of carving Fig. 4 is of a very early type.

I hold therefore that there are good grounds for believing that there was once a Buddhist institution (a Vihara probably) on the spot with its outlying chapel, which latter was appropriated by the Hindus, for the worship of first, Siva, then Krishna and then—allowed to go to ruin. The drain-stone from the Lingam, shaped out of an old block, is still there projecting over the original step; although the emblem of Siva has departed, and no reverence would seem to be paid to the spot by the present villagers, whose zamindar kindly *sent* me one of the finest of the carved stones, (Fig. 11,) without any objection.

Karimganj. About five and a half miles north of Mainpuri, towards Eta upon the cross road stand the large village of Karímganj. Approaching it from the north, a large mound, a short distance from the road, attracts attention and appears worthy of investigation.

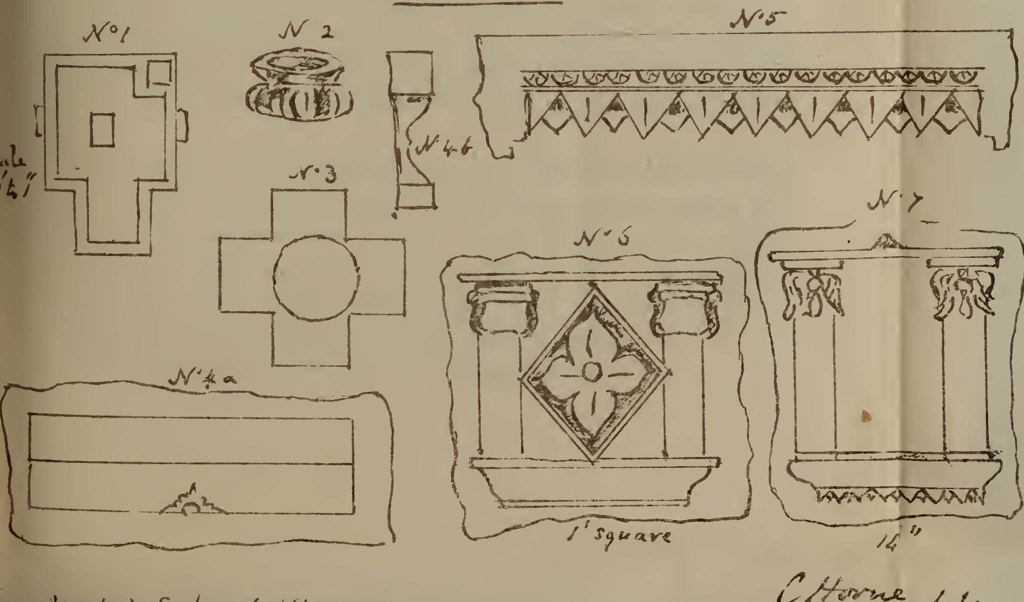
This mound, which is of very great extent, being at base 530 by 330 paces, and which has been formed in ancient times by the heaping of the surface earth brought from a long distance, stands between forty and fifty feet above the level of the country, and upon its crest has been erected in more recent times a mud fort. The level of the general raised surface being taken at ten feet, this fort rises yet thirty feet above that, and presents a very picturesque aspect in its decay. (Plate VI.)

Three sketches and a plan accompany to give an idea of the above. The whole mound is strewed with broken pottery, which is accounted for by the fact that a village used to stand upon it, but has since been removed leaving only these " traces. The kherá" or mound is called by the villagers " Khán Bahádur ká Kherá," and this would appear to have been the name of the petty chief who, subordinate to the Nawáb of Fatehgarh, built the mud fort in the time of Lord Lake.

I examined the mound most carefully; but could not find anything in situ, except a few bricks and these of no unusual size. The fort

Karimganj

Thákúra.



No 4b is Section of No 4a.

C. Horne delt.

is composed, as before stated, of surface (here "saltpetre") earth. Hence the mass of mud is gradually disappearing, being dug out and taken away by the villagers to manure their poppy crops, and thus in the course of time the whole of the upper mound will be levelled. But, although there are no remains "in situ," there are plenty around the large well-mouths and scattered throughout the village, and I subjoin a small sheet of illustrations (Plate VII.) to shew that there must have been in later Buddhist or early Hindu times, a building of some pretensions on this spot. Here too I observed for the first time, kankar blocks, with the main lines of the carving sunk deeply in them, and the whole face of the stone covered with fine lime plaister which was admirably moulded.

The patterns thus produced abounded in curved lines, an illustration of which is given in Fig. 3; they resemble those used in the temple at Máláun (distant perhaps twelve miles) and in the "chaitya" at Anjani, two or three miles distant.

The whole country appears covered with kheras, upon which many of the villages are built, and my own house here stands on one. So that I hope to discover many more sites of ancient buildings, the remains of a very thickly populated Buddhist state.

Ṭhákurá. Leaving Karímganj to the west and proceeding due east over the large "jhíl" or marsh and some barren sand hills for about $1\frac{3}{4}$ miles, one comes to Thakurá village, on the farther side of which, under some noble trees are the remains of an early Hindu temple.

These remains, some illustrations of which accompany, (Plate VI.) are curious principally as shewing how the Hindus adopted the Buddhist forms of ornament, and gradually changed them until the ancient style was lost or blended with the more corrupt modern one.

The material used throughout appears to have been block kankar, which is a most intractable stone, being much like a solid sponge, and the people deserve great credit for the way in which they have worked it. It is I believe softer when first dug than it afterwards becomes. The people of this village were very ignorant, and as they had a lurking reverence for the stones I brought none away.

The drawings on the plate may be thus described.

Fig. 1 is the small enclosed shrine, built with squared kankar blocks.

Fig. 2 is a more recent capital.

Fig. 3 is a very singular capital, for a round pillar 11 inches in diameter, in which the ancient cruciform shape is retained.

Fig. 4 is an odd ornament, curious but ineffective. It must have been placed over a window.

Fig. 5 is an extremely handsome ornament of the same kind for placing over a window or niche.

Fig. 6 is a portion of the ornament always found in the projecting faces of old Hindu temples, the form of the capitals is singular, whilst the " viraja" or jewel of Buddha thus set, has become a flower, subsequently often used in ornamentation.

Fig. 7 is a portion of a similar ornament. The form of the capital resembles some seen at the cave temples, and is essentially Buddhist in design.

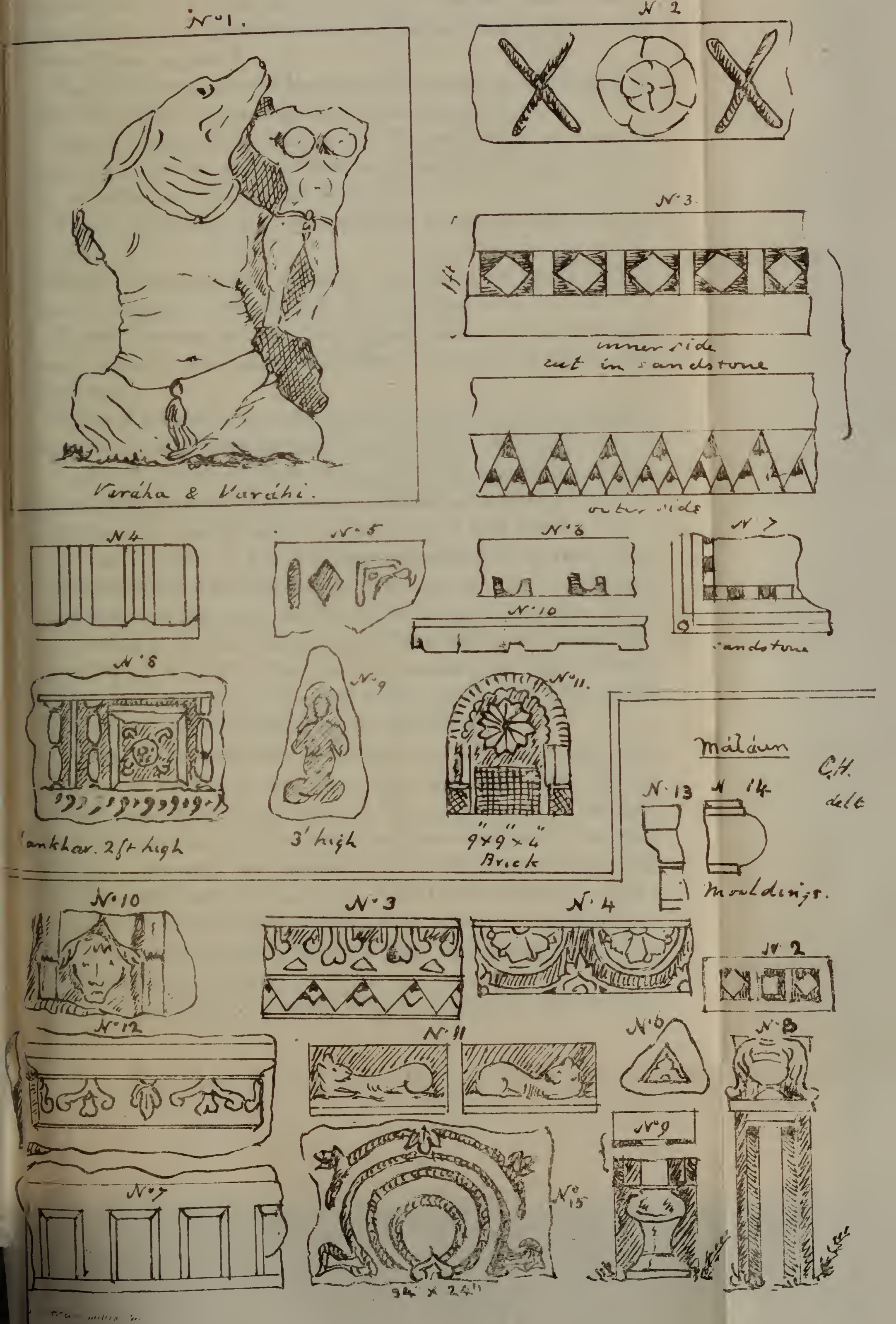
Nonairá. This large and ancient village stands on a very extensive mound which rises from the plain to a height of about 40 feet. It is perhaps $1\frac{1}{2}$ miles north of the Grand Trunk Road, and about the same distance from the Police Post and Canal Chaukí of Dhanahár, and nine miles from Mainpuri.

The name savours of " salt," and we find that until quite recently, from very ancient times, there was a large saltpetre manufactory at this place. Doubtless salt was also formerly made, and hence the name from " nún," salt and " nonairá," salt-maker. Although the mound is so extensive, there is no marsh or " jhíl" around the village. It would seem to have silted up, and the lands are now watered by a branch of the Ganges canal.

On the eastern spur of the mound, I, as usual, found the traces of the foundations of an ancient religious building ; whilst to the north stands the fort, in the construction of which have doubtless been employed most of its materials, as remains of heavy cornices were seen cropping out of the foundations.

Enough, however, remained to shew that there had been a small Buddhist " chaitya" with a Jain ceiling. I subjoin a few drawings, (Plate VIII.) and would draw attention to Fig. 1, which represents the boar incarnation of Vishnu, or the " Varáha-avatár." He is accompanied

Nonairá



No 1.
Varáha & Varáhi.
No 2
No 3.
1 ft
inner side
cut in sandstone
outer side
No 4
No 5
No 6
No 7
No 10
sandstone
No 8
Sankhar. 2 ft high
No 9
3' high
No 11.
9"×9"×4"
Brick
Máláun
C.H.
delt
No 13
No 14
Mouldings.
No 10
No 3
No 4
No 2
No 12
No 11
No 6
No 8
No 9
No 7
No 15
34 × 24"

by the "sakti" or female energy—his wife "Varáhi;" and I observe that Moor in the original edition of his Hindoo Pantheon has a very similar figure on plate 6.

Figure 2 shews the centre boss of the Jain ceiling, whilst Figure 3, gives the details of an architrave of the most ancient type.

Figure 4 is curious, as shewing how the same plan of eaves-stones was adopted over the small windows, cut in imitation of wood, as found by me at Saidpur, Juanpur and Benares.

Figures 5 and 6 are also representations of very rough and ancient carvings.

Figure 7 represent the projecting entablature, of which I found several portions, and which is very finely finished.

Figure 8 shews a portion of the original shrine. It is extremely worn, although the kankar in which it is cut, is of the hardest description.

Figure 9 has also been originally well cut; but the wear of centuries has almost levelled the high relief in which it was executed.

Figure 10 shews a detail which, taken in connection with two pillars found, proves that there was a smaller under shrine.

Figure 11 is another instance of bricks carved with a tool.

I was not able to find any large square bricks, commonly called "Buddhist," but many occurred of an unusual form, and the Kárindá of Rájá Prithvi Sing, the zamindar of the village has kindly sent me one, which is at the service of the Asiatic Society, and which measures $12\frac{3}{4}'' \times 9'' \times 4''$. The ornament represented in Figure 11 was cut from such a brick, but the art of cutting and shaping bricks would seem to have been now entirely lost in the village.

In spite of their thickness, these bricks are beautifully burnt, and each one is marked on one side. The lines with which they are marked appear to have been made with the three fingers of the right hand, having been very carefully drawn across the brick when first moulded. Amongst more modern (yet ancient) bricks I have often seen the mark, made with the finger. This I believe to have been as a charm, and to have roughly represented the trident. This mark also occurs as a mason's mark on marble at Agra, in buildings of the time of Sháh Jahán and Akbar.

I am not aware of similarly ornamental bricks having been elsewhere noticed, or described; although I may here add that I found one carved into a capital at Sarnáth, which may be seen by the curious at the Museum, Queen's College, Benares.

Máláún. When driving on the Grand Trunk Road on my way to Eta, and 13 miles east from that place, I unexpectedly came upon an old temple, and as I have not met with any account of the same, I made a few notes and drawings which may perhaps prove of interest to some, and which I therefore annex. The first thing which attracted my notice, was the size and regularity of the kankar blocks with which the temple had been built.

They varied from 3′ 6″ to 4′ × 7″ × 9″, and appear to have been freely used by the officers of the Grand Trunk Road for bridge building, for many miles of road. Jaswant Singh, the old Ṭhákur zamindar of the place, told me that a certain "Conolly Sahib" had taken the road right through the temple, entirely clearing away the southern arm of the cross, in which ancient form, the erection had been constructed, and used Government vans at night to transport blocks of kankar, carved and plain, for his works; whilst the "oldest inhabitants" who professed to have remembered the occurrence, added—"The kaidís (prisoners') backs were broken by their weight," and a third put in, "Nay, but they were killed outright!"

This is merely mentioned, to shew the need of some officer to see to the preservation of old ruins; for the zamindar offered me as many stones as I might require, and did not appear to mind their removal.

But to resume my account. The only portion of the original foundation that I could find laid bare, was built with large bricks 14″ or 15″ × 8″ × $2\frac{1}{2}$″ and was $5\frac{1}{2}$″ in thickness, with a buttress extending 9 feet. The facing of the superstructure, was originally composed of the large blocks of kunkur formerly alluded to, and very little other stone appears to have been used.

In Figure, No. 14, a specimen of the basement moulding is given. This is about 1 foot in depth, and is of the most ancient type. Sundry traces of Hindu restoration of an ancient Buddhist chaitya are apparent; amongst others, a large lintel stone (of Agra (?) sandstone) with the peculiar frog-like crushed figures at either end, so often seen in modern Hindu temples at Benares and elsewhere. This stone


Máláún
No 1
roof stone
No 5
capital
Finial
Keraolie
No 1
No 2
No 3
4
7
8
No 9
No 5
No 6
Jasráo
No 1 (40' to 1')
No 2
E
W
N.S
N
No 3
Capital
2'
No 6
No 8
No 9
Ornament on the face of projections.
No 5
Stone very much broken & head separate.
No 10
No 4
Cut in a kunkur block
C Horne delt

is fully 6 feet in length. There were lying about, both in the temple and near a bridge three miles nearer Etá, by the road side, many cut blocks of kankar.

One of them, figured as No. 10, bore traces of great antiquity, and reminded me of some faces similarly arranged, which I had drawn at Benares: the type is a universal one.

Many fragments of cornice were also lying there, all indicating a large building. Two of these are shewn drawn to scale in Figures 3 and 4. Ornamental details, figures 2 and 12 indicate the date of the work, the former being very bold and effective; whilst the latter, in spite of the rough grain of the kankar, looks very rich.

Moulding, No. 13 is ornamented with the old denticulated pattern, and has a good effect.

Figure 11, shews two tigers, more modern in their design.

From the above it will be seen that the details of ornamentation were very rich, in spite of the uncompromising nature of the material, viz. porous block kankar.

The temple was built upon a slight mound raised with earth, dug from the neighbouring marsh, now nearly filled up by the annually drifting sand of this part of the country. The temple covered a space of about 75 feet square.

The form would appear to have been oblong. I was able to recover two of the pillars, which had been originally used. It will be seen by figures 8 and 9, that they were of a very simple and early style.

The base figures in both and the central portion in each is eight-sided. The upper recessed portion in Figure 9 has, however, only six sides. These pillars may have formed part of the same building; for we often find different patterns employed in one edifice.

Figure 7 represents an eaves-stone cut in imitation of wood work. It probably covered some small door or upper light, and, as before remarked, resembles those found at Jaunpur (Pair Daruba and Atala mosque) and Rajghat, Benares. The figure of a sitting Buddha is still on the spot to point out who were the founders, although there are also several Hindu deities present in effigy on sundry slabs of stone, to attest the subsequent appropriation.

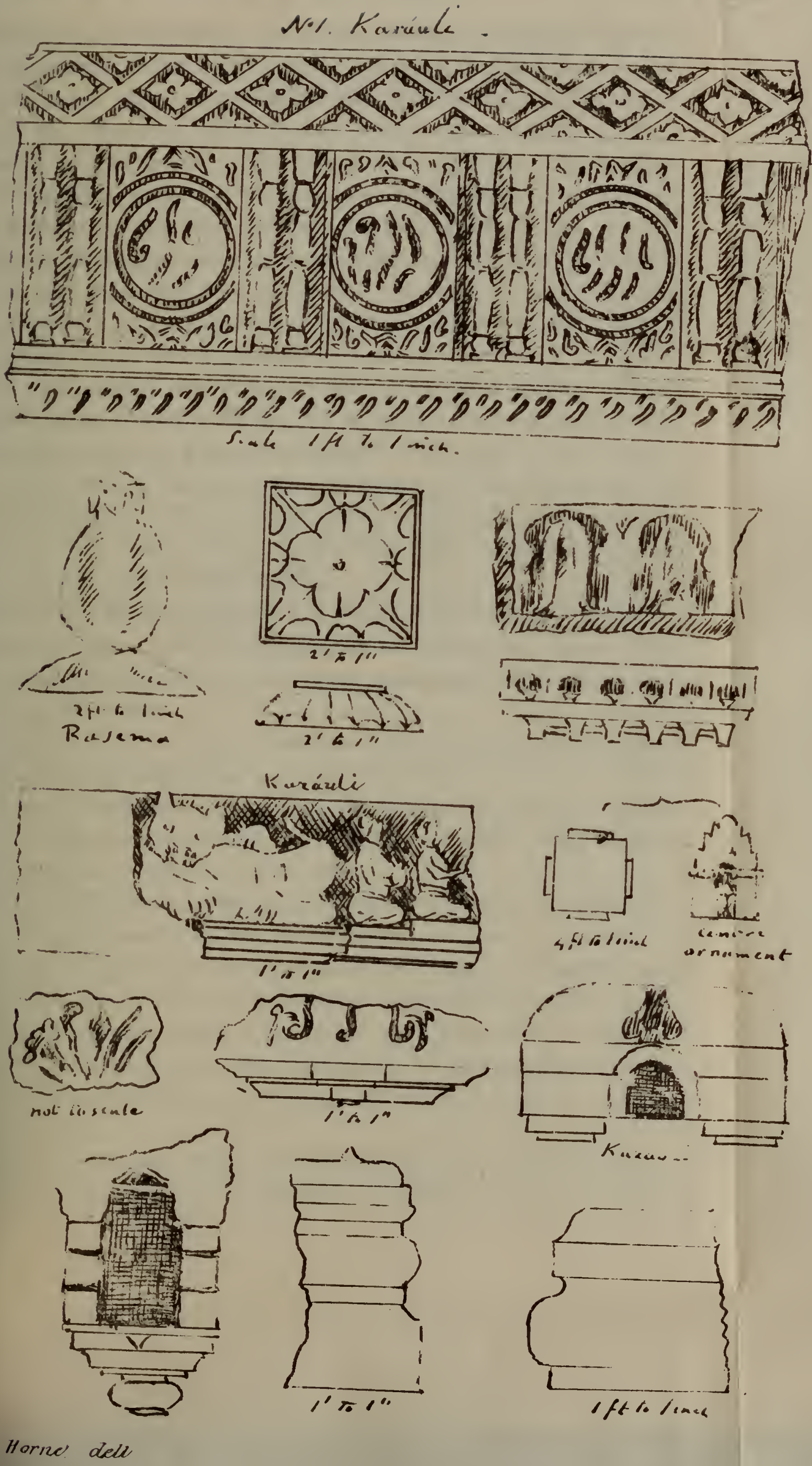
Around the niches once occupied by figures of Buddha are handsome ornaments one of which, (32 inches by 24 inches) has been figured by me as No. 15. There were many others of the same character. We now come to the roof. Of the central slab of this Buddhist (or as Fergusson would call it "Jain") ceiling, I was fortunate enough to find three portions, one of which has been figured as No. 5; it is drawn to scale, from which it will be perceived that the central rose lotus blossom must have been 5′ 4″ in diameter. This would give a central chamber vault of at least 11 feet, or with the cornice 12 feet. The massiveness of the long slabs of *block kankar*, must have been very great; but they were not sufficiently strong to bear the weight of a large pípal tree, which now stands upon this spot, and which doubtless helped much to cause the ruin.

Arrived at the exterior of the roof, we find a strange pinnacle, of a form new to me, one in which the form of the vase is not abandoned, but very well adapted. Vide figure 1.

There were also built into the walls around, the remains of three kalasas, each of 3 feet diameter, which, doubtless, at a subsequent period, capped portions of the edifice. I also observed the fragment of a very singular capital (figure not numbered) which would seem to have been used in the building. An emblem of S′iva has been erected in the centre of a wretched enclosure on the site, and the said enclosure is generally kept clean; but except by the women, much sanctity does not seem to obtain for the place. It is, however, the scene of many a festive "mela" or fair, held at regular intervals, and for the convenience of visitors at which, the kankar blocks have been much scattered and rebuilt into small walls. The temple was undoubtedly of Buddhist origin, and belonged probably to the fifth or sixth century after Christ. Of course, it was impossible to find any mason marks, as these could not be well cut on kankar blocks. There was no inscription that I could discover, whilst my search for coins in the village produced nothing.

These notes may prove the more valuable, as it is probable that in a short time not a trace will remain of this ancient ruin.

Karauli.—At the suggestion of General Cunningham, I drove over to Karauli, which is about 11 miles north of Mainpuri, and upon the Grand Trunk Road from Allahabad to Delhi, being 240 miles from the latter place.


No 1. Karáuli.
Scale 1 ft to 1 inch.
2 ft to 1 inch
2' to 1"
2' to 1"
Karáuli
1' to 1"
centre ornament
not to scale
1' to 1"
1' to 1"
1 ft to 1 inch
C Horne dell

There is a magnificent grove, at the road side, of gigantic tamarind and other trees, under which are scattered some Muhammadan tombs, and there are traces everywhere of this town having once flourished under the Musalman emperors, of whose coins I obtained three or four, as well as two of the nail-headed character. These latter abound in these parts. A thorough search through the town shewed no traces of very ancient buildings in situ, although the old fort mound, now being levelled and converted into a "ganj" or market place, may have been the site of one. I, however, marked about 30 stones, *i. e.* block kankar and sandstone, which had once formed parts of a Buddhist erection, and all of which appeared to me to have been brought from Malaún about eight miles distant. I have figured some of these. Of No. 1, I found two portions; the rest of the cornice being at Malaún, and a band of the same pattern adorns one of the faces of the great tope at Sárnáth, and has been figured in the "Researches" of the Asiatic Society by General Cunningham.

Figure 2 is commonly to be found carved at the Atala mosque, Jaunpur, and on very early capitals.

The forms shewn in Figures 4, 5, 6 and 7 indicate great antiquity. There are similar ones at Malaún and at many other places. The basement moulding Fig. 8 is very bold, massive and effective, and also of a very early date.

Figure 9 is very singular; but there may be doubts as to its age.

Cornice, Figure 3, needs no special remark.

Many of these stones were found built into the gateway of a new sarái; some were seen near the Old Fort or walls; whilst others were used to form the mouths of wells.

Fragments of three kalasas, of a similar size as those found at Malaún, were also discovered; so that the conclusion I arrived at was, that no building of any note in Buddhist times, had existed in Karauli, but that these remains had been plundered from Malaún, which would seem to have been used as a quarry for many years past. I find this district to be dotted over with high mounds of great antiquity, many of which produce stones as herein illustrated; I hope to examine more of them.

This fact, however, shews one that caution must be exercised in statements as to whence stones have been taken; for there may have been many small shrines or "chaityas" in connection with monasteries on mounds, which latter may have been built of bricks, which said bricks, which is commonly the case here, have been annexed and used by the surrounding villages.

I can, I am sorry to say, obtain no written notice of these mounds, and they are far beyond the range of oral tradition. A collection of the best of these carved stones might be made *here* by Government at a very little expense; but no one in these parts appears interested in the subject.

Jusrau, visited February 13*th*, 1866. About two miles west of Anjani village, described in a former paper, lies the village of Jusrau. It forms part of the titular Rájá of Mainpuri's zamindári or estate, and has, I have little doubt, been plundered of its best archæological remains in the shape of pillars and capitals by former residents of Mainpuri, from which it is scarcely three miles distant. The last attempt would, however, seem to have secured immunity for the future from these spoliations.

The "oldest inhabitant," a grey-haired Brahman, informed me gravely, pointing as he spoke to a large block of kankar which had once formed part of the ancient Buddhist shrine at this place, that the Rájá had sent for this to be used in building; that he had laden it on a two-bullock cart; but that the cart had broken down and the bullocks been drowned whilst crossing the river Isan, not very distant, in the sacrilegious attempt to remove it. He added that the fresh cart and bullocks then sent by the Rájá brought it back *with ease*, and restored it to the spot where I then saw it. So alarmed are the villagers, that they will not use the smallest, plainest stone for any purpose, and in proof of their sincerity, they shewed me their great need of a good well, saying that they were too poor to burn bricks for it, yet they dared not use the blocks lying about in profusion. And this was the more curious, as the remains about to be described, are thoroughly Buddhist, and not at all Brahminical in their character, whereas the village is a Brahman one.

The cart track leaves the high road from Mainpuri to Etá, shortly after the 4th mile, and crosses a sandy expanse, now covered with crops of barley, &c. until it terminates in the village. To the east of this are remains of what had been formerly two village

Buddhist shrines, and these were all the buildings to be traced. These are both 50 feet by 30 feet, measured outside, and Plans Nos. 1 and 2 sufficiently explain them. Each has a raised platform 19 by 12 feet, built of well-cut kankar blocks without cement, and quite plain. These must originally have risen from 5 to 6 feet, from the terrace in which they stand; for even now in one place the finished upper work is of that height, whilst in others, rubbish has accumulated. On these raised platforms were probably originally built open chaityas as at Bakáriyá Kund. The remains of kalasas or dome caps, of 5 feet in diameter, such as could crown a "Vimána" of 30 or 40 feet in height, evidence large buildings; whilst the finding of several projecting face ornaments enabled me at once to state with certainty the original form of the building. See Figures 4, 5 and 9.

The present residents of the village call the ruins by the name of Jagat Deví's temple, and they tell me that at the Holi festival, a great "mela" or fair is held here, when offerings of ghi and rice are made to the Deví, who is neither more nor less than our old friend "S'ákya Muni" or Buddha. The local name merely means "The deity of the locality."

Buddha is to be found sitting in every niche in the sculpture, and there is, besides, the two small figures, one of which does duty for Jagat Deví, (Figure 5,) and another very well carved, some 4 feet in height, of which I give a rough representation, Figure 8. Nearly all the Buddhist ruins about here, would seem to belong to the time of the decay of the purer faith, and these are no exceptions; for we find the ornaments of the projecting faces to have been the same at Anjani, Karímganj, Karauli and Malaún. Vide Figures 4 and 5.

Here I saw for the first time on kankar, what I believe to be a kind of mason's mark: Figure 11. The carving of the large Buddha is very well executed; but the head has been knocked off and replaced minus part of the neck; and the two upper groups of "Kinnaraṣ," or cherubs, are altogether broken away. The two tigers under the lotus, are the same as those I saw at Malaún; the animals are something between a pig and a bear. The forms of these I saw in Behar, and also on a stone in Benares opposite to the Golden Temple.

To the right at base is the figure, supposed by Mr. Sherring and me to be "Surya," the sun, and figured amongst the remains from Bhitári in the Society's Journal, Vol. XXXIV. Part I. plate xvii. The lotus or glory around the head, is finely cut in relief, as is also the canopy. There were no traces of large bricks, but all seems to have been built of kankar blocks. In all this village, I saw no trace of the worship of S'iva, and truly, *all* fell down before, although many openly laughed at this their *Unknown god*dess, "Jagat Deví," the fear of whom was moreover shewn by their not daring to touch a stone of her former temple.

Additional note on Karauli.—Since recording the foregoing notes, I have had several opportunities of examining ancient carved stones at Karauli. Chaudhari Lachhman Siñh is constructing a tank in steps, the entire facing of which, consisting of squared kankar blocks, is composed of the remains of some very large and handsome Buddhist buildings, which, contrary to the opinion heretofore expressed by me, existed on the spot.

These blocks, in number several thousands, were found when levelling the mound or "khera" for the purpose of laying out a large market. I subjoin a plate (x) of some of the more remarkable, which need little explanation. There were besides, large and handsome mouldings and specimens of nearly all the carved ornamental bands in use in this class of buildings. As usual, however, there had been a reconstruction; for I found two huge blocks of kankar with the tigers "couchant" placed one on either side of the doorway; whilst originally they had been joined and formed the basement for a large figure of Buddha.

The drawing No. 1, Plate X., represents what was probably at the back of the shrine, and resembles other portions found at Noner and elsewhere. It is very complete and curious. No one can say what may have been built into the tank-facing, but this is one of many instances in which valuable carvings have been lost. A few slabs were secured by me for a local museum, should such ever be established in Mainpuri.

At the village of Rasemá, where is a large and ancient khera, I saw remains of a small building, similar to some of those described in these notes. This village is about two miles south of Karauli, and I here secured a curious vase-shaped pinnacle which well denoted the period of its construction.

Literary Intelligence.

A very useful handy-book on the Hindu law of adoption has just been published under the patronage of Honorable Prasanna Kumár Tagore, C. S. I. It is entitled the *Dattaka-Siromaṇi*, and contains the substance of all the leading treatises on the subject, including the *Dattaka-mimáṅsa*, the *Dattaka-chandriká*, the *D. nirṇaya*, the *D. Darpaṇa*, the *D. Dídhiti*, the *D. Kaumudi*, the *Dattaka Siddhánta manjarí*, as also of an apocryphal treatise named the *Dattaka Tilaka*. The work has been compiled with great care and judgment by Professor Bharatachandra S'iromaṇí of the Sanskrit College of Calcutta, who has also supplied, at the end of each chapter, an excellent summary of its subject.

Anglo-Páli literature has received an important accession in an English translation of the Attanagalluvansa of Ceylon, by James d'Alwis. Though professedly a history of the Temple or vihára of Attanagalla, it contains the chronicles of King Sangabodhi, who reigned in the middle of the 3rd century A. D. In an elaborate preface the translator has discussed a number of interesting questions regarding the Singhalese Chronicles of the Mahávansa and the Dípawansa, and of translations of particular passages in them by Turnour and others.

The Librarian of the Sanskrit College of Calcutta, Paṇdita Jaganmohan Tarkálankára, has brought out an edition of the play of *Chaṇda Kausika* of Khemísvara. The author flourished in the court of Mahipála Deva of Gour, and his work therefore is about 900 years old. By a curious mistake the editor, confounding an epithet with a proper name, says in his preface that the work was written for the entertainment of a king of the name of Kártika who flourished between four hundred and a thousand years ago. The subject of the book is the preëminence of truthfulness as illustrated by the story of Visvámitra and king Harischandra. The Tamil version of this work is well known under the name of *Arichandra*, of which an excellent English translation was, a short time ago, published in England by Mr. Matukumára Svámi of the Ceylon Legislative Council.

The same editor has also published a new and very carefully revised edition of the Venisañhára of Bhaṭṭa Náráyaṇa, with a new commentary.

The learned professor Jayanàráyaṇa Tarkálañkára, to whom Sanskrit scholars are indebted for several excellent commentaries on ancient Sanskrit authors, has lately presented to the public a very useful little digest, named *Pudártha-tattvasára*, containing an epitome of the Philosophy of Kapila and Kanáda. The book will prove a great help to the students of philosophy in the Sanskrit colleges of Calcutta and Benares.

An original treatise on the mode of performing the ceremony of weighing one-self against gold, silver and other articles intended for presentation to Brahmans, *Túládána-paddhati*, and a new grammar of the Sanskrit language (*A'subodham Vyákaranam*), have been brought out by the indefatigable Professor Táránátha Tarkaváchaspatí of the Sanskrit College. The former will prove useful to those who have especial faith in, and the means to perform, the interesting ceremony of which it treats, but we doubt very much if the latter is likely to supersede the excellent compendium of Varadaraja, the *Laghu Kaumudi*.

To the Persian scholar, we have to recommend a small volume containing two small treatises on Metre and Rhyme, the *'Arúz* of Saifi, and the *Káfiah* of Jámi, very carefully edited by the learned Shemitist, Professor H. Blochmann.

In three old letters found in the archives of the Asiatic Society, the late Colonel Wilford announced to Mr. Edward Colebrooke, the discovery of certain Sanskrit MSS. on geography, of which no notice has since been met with, and which seem not to be known to Sanskrit scholars. The works named are, 1, *Bhavishya Puráṇa* of 60,000 slokas. The Puráṇa of that name, according to the Vishṇu Puráṇa, should contain only 14,000 slokas. In the commentary on the second work on our list Jayasinha, " who often speaks or is made to speak in the first person, says that he had in vain sent people all over India to procure it; he ascertained that it was not to be found, and supposed it no longer existed; however near Allahabad he heard that it was in *Trina guru Desa* or Tibet, in the possession of Jnáni guru, and that he got a copy from him." 2nd *Dharma Kosha*, of 700,000 s′lokas, compiled by order of Jayasinha Rájá of Jayapur, who is said to have "sent the author to perambulate the Gangetic provinces. He was furnished with a *Machileswara* or compass, and a water clock which as he advanced shewed the coss and its parts." 3rd, *Bhrigu Sañhitá*, "between 40 and 50,000 s′lokas, all on geography." 4th, *Garga Sañhitá*, "certainly about 2½ lakhs of s′lokas." 5th, *Mâdhavi Kosha*, "entirely on geography. It consists of 10,000 leaves or above nine lakhs of s′lokas. It requires three men, or at least two very strong ones, to carry it. It is divided into 56 books describing the Chhapan Desa of India." 6th, *Ishṭa Puráṇa*, "compiled by order of Mána Sing for the illustration of the geography of the Puráṇas—about 2½ lacks of s′lokas." 7th, *Ahabala Sañhitá*, "of 56 Sections relating to the 56 grand divisions of India." 8th, *Súta sañhitá*. 9th, *Parásara Sañhitá*, "both on geography." Wilford possessed MSS. of most of these, and it would be of interest if they could now be traced.

The following are extracts from three letters lately received from Professor Holmboe of Christiania, giving the results of his recent researches into Indo-Scandinavian antiquities. The first is an abstract of a memoir on some figures sculptured on a rock in Scandinavia, which will be found interesting to Indian Archæologists :—

"Depuis un temps immémorial on voit sur les rocs près de la mer aux côtes de Suède et de Norvège un grand nombre de figures sculptées, représentant des navires, des roues, des voitures, des hommes armés, des chevaux, des cavaliers, des souliers, &c. Elles se trouvent ordinairement groupées ensemble, ce qui a motivé quelques archéologues à les prendre pour des tableaux executés en mémoire de batailles, particulièrement par mer. Mais il est constaté, que les figures, qui forment une groupe, ne sont pas contemporaines, mais fabriquées à différentes époques. Le navire ou bateau sont des symboles ordinaires de la métempsychose en Orient, et les mêmes symboles se trouvent parfois sur des pierres sépulcrales dans le Nord. M. H. suppose donc que ces figures sculptées sur les rocs y sont placées en mémoire de personnes décédées, et que le choix des figures depend ou du gout des parents survivants, ou de la position, sociale du défunt, ou de quelque évènement important de sa vie. Quant aux autres figures, les souliers, les voitures, les chevaux &c. l'auteur renvoie le lecteur à la croyance des payens, que le défunt devait passer par des chemins obstrués par des épines et d'autres difficultés, à cause desquelles on avait dans le Nord la coutume de lier des souliers sous les plantes des pieds des morts. On peut donc envisager les souliers, les chevaux et les voitures comme symboles de leur voyage à Valhal. Enfin M. H. émet l'opinion que les petites voitures de bronze qu'on a découvertes en Allemagne et en Suède, une fois du moins dans un tertre sépulcrale, ont servi à des cérémonies funéraires emblématiques symbolicant le départ de la vie terrestre. Les mémoires sont illustrés d'une planche et de beaucoup de tailles en bois."

The Professor gives the following brief notice of an essay of his on the sacrifice of the Horse among the Scandinavians :—

" On lit dans les anciennes Sagas ou histoires de la Norvège que plusieurs hommes consacraient des chevaux au dieu Frey, et au commencement de chaque année on sacrifiait des chevaux et en mangeait la viande. Mais dans une Saga Islandaise, dite Vatsdælasaga, il est raconté, qu' un homme nommé Hrafnkel avait un Freyfux, c. à d. un cheval consacré à Frey, et qu' il avait défendu chaqu'un d'y monter sous peine de mort. Néanmoins un de ses serfs le monta, et fut puni de mort. L'auteur compare cet évènement aux effets de la consécration des chevaux chez les anciens Indiens et chez les Kalmuks et les Mongoles actuels. Chez ces peuples il était et est défendu sous des sevères peines de monter les chevaux consacrés."

The next two memoirs of his noticed by the Professor are on certain gold rings on which the ancient Scandinavians took oaths. In the first of these—

" l'auteur attire l'attention aux anneaux, sur lesquels les Scandinaves aux temps du paganisme portaient la main en prêtant serment. Plusieurs de ces anneaux ont été trouvés dans la terre est sont conservés dans les musées du Nord. Ils sont faits d'une barre d'or, courbée en forme d'un anneau oval dont les bouts, qui sont un peu plus larges que la partie intermédiaire, ne se touchant pas, mais laissant une petite ouverture entre eux. Pour prouver, que la manière susdite de prêter serment tire son origine de l'Orient, M. H. donne sur la 1 re planche les dessins de 4 anneaux, un de Norvège, un de l'Angleterre, un de Bretagne, et un de Persépolis. Les trois premiers sont d'or, le quatrième se trouve parmi les sculptures de Peréspolis ; le dernier ressemble tout à fait celui de Bretagne, où on voit dans la grande procession sacrificale des hommes portant en mains levées de tels anneaux. Puisque les sacrifices et la jurisdiction étaient ordinairement réunis dans les grandes assemblées des peuples payens, les anneaux à serment défendent leur place dans la procession sacrificale. A la 1re. pl. on voit aussi le dessin d'une monnaie celtique, dont l'avers présente un homme portant en main un anneau de la forme susdite (symbole de la jurisdiction), et sur le revers un animal et un couteau dessous (symbole du sacrifice). L'auteur émet ensuite l'opinion, que les sculptures Sassanides en Perse òu on voit deux personnes portant couronne, dont l'une présente un anneau et l'autre pose sa main là-dessus, représentant le chef des Mages, le grand-mobed, qui reçoit le serment du roi, qui vient de monter sur le throne. Les planches 2, 3 et 4 donnent les dessins de trois des sculptures sus-nommèes. A la fin l'auteur donne une liste des poids de 37 anneaux d'or à serment, pour mettre les lecteurs en état de juger, si les fabricants, comme quelques archéologues ont pensé, eurent eu le dessein de leur donner un certain poids correspondant avec les poids convenus ou non; l'auteur en doute.

" Dans le second mémoire M. H. defend son interprétation des sculptures Sassanides contre un savant Danois, M. Müller, qui pense, que le symbole du serment ne consiste pas dans l'anneau, mais dans le poing que le roi tient devant la bouche (v. pl. 1 et 2 de M. H.). L'auteur objecte contre cette opinion que sur plusieurs sculptures on voit des personnes avec le poing devant la bouche se trouvant dernière les personnages principaux et même tournant le dos envers eux.

The following is the substance of a paper by the learned Professor on the numbers 108 and 13 :—

Chez les Indiens, aussi bien que chez les Bouddhistes autre part, le nombre 108 a depuis des temps immémorials obtenu le crédit de posseder un pouvoir magique, et son emploi est très repandu où il est question de cérémonies religieuses. Leur Roudrákshas ou chapelets contiennent partout 108 globules ou corails. Déja au 3me siècle avant notre ère le puissant monarque Asoka fit reciter 108 prières à la consécration d' un Tope, et environ 100 ans plus tard le roi Dhutthagamini de Ceylan fit employer plusieurs articles au nombre de 108, lorsque le grand Tope, Mahathupa, fut bâti. Plusieurs temples de l'Inde contiennent 108 Lingas ou symboles du dieu

Çiva. La veuve du Raja Tilouka Chandra fit bâtir 108 temples pour le culte de Çiva, et on y plaça 108 Lingas et 108 images du boeuf sacré. Dans quelques réglements il est préscrit de se promener 108 fois autour de l'image des dieu. L'auteur émét la conjecture que l'influence du même nombre s'est fait sentir dans l'emploi du nombre 540, qui selon le rapport de l'ancienne Edda fut le nombre des portes de Valhal, la demeure d'Odin, le suprême dieu des Scandinaves; car $540 = 5 \times 108$, et le nombre 5 a aussi joui de la renommée d'un nombre merveilleux. Si nous resolvons le nombre 108 dans ses éléments, nous aurons $2 \times 2 \times 3 \times 3 \times 3$, et la somme de ces éléments est 13. Or le nombre 108 une fois reconnu sacré, la somme de ces éléments ne doit pas avoir trouvé difficile d'acquérir le même crédit. Les Bouddhistes de Népal enseignent, qu'il y a 13 bhuwanas ou demeures après la mort pour les vrais croyants, et par conséquent ils construisent sur leurs bâtiments sacrés des tours, ayant 13 étages. Dans une légende Tibétaine on trouve la déscription d'une contrée ravissante, où il croissaient trois fois treize (sic) sortes de fleurs, et 108 sortes de plantes odoriferantes, et qui étaiént arrosées par 108 sources. Les devins de la Çhine se servent d' une baguette divinateuse divisée en 13 paliers.

Une confiance égale dans le nombre 13 se découvre en Scandinavie dans l'emploi de 13 pierres placées debout formant des circles, qui marquent les places où des reliques de personnes d'importance ont été enterrées. Quoique ce nombre n'est pas l'ordinaire, il est cependant remarquable qu' on le trouve assez souvent. L'auteur cite entre autres par ex. une paroisse en Norvège, où il restent encore trois tels circles de 13 pierres chaqu'un.

Concernant la raison de choisir le nombre 108 l'auteur propose diverses hypothèses, parmi lesquelles il trouve celle la plus vraisemblable que le choix est dérivé de quelques idées astrologiques ou astronomiques. L'ancien astronome Varáha ayant calculé la prècession du point équinoxial du printemps, crut avoir trouvé, qu' il procède pendant 3,000 ans vers l'Orient, parcourant 27° du zodiaque, retourne ensuite ver l'Occident, passant 54° du même, et enfin retourne vers le point de départ par 27°, ayant fait en tout un passage de 108°.

La dérivation du nombre des portes de Valhal, la demeure du dieu suprème des Scandinaves, d'un nombre sacré (5×108) a son analogue dans la dérivation du nombres des portes de la demeure du dieu suprème des Kalmuques et des Mongoles, dont le nombre 169 est $= 13 \times 13$.

The following is the substance of a very interesting memoir affording curious traces of the worship of S'iva in Europe in former times :—

Pour se fournir de matériaux à une comparaison entre les traces de Çivaisme en Europe (hors la Grèce et l'Italie) et les idées Indiennes sur Çiva ou Rudra, l'auteur donne d' abord un court aperçu des qualités de ce dieu. Comme point de départ pour la comparaison il cite un mémoire de M. Ganjal, sur une idole Gauloise appelée Ruth (inséré dans les Mémoires de la Société Royale des Antiquaires de France T. IX p. 61 fig. v.) dans lequel il prouve qui les deux anciennes villes Rode (dite Ruthero par les Romains) et Rouen (dite Rotomagus) derivent leurs noms d' une idole nommée Ruth ou Roth qui avait été adorée par les habitans des villes et des environs, et dans le culte de laquelle les débauches jouaient le rôle prédominant. M. Ganjal tire de là la conclusion que Ruth fut la même divinité que Roudra ou Çiva des Indiens.

M. Holmboe donne ensuite une liste de noms propres de villes et d'autres places en Europe, qui éveillent l'idée d'une derivation de Roudra, p. e. Rhoden, Rodenacher, Rodenberg, Rodenthin, Rottenburg, Rottenfels, Rhode, Ruhte, Ratheborg &c. en Allemagne ; et Rutland, Ruthwel, Ruthin en Angleterre ; Rot, Rotholet, Rotnoe en Norvége. Comme dans l'Inde Rudra, à la tête des Maroutes (les vents), est la personification de l'ouragan, ainsi en Europe l'ouragan est personifié par un chasseur faroûche (en Hannover appelé Rodo) courant dans l'air, suivi d'un grand cortège. En Norvège et en Suède on a trouvé un nombre de Lingas (symbole ordinaire de Çiva), une fois debout sur un tumulus, une fois dans la chambre sépulcrale d'un autre tumulus, et plusieurs fois autre part. Ils sont fabriqués de marbre ou d'une autre pierre blanchâtre. Le musée de Bergen conserve quatre de ces pièces (voyez les tailles en bois aux pages 24, 25, et 26). Dans une ancienne loi ecclésiastique de Norvège on rencontre une expression, qui jusqu'ici n'a pas été comprise, c'est le mot *Rot*, qui se trouve dans une énumeration d'articles payens que la loi défend d'avoir dans les maisons, comme sorcier, idole, &c. L'auteur suppose que Rot a été le nom du linga, emprunté de Roudra. Il cite d'une ancienne rédaction de l'histoire du roi Saint Olaf, qui introduisit le Christianisme en Norvège, un récit d'une famille payenne demeurant dans la province Nordland, qui adorait le linga d' un cheval, qu' on avait tué, mais dont on avait conservé le veretrum. Les soirs cette pièce passait de main en main non seulement parmi les personnes de la famille, mais encore parmi les hôtes qui pussent être presents, chaqu'une récitait un verset en délivrant l'idole à une autre. L'auteur pense que c'est la forme du linga qui a été imitée par quelques urnes sépulcrales, qui ont été découvertes dans les celles de plusieurs tumuli, car elles sont cylindriques et arrondies au fond, (voyez p. 33, où une de Norvège, une d'Angletere et une de l'Inde sont dessinées). Plusieurs de ces urnes sont ornées de figures émoulées en forme d'o vales. Le musée de l'Université de Christiania en possède quatre ornées respectives de 13, de 39 (3 × 13), de 14 (2 × 7) et de 21 (3 × 7) ovales, or les nombres sacrés de 13 et de 7 entraient dans tous ces nombres,—preuve qu'on les a destinés à un usage religieux, et que les ovales peut-être aussi désignent les œufs, étant symboles de métempsychose ;—une doctrine, dont on trouve aussi des traces en Scandinavie. La même idée parait être symbolisée par les pierres en forme d'œufs, dont on a trouvé des exemplaires aussi bien dans les celles de topes de l'Afghanistān, que dans celles des tumuli de Scandinavie. M. H. renvoie ensuite à un mémoire, qu'il publia en 1859 sur le type de plusieurs bractées d' or, dont les musées du Nord conservent un nombre considérable, deterrés parfois de tumuli payens. Il y a démontré que le type représente Çiva sur le dos du bœuf sacré (Nandi). Preuves, que le culte Indien du bœuf a penetré dans la Scandinavie sont des légendes de vaches sacrées, qu'adoraient un roi de Norvège nommê Augvald et un roi de Suède, appelé Eustein Beli. Augvald étant mort, ces reliques furent deposês dans un tumulus, et sa vache dans un autre à côté de celui du roi ; et en Danemark on a au milieu d' un tumulus trouvé le squelette d' un bœuf. Un nombre si considérable de traces du Çivaisme prouve évidemment, que le culte de Çiva ou Roudra a été très répandu en Europe au temps du paganisme.

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"It will flourish, if naturalists, chemists, antiquaries, philologers, and men of science in different parts of *Asia*, will commit their observations to writing, and send them to the Asiatic Society at Calcutta. It will languish, if such communications shall be long intermitted; and it will die away, if they shall entirely cease.

Sir Wm. Jones.

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CONTENTS.

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Part II.—PHYSICAL SCIENCE.

No. I.—1867.

Experimental Investigations *connected with the supply of* water *from the Hooghly to* Calcutta, *Part II, being Supplementary Observations; by* David Waldie, *Esq. F. C. S. &c.*

[Received 28th September, 1866.]

In the preceding remarks I have directed attention to the discrepancies between my own results as to the quantity of organic matter by weight in the Hooghly water and those given in Dr. Macnamara's Report, and I have also made some pointed observations on the very doubtful accuracy and unsatisfactory nature of the results generally given by chemists respecting organic matter in waters, except some of the most recent. For though I have found that the process detailed in the previous part of my paper is older than I then supposed, having been recommended by Mr. Dugald Campbell in 1856 as suggested by Dr. Clark,* and that an analogous plan was given by Abel and Bloxam in 1854,† though imperfect, yet these plans seem either to have been little known, or neglected, or imperfectly carried out. Some analysts indeed of later date do not even attempt to estimate the amount of organic matter at all, apparently despairing of reliable results. But the process given, I believe, yields the most trustworthy results hitherto obtainable, if properly performed.

* Journ. Chem. Soc. Vol. IX. 1856, p. 51.
† Handbook of Chemistry, 1854.

But if the estimation of the organic matter in waters is to be of any value at all as a means of judging of their salubrity, it is essential that it should be done accurately. If it is to be a fundamental datum on which Municipalities are to choose or reject certain waters for the supply of large towns, that sanitary boards are to draw conclusions from as to the healthiness of certain localities for the residence of troops or other collections of human beings, and on which medical men and hygeists are to reason respecting the origin of disease or the maintenance of health, it is unnecessary to say that it ought to be ascertained in a reliable manner.

In the case of my own results, differing so widely from those referred to, the question occurs, is there no way of accounting for them or reconciling them? One cause has been suggested to me independent of correctness of method of analysis or of accuracy in its execution, namely the age of the water when examined, that is the length of time which had elapsed since the water was taken from its source. High chemical authority has been adduced for the necessity of setting about the analysis with the least possible delay, on account of the chemical changes which the water would undergo by keeping, which would result in a diminution of the quantity of organic matter present. The validity of the caution I am not disposed to deny, neither am I prepared to deny that in my own operations this point was not always sufficiently attended to. Indeed it had not particularly attracted my attention; except as regards gaseous constituents the point had not been particularly noticed either in text-books or monographs I had seen, and the consideration that the organic matter collected by rivers had already been freely exposed to decomposing agencies, so that probably what remained was not readily decomposible, confirmed as this was by my own observations while operating, led me not to attach much importance to it. Still it appeared that there might be a change of considerable amount shortly after collection which had passed unnoticed, while afterwards the water remained less liable to change. A small change, experiment shewed, did occur speedily, but the present question did not refer to a small change but to a large one, and it was desirable if possible to ascertain to what amount it might extend. The question principally concerned the waters of the hot season and of the rainy season.

So far as general observation could go, having been engaged in collecting and examining the river water from 1st May to 14th June for the purpose of ascertaining the amount of tidal contamination, I had abundant opportunities of judging of the physical characteristics of the water and observed nothing particular except a comparatively slight, somewhat fetid smell, which contrasted distinctly with the very decidedly worse smell of the water after the rains had come on, and of which the personal use of the river water gave me a vivid illustration. Other differences I have already noticed in the earlier part of the communication, all suggesting the greater proportion of organic matter in the water of the rainy season, at least in the earlier part of it. Moreover looking to the absolute weight of organic matter, I had only found even in the worst of the tanks, when their water was low and putrid, four or five grains in 100,000 fluid grains of water, equal to rather less than three or four grains per gallon ; while the river water at any season was much superior to these in smell and colour, even during the rains, that is after the mud had settled.

Yet as these observations might not be sufficiently precise, experiments were instituted to endeavour to determine the question. The oxidation of the organic matter by permanganate of potash offered the readiest and easiest way of examination, and was applied to various samples of water, more particularly to determine the rapidity of change after collection. And it did indicate a rapid change even in course of a day or two, indeed the greatest amount of change took place within the first 24 hours. But it has already been pointed out that this test indicates the proportion only of certain kinds of organic matter, and gives no information as to the total amount. It may even indicate more oxidizable matter after the amount by weight of organic matter has diminished, as was really the case in some of the experiments made. This will be seen in the case of the mixtures in the succeeding table, in which the proportion of oxidizable matter diminished for the first few days, and then increased decidedly, afterwards diminishing again. In No. 3 mixture it increased to a large extent up to time of writing this, and no doubt would diminish afterwards. The great extent of change in this case is accompanied by a great diminution in weight.

The question at issue, however, was the amount by weight of organic matter present. It was impossible of course to get the hot season water in its original condition, but experiments could be made with river and tank water, and with mixtures intended to imitate the real or supposed peculiarities of hot season water. These could be examined to ascertain the amount of change produced on them by keeping. Accordingly experiments were made the results of which are exhibited in the following table.

Date of collection or preparation.	*Date of Expt.*	*For 100,000 fl. grains W.* *Organic matter. Grains.*	*Oxygen reqd. Grains.*
	Calcutta Sewage Water.		
13th Sept. 1866,	13th Sept.		2.300
	14th		2.040
	15th	21.80	
	17th		1.470
	27th	10.75	
	Mixtures of River Water with Sewage.		
No. 1, containing $\frac{1}{5}$th Sewage.			
10th September.	10th Sept.	5.44	.535
	11th		.480
	15th		.422
	24th	3.63	
	25th		.624
	*2nd October,		.203
No. 2, containing $\frac{1}{12}$th Sewage.			
11th September.	11th Sept.		.245
	12th	2.18	
	15th		.163
	24th	1.88	
	25th		.441
	*2nd October,		.353
No. 3, containing $\frac{1}{8}$ Sewage and $\frac{3}{8}$ Barn. Tank Water.			
18th September.	18th Sept.	6.05	.420
	26th	2.65	.725
	*2nd October.		1.938

* Introduced after date of paper.

Date of collection or preparation.	*Date of Expt.*	*For 100,000 fl. grains W.* *Organic matter. Grains.*	*Oxygen reqd. Grains.*
	Cornwallis Square Tank W.		
14th May, 1866.	June	5.15	
	21st May,		.209
	20th June,	4.40	
	11th August,		.155
	6th September,	4.37	
	Baranagar Tank W.		
15th September.	15th Sept.		.350
	17th	2.38	
	29th	2.16	.256
	*2nd October,		.228
	Dalhousie Square Tank.		
18th September.	19th Sept.	1.59	.100
	29th	† 1.89	.070
	River Water.		
8th August.	17th August,	1.08	
	25th Sept.	1.01	
18th September.	18th		.085
cleared by	19th	1.69	.044
Acid	29th, more than	‡ 1.36	.046

The Mixtures were composed of river water of the hot season three or four months old and of recent river water with a little Salt Lake water, No. 3 containing also Tank water; with these were mixed the specified proportions of sewage water which had been collected on 8th September, and, as tried on the 9th, contained 27.33 grains organic matter in 100,000 fl. grains.

It will be observed that in the organic matters oxidised by the permanganate of potash there is a distinct diminution early, even by the lapse of a single day, as indicated by the smaller quantity of oxygen

* Introduced after date of paper.

† Evidently an error of Expt. The organic matter could not increase.

‡ Exp. faulty. Enough of Carb. Soda had not been used. Result could not have been less, but probably would have been greater, had it been correct.

required subsequently; afterwards the diminution is slower, or in some cases even an increased quantity of oxygen may be required, from changes taking place in the water causing the production of a larger quantity of readily oxidisable matter. This therefore gives no indication of the weight or actual quantity of organic matter present. The weight of organic matter ascertained by experiment however, indicates in some cases a rather rapid diminution at first. But this is only to a small amount, except in the case of highly decomposable or putrefying liquids, such as sewage or mixtures containing much sewage. Calculation will show that the loss of weight of organic matter in mixtures Nos. 1 and 2 is less than would have been sustained by the constituent proportion of sewage water in them. In No. 3 probably the vegetable matter of the Tank water added caused the more rapid and extensive decomposition.

The loss of weight in the mixture No. 3 is 3.4 grains in 8 days, being fully more than half of the original amount; in Nos. 1 and 2 it is only only 1.8 grains and 0.3 grain respectively.

But the river water at no time could contain anything like the proportion of sewage that these mixtures did, such as one-fifth, one-eighth or even one-twelfth of sewage, the smell alone of such mixtures makes the supposition quite inadmissable; besides a comparison of the size of the river with the amount of drainage of the town would show that such a proportion was quite impossible. The amount of liquid discharged by the drains compared with the volume of water in so large a river must be insignificant.

But instead of citing results of my own, which if incorrect may be supposed to be all equally incorrect, it may carry more weight to quote the results of others. The older determinations of organic matter are generally of no value whatever, and I shall refer only to the most recent and trustworthy. I have already quoted Dr. Frankland's results with the London waters, but as all these are of water filtered for distribution they may be considered not quite comparable. Another example I shall adduce from the paper of Lawes and Gilbert in the Journal of the Chemical Society already quoted. They give tables of the composition of the Rugby sewage from May 1862 to October 1863, shewing that it contains in solution from 7.6 to 8.35 grains per gallon, and also a statement of the amount in the River

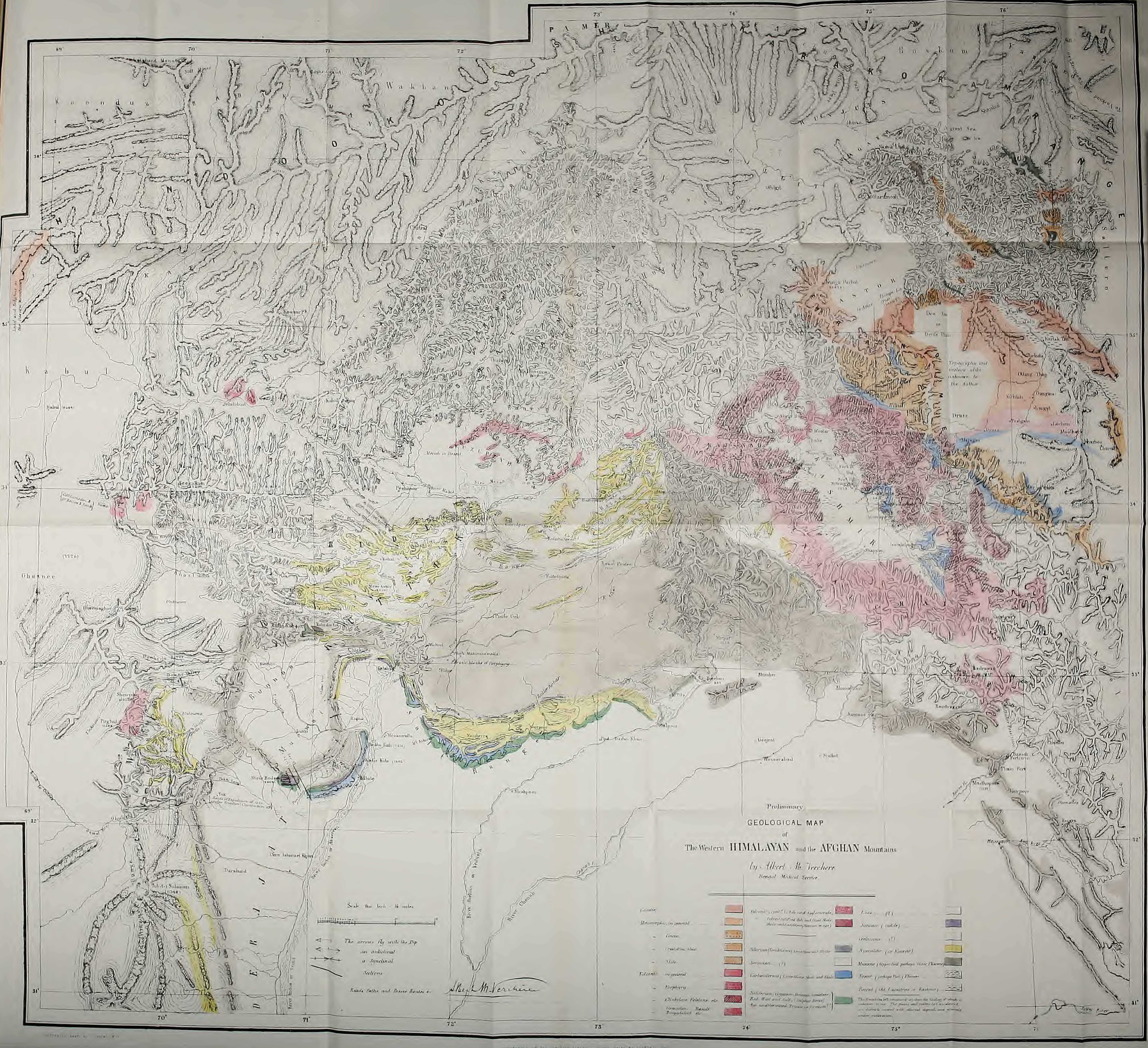
Wandle before receiving the Croydon sewage which is 1.44 grains per gallon, and after receiving it which is 2.08 grains per gallon. According to this the estimates of organic matter to the extent of 8 or 10 grains per gallon in the Hooghly water during May and June shew that it contains fully more than the liquid part of the Rugby sewage, and this in a tropical country.

I do not wish it to be understood that I maintain the perfect accuracy of my own results. The oversight in not examining the samples speedily enough after collection must be admitted, though from all that I have been able to learn from the experiments instituted for the purpose, the error cannot be a great one. There was no great delay in examining the water of the hot season,—about ten or twelve days, and this caused by the time and attention taken up in examining the influence of the tides in numerous samples. There was greater delay with the water of the rainy season, probably about a month with the first samples in July, about a week or 10 days with those of August. This was caused by waiting for the settlement of the very finely divided clay, the presence of which was very unfavourable to the accurate estimation of the organic matter. Recently I have found that the addition of a small quantity of hydrochloric acid causes the mud to settle so rapidly that the water may be filtered clear in course of a few hours: solution of potash or soda and milk of lime do the same, but the water cleared by these reagents seems to contain a different proportion of organic matter than that cleared by simple subsidence. It is of less importance, as the question at present is not respecting the water of the rainy season. The samples of December and February water circumstances prevented me from proceeding with, and they were preserved in stoppered bottles and probably not much done with them till April. The results are consequently more doubtful, though I do not suppose that they are very wide of the truth. As the season advances, should circumstances admit of it, I shall not fail to repeat the analyses, in order to get unobjectionable results.

The observations made during the last month enable me to add a little to my former statements respecting the effect of the change of seasons on the river water. The increase of organic matter from the rains seems to be chiefly of the more soluble and putrescible kinds; as the season has advanced, the fetid smell has materially diminished. This is indeed to have been expected: the soil has been washed comparatively clean, and there is less of such matter to wash away.

The only possible way in which my results as to the small quantity of organic matter in the water of the hot season (supposing there is no great error in the analysis) can be reconciled with the results of those analyses that give it as equal to 8 or 10 grains per gallon, would be to suppose that the water at that season contains a large quantity of organic matter having no very offensive smell, but capable of very rapid decomposition, so that about $\frac{7}{8}$th to $\frac{9}{10}$th of it would be lost during the first two weeks. Without denying the possibility of this, I can only say that I know of nothing that makes it probable that such is the case, while I have already given reasons for believing that no such state of matters exists. Further observation and experiment can alone decide the question beyond doubt; while I may remark that if such be the case, it will be a fact well worth noticing and establishing.

It may also be observed, that as in the case of supplying towns the water must always be stored for a time in tanks or reservoirs, it is a point of some importance to note the changes which it undergoes by keeping in these circumstances. I have made some observations in the course of these enquiries suggestive of further investigations on this subject, and which may also have a bearing on the purification and preservation of such waters, a subject which has lately been occupying much attention in England. It is obviously a possible thing that one water may be putrefying but its putrescibility nearly exhausted, while another may be highly putrescible, and yet its actual putrefaction may be only about to commence. As regards the preservation of waters too, it is one thing to keep them in stoppered bottles, and another thing to keep them in tanks. It seems to me questionable if they improve in tanks as they do in glass bottles. It is by following out such inquiries that advance in knowledge of such subjects is attained, and in the present case the activity of chemical changes produced by the high temperature and the regularity of the seasons are in no small degree favourable for carrying them to a successful result.



Preliminary
GEOLOGICAL MAP
of
The Western HIMALAYAN and the AFGHAN Mountains
by Albert M. Verchere
Bengal Medical Service
Kabul
Wakhan
Peshawur
Ghuznee
Sialkot
Wuzeerabad

Kashmir, the Western Himalaya and the Afghan Mountains, a geological paper by Albert M. Verchère, *Esq.,* M. D *Bengal Medical Service, with a note on the fossils by* M. Edouard de Vernueil, *Membre de l' Acadèmie des Sciences, Paris.*

(Continued from page 203, of No. III. 1866.)

Chapter III.—*Cursory Survey of the several chains of the Western Himalaya, the Afghan mountains and their dependencies. Preliminary geological mapping of the Western Himalayan and Afghan Ranges.*

59. It is intended, in this chapter, to give, in as few words as possible, an idea of the general geology of the several portions of the Western Himalaya, the Afghan mountains and their respective dependencies. In doing so, I have availed myself of all sources of information which have been opened to me; I have, however, been sadly in want of the help of a more extended library, and I have never seen some excellent works which would have much improved this chapter, if they could have been consulted. I need therefore hardly say that it is a most superficial of surveys; but I hope nevertheless that it may be found to contain a few interesting observations and some new matter yet unpublished. Such as it is, it will enable us to sketch at least the first preliminaries of a geological mapping of the Himalayan and Afghan Ranges; and also to attempt, in the last chapter, to draw the history of the mightiest mountainous mass of our globe.

By reference to the map and and to the long Section (Sect. G) it becomes evident that the Himalayas are a succession of more or less regularly parallel chains, having a general N. W. to S. E. direction. Between the chains are situated valleys which are elevated above the sea in proportion as one nears the centre of the mountainous mass: thus the Rawul Pindie plateau, between the Salt Range and the Sub-Himalayan hills, is about 1700 feet high; Poonch valley, between the Sub-Himalaya and the Pir Punjal chain, is under 4000 feet; Kashmir between the Pir Punjal and the next chain (called in the map Ser and Mer chain), is above 5000; Ladak between the Ser and Mer chain and the Kailas chain is 10,000 to 11,000; Nubra and the valley of the Shayok, between the Kailas and Korakoram chains is a plateau nearly 15,000 feet high. It is probable that on the other side of the Korakoram chain the elevation diminishes and that the Aksai chain and the valley of the Yarkandkash river, between the Korakoram and Kuen-Luen chains, are about 10,000 feet high; beyond the Kuen-Luen is the province of Kotan which has been satisfactorily determined by its vegetation to be no more than 5000 feet high.

We have therefore a series of steps rising from the plains of the Punjab to the high plateau of Little Thibet, and descending from Little Thibet towards Turkish China. These steps are supported by parallel chains or walls which tower by some thousands of feet above the plateaux which they support. These chains offer a considerable impediment to the flow of rivers towards the plains, and most rivers have a considerable course parallel to the direction of the chains, before they can find a gap to pass through.

The Afghan mountains present the same arrangement as the Himalayas; the direction is from the N. E. to S. W. the direction of parallel chains is less well marked than in the Himalaya, but this is probably due to the little which is correctly known of the topography of these mountains. The plateaux are similarly graduating: Bunnoo being about 1200 feet above the see, Kabul 7000 feet, Kaffiristan higher, whilst the plateau of Koonduz, on the other side of the Hindoo Koosh, slopes gradually towards the west. This arrangement by plateaux is the same as is seen in the Andes with their high central chain and their plateau between that chain and the Cordilleras.

From the hypothesis, advanced in the next chapter, of the manner the Himalayan and Afghan mountains were upheaved, we will deduct which of the lower hills belong to the Afghan and which to the Himalayan mass, and I will therefore not discuss this subject here, as it would but lead to useless repetitions. I shall begin with the hills which one first meets crossing out of the alluvial plain of the Punjab, as he travels north from Mooltan; and I shall take the parallel regions of the Himalaya one after the other, noticing as I go on whatever little I know of the geology of the Afghan mountains in the same latitude.

60. In latitude 32° 10′, longitude 70° 50′ to 71° 20′ rises the double chain of the Kafir Kote range or Rotta Roh and the Sheikh

Bodeen range. A small valley, the Paniala valley, separates the Rotta Roh range from the Sheikh Bodeen range, and the direction of both small chains is from the N. E. to the S. W. as far as the highest summit of Sheikh Bodeen, whence westwardly the Rotta Roh altogether disappears, and the Sheikh Bodeen range is continued by a small and low ridge of hillocks directed towards the W. N. W. and supporting the plateau of Bunnoo. (See map.)

The Rotta Roh is mostly composed of carboniferous limestone. The Zeawan bed is well developed, but extraordinarily disturbed; it is a yellowish rock, often very sandy. It forms the base of the hills on the E. and S. E.

Dr. A. Fleming sent home some fossils from Kafir Kote, which were ascertained by M. de Verneuil to belong to the following species :—

Productus cora (D'Orb.) ; *Productus costatus* (Sow.).
Productus Humboldtii, (D'Orb.) *Spirifer?*
Dentalium ingens, (DeKönig).

All the species of which I have given drawings in Pl. I, III, and V, were found in the Rotta Roh limestone, with the exception of the Spirifer like *S. trigonalis.** Several species of corals, either not found at all or very rare in Kashmir, were found abundantly in the lower beds of the Rotta Roh ; but altogether the fauna of the Zeawan bed in Kashmir and in the Rotta Roh is so very similar, that it can be called identical.

The limestone rests† on a quartzite rather peculiar in some localities. It is composed of opaque white quartz in which are imbedded plates of pearly white mica half an inch wide ; these plates of mica are arranged in tufts; there are also some irregular nodules or granules of black augite (?) quite lustreless (see fig. 74, pl. IX). There can be

* A distinct species of Sp., according to Mr. de Verneuil.

† I failed to find the bed of quartzite in situ; my examination was much more superficial than I could wish. But it is hardly to be wondered at that the quartzite beds are not found in situ, if we consider the wonderful state of confusion the beds are in. The limestone is in an extremely shivered condition, having been thrown into stray arch-like anticlinals separated by numerous faults. The shivering of the beds often goes so far that it is difficult to ascertain the dip and strike of the beds. In such convulsions as those which must have taken place in these hills, the brittle and fragile beds of quartzite must have been entirely broken, and are therefore not to be seen in situ at their outcrops, but are only indicated by the fragments into which they were reduced. In several localities the ground is covered with angular pieces of quartzite, either with mica as described in the text, or plain and opaque.

no doubt that this micaceous quartzite represents the bed of quartzite which we have seen invariably underlying the Zeeawan bed in Kashmir. The beds of volcanic ash which it probably covers are not exposed in the Kafir Kote Range.

The Zeeawan bed of limestone is capped by very extensive and thick beds of Weean limestone rich in goniatites, in mussel-like anthracosiæ, in *Aviculo-pectens* and other characteristic fossils. I found some blocks of the sandy limestone in which the *anthracosiæ*, *solenopsis* and *A. pectens* are generally found, containing one specimen of *Productus semireticulatus*, several *Athyris subtilita* (Hall) and *A. Royssii* (L. W.), and also the *P. Bolivicutis* (D'Orb.) mixed up with the *anthracosiæ* and *A. pectens*, a mixture of Zeeawan and Weean fossils which I never saw in Kashmir. Some very large bivalves of which debris had been found in Kashmir and resembling an aviculoid inequilateral *pecten* were also found; the transverse diameter is 7½ inches. Fine *nautilides* and spines of *cidaris* six inches long were also found. In the Rottah Roh the difference between the Zeeawan and Weean beds is not everywhere so well marked as it is in Kashmir, as I have just exemplified; generally, however, the assemblage of fossils given in the plates as characteristic of the beds is the same as it is in Kashmir.

In the northernmost end of the Rottah Roh, the Zeeawan bed does not appear, and is only represented near Kumdul by a few small mounds of debris rising through the sandy plain close to the foot of the hill. As we travel south and approach the Kafir Kote river, the Zeeawan bed appears under the Weean, and can be traced without interruption as far as the southern end of the hill a few miles from Paniala. It is impossible to give the dip and strike of the Zeeawan bed, as not a hundred yards of it keeps the same direction; the broken fragments of the bed are more like packed ice in the polar seas than like courses of rock in a hill. The Weean bed above is much less disturbed, except the deepest beds which rest immediately on the Zeeawan; it dips generally N. W. with a very trifling angle varying from 20° to 8° or 9° with the horizon; occasionally the dip becomes W. and even S. W.

I have not seen any beds in the Rottah Roh similar to the Kothair bed of Kashmir.

At the northern end of the Rottah Roh, the carboniferous limestone is immediately covered in by a Miocene sandstone and conglomerate. A little further south, some beds of reddish limestone and some sandstones, grey and bituminous, are either the top of the carboniferous or possibly Permian or Triassic beds. The fossils are very scarce and mere debris. The sandstone contains thin layers of a shale which is full of carbonized remains of plants, and from the sandstone, near the shale, a black bitumen oozes out. It is a mineral pitch or impure petroleum ; the quantity is insignificant.

As we continue to travel south and west, we find the Weean bed forming the top of the hill the whole way ; with here and there patches of gypseous marls, red marl, grey sandstone and variegated thin-bedded non-fossiliferous limestone, or rather dolomite, which are in all probability Triassic, but which will require much more careful study than I have been able to give them, before they can be satisfactorily classed. I believe them identical to the red marl and gypsum of the Saliferian formation of the Salt Range. Close to the village of Paniala these supposed Triassic beds are well developed, and from them issue some saline hot springs. Near Gunga, at the other (northern) extremity of the little Range, a patch of these same gypseous sandstones and marl appear at the end of a fault in the carboniferous limestone, and from these supposed Triassic beds two or three small hot and saline springs issue. It is a remarkable fact that everywhere in the Himalaya and in the hills of the Punjab, where these gypseous marls, red marls, sandstones and dolomites appear well developed, they are generally accompanied by saline springs, usually hot.

At the northern extremity of the Rottah Roh, over the village of Kundul, we have seen that the Weean limestone forms the bulk of the hill. Under it, at one place, is found a feldspathose sandstone invaded by tortuous veins of quartzite ; it has acted powerfully on the limestone near it, this being much metamorphosed, cellular, traversed in all directions by thick bands of crystalline carbonate of lime, and all fossils being obliterated or changed into a lump of spar. The feldspathose sand has the appearance of having been forced between the broken ends of the beds of limestone which is thrown into an anticlinal ; it is generally white, occasionally coloured

red in patches; it is not stratified, but mammilated, globular, irregular, and branching like a dyke. This intrusion of a feldspathose solution or paste took place before the final upheaval of the Himalayas, as there is evidence that some of the beds have been redisturbed by this upheaval, and as the Miocene conglomerate which partially fills the fault is unconformable to the limestone. A full description of this locality would be complicated, and I have no intention of giving here such a description. I merely want to point out that we have here Weean beds disturbed and baked by a geyserian action, similar to that which we have seen at Ishlamabad and at the Manus Bal.

61. The Sheikh Bodeen Range is mostly composed of miocene sandstone, clay and conglomerate. These beds are thrown into an anticlinal, the south-eastern and southern slopes dipping to the S. E., and the S. and the north-western and northern slopes dipping N. W. and N. One can see, from the top of the highest summit, that deeper rocks have endeavoured to push their way through the miocene, the beds of sandstone and conglomerate being arranged in semi-theatres on both sides of the points where an underground mass has endeavoured to break through. But everywhere these underground masses have failed to find a way to the surface except at one point, *viz.*, the Sheikh Bodeen summit, in the centre of the Range. This summit is 4604 feet above the level of the sea, whilst the Miocene range does not reach higher than 2800 feet and is generally very much lower. There is evidence that the Miocene was at one

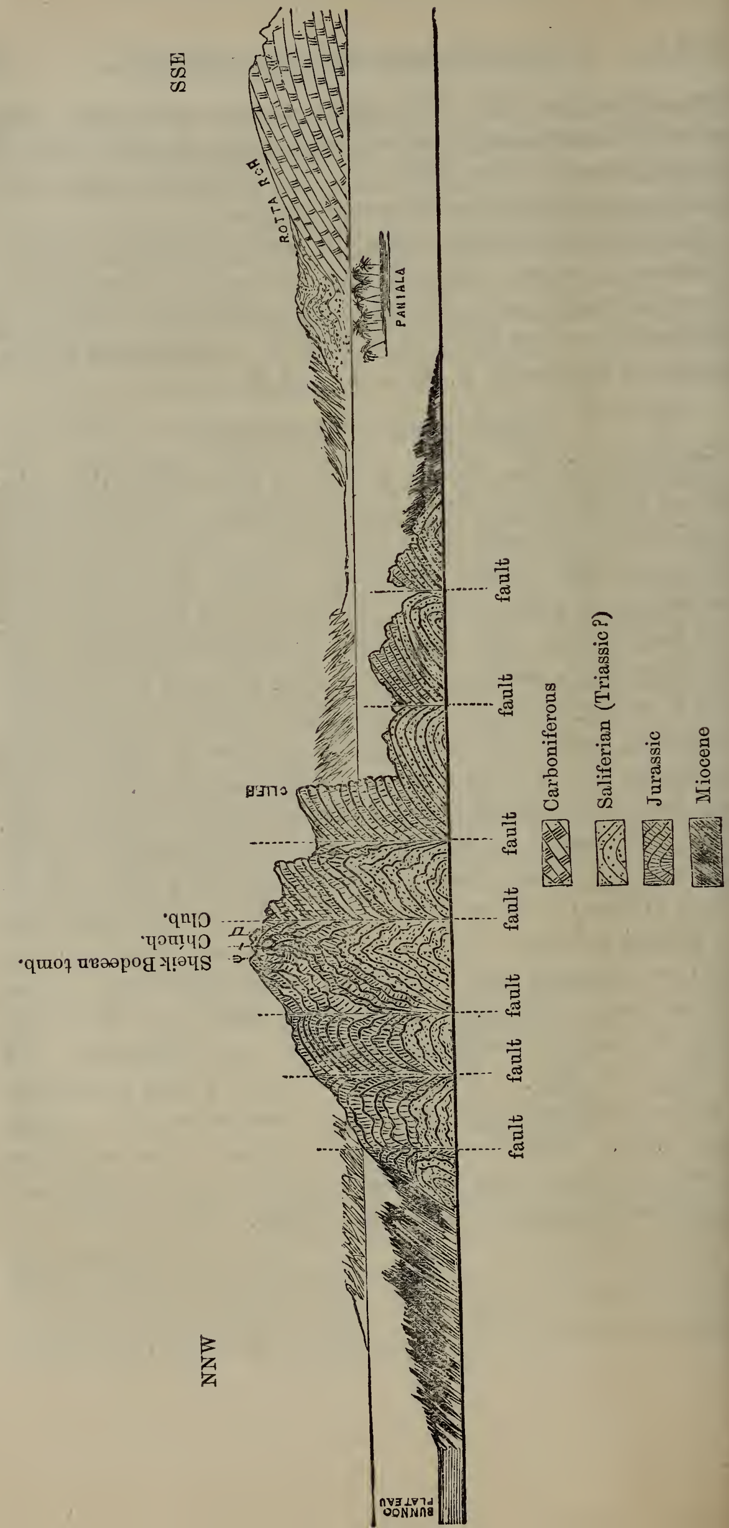
Horizontal appearance of the Miocene beds, Sheikh Bodeen range.

time much higher and reached to within 8 or 900 feet of the summit of Sheikh Bodeen. But the friable sandstone and loose conglomerate disintegrate very quickly, whilst the limestones of Sheikh Bodeen summits decay but slowly; hence the Miocene portions of the Range have become low hills, whilst Sheikh Bodeen summit has nearly retained its original height, and appears therefore to stand now as an isolated summit in the middle of insignificant, low, barren and crumpling sandstone and conglomerate hillocks.

Sheikh Bodeen hill (not range) is mostly composed of Jurassic limestone, excessively shattered from having been thrown into a succession of very sharp anticlinals. The anticlinals are separated by faults which run from W. S. W. to E. N. E. The following diagram sections are from the N. N. W. to the S. S. E.

Sections V and VI General Map.

The section in the distance is about a mile north of the section through Sheikh Bodeen Hill. Jurassic limestone is at least 800 feet thick; it is rich in fossils which are, however, seldom well preserved. The lower beds contain Belemnites, Ostreæ, Rhynchonellæ and Terebratulæ in great abundance, especially in and near some ferruginous sandy beds. Shaly beds are full of petrified branches of trees. The limestone is sandy and impure; along the great cliff facing the S. S. E. and formed by the removal of half the arch of an anticlinal (see section, marked cliff) some very fine specimens of ripple-marking are exhibited on a large scale. *Ammonites* are also found, but very much broken. *Cariophyllides* and an *Astræa* are the commonest corals. Two or three species of *Pholadomya* are tolerably abundant. In the uppermost beds I have found a *Nerinæa*, very likely the *N. Bruntrutana* (*Thuma*) of the coralline. In both the lower and upper beds the mineral characters appear to be identical, and many species of fossils are common to both, especially *Rhynchonellae*, of which no less than ten species are abundant. In the lower beds I have found eight species of *Terebratulæ* with short loops, or true *Terebratulæ*. The *Belemnites* are three or four species, of which a thick one like the *B. sulcatus*, a grooved species like the *B. canaliculatus*, and a *hastate* species like the *B. hastatus* are the most abundant. Gasteropods are extremely abundant in some beds, most especially a species of *Acteonina*; a few encrinite stems were found, but no heads.


SSE
PAHIALA
fault
fault
fault
fault
fault
fault
fault
Club.
Chinch.
Sheik Bodeean tomb.
Carboniferous
Saliferian (Triassic?)
Jurassic
Miocene
NNW

From this fauna it appears therefore that the limestone of Sheikh Bodeen* is equivalent to the Oxfordian formation of England, and that the uppermost beds are contemporary to the English Coral Rag or rather to the *Calcaire a Néimaes* of the Zena. We shall see presently in the country of the Wuzeerees, beds which are, in all probability, the equivalent of the Coral Rag. Some of the Oolitic shells collected by Dr. Gerard in Spiti are represented in Dr. Royle's Illustrations of the Botany and other branches of the Natural History of the Himalayan mountains; the drawings are by T. Sowerby and are remarkably good. The form numbered 17 in Royle's plates and described as an Arca or *Cucullœa* is found at Sheikh Bodeen; the *Rhynchonellœ* 20 and 21, described as *Terebratulæ* or *Atrypæ*, are common at Sheikh Bodeen; the two species of *Ammonites*, figs. 22 and 24, are also found at Sheikh Bodeen, as well as the two species of *Belemnites* represented figs. 25 and 26 and fig. 27. The fig. 23, called a *Delthyris*, has also been found at Sheikh Bodeen, I believe, but I do not possess a specimen of it.

The *Rhynchonella* represented by Royle and which is common at Sheikh Bodeen, has also been found in Rukshen by Captain Austen.

The Jurassic limestone of Sheikh Bodeen rests in variegated dolomitic limestone without fossils (?), red marls, gypseous dark marls, and feldspathose white sandstone extremely friable; and this formation appears identical to the Saliferian formation of the Salt Range. From these lower beds issue a few small springs of brine, and it is, probable that masses of salt exist here and there in the marl, as it does in the Salt Range, but nowhere does the salt crop out. Some beds of massive gypsum occur on the southern side of the hill near its base, but are not extensive. The Oolitic and Saliferian formations conform in all their folds, faults and twistings most perfectly, but there is a slight nonconformity between the Saliferian and Oolitic beds and the Miocene sandstone and conglomerate. The Saliferian and Oolitic formations had been upheaved to some extent before the Miocene began to be deposited, as boulders of gypsum and Oolitic limestone are found in the Miocene conglomerate in company with boulders of volcanic rocks, of nummulitic limestone, of carboniferous limestone, and with rolled *Producti* brought from the Bilote Range. But the

* A few fossils of Sheikh Bodeen are sketched at Plate XI. figs. 2 to 6.

hills formed by the first upheaval were so low, and their beds probably so near the horizontal position, that the non-conformity of these beds and of the Miocene beds is not now very apparent, both sets of beds having been redisturbed to a great extent by the final great upheaval of the Himalayan mountains.

62. In the country of the Wuzeerees, lat. N. 32° 15′ to 32° 45′ and Long. E. 69° 45′ to 70° 15′, we find the continuation towards the north of the Soolimanee Range to be formed of a chain of mountains of which the Pir Gul (11,583) and the Shewy Dhur (10,998) are the highest summits. These high summits were not ascended by the expeditionary force against the Mosood Wuzeerees in 1860, but the army marched along the fine plateau of Rusmuk (7,000 ft.) which skirts the main chain; and by collecting the pebbles of the torrents which descend from these high peaks I was enabled to estimate to a certain extent the mineral nature of the central ridge. These pebbles were all volcanic, trappean and metamorphic, and none of a granitic nature were found. The following specimens of rocks were collected in ravines descending *directly* from the Shewy Dhur: basalt, having the appearance of hard jet; it is divided by joints and by innumerable cracks filled with carbonate of lime. It fuses quietly before the blow-pipe into a black bead. Some varieties do not shew the cracks filled with carbonate of lime, but are schistose in appearance, and the joints, which are large, are lined by quartzite. Half inch thick plates of volcanic ash, composed of a central layer of a pale dirty-greenish and compact mineral, and external layers of a brownish granular substance. The central layer fuses very easily before the blow-pipe, boiling up into a swollen and blistered surface; it has the appearance of tremolite, the outer layer appears to be a mixture of tremolite with grains of augite; the augite here and there forms little masses, and these fuse partially, the assay becoming studded with minute dark globules. Hornblende rock with grey mica. The paste appears to be an intimate mixture of felspar and hornblende, and is invaded by irregular and small plates of grey mica; the rock is divided by a series of well-marked joints, an inch apart. An augitic porphyry; the paste is perfectly black and apparently composed of chatoyant augite; it is invaded by closely set and minute prismatic crystals of dull white albite; it is more like a porphyritic lava than like a true prophyry.

A metamorphosed micaceous limestone, schistose, the foliation being extremely wavy. It has the appearance of a thin-bedded micaceous and calcareous shale which had been both crumpled and highly metamorphosed. It is nearly entirely composed of exfoliating mica imbedded into grey bands of magnesian (?) carbonate of lime, which effervesces feebly, and other bands of white felspar. The felspar forms bands by itself, a quarter of an inch thick and free of mica. The rock exhibits a foliation or stratification which is thin-bedded and wavy. Greenish, soapy, spotted chlorite schist. Jaspery flint, bluish and transparent, with veins and patches brownish and opaque, and occasionally threads of milk-white quartz. Quartzite with well formed crystals, six-sided prisms, at one end terminated by a six-sided pyramid.

These rocks are therefore mostly volcanic; the four last are, however, metamorphic, and such rocks are not seen in Kashmir; but they are extensively developed in the most northern portion of the Himalaya, as in Skardo, Zaskar, &c.

63. Between the range of the Pir Gul and Shewy Dhur and the plains of the Derajat, is a thick belt of low hills which are nearly entirely made up of nummulitic limestone, slate and shales, and of Miocene sandstone and conglomerate. At Palusseen, however, (see map) under the nummulitic limestone is discovered a rock of a very hard and dirty appearance and not forming beds, but huge masses of flesh-coloured limestone which are imbedded either in a grey sandstone or in the lower beds of the nummulitic limestone. These masses are most evidently old coral reefs, once rising from the bottom of the sea and ultimately covered by sand and calcareous mud; they are a confused agglomeration of corals of many species, imbedding shells, but unfortunately neither corals nor shells are in a good state of preservation. I am not sufficiently familiar with the forms of the Coral-Rag of England to say whether this bed is its representative in India, but it is not unlikely to belong to secondary strata, for the following reasons.* 1. It is situated under the sandstone, which generally forms the base of the nummulitic formation. 2. It does not contain any of the

* A coral reef formation, apparently closely analogous both in lithologic characters and mode of occurrence, occurs at the base of the Ootatoor division of the cretaceous rocks in Trichinopoly. See Mem. Geological Survey, Vol. IV, Pt 1, pp. 52-72.—*Ed.*

fossils found in the nummulitic limestone above. 3. It appears much disturbed and dislocated by local movements, whilst the nummulitic limestone is to be seen in regular, though much tilted-up beds above it. 4. It rests immediately over beds of red marl and gypsum which are always found, in the Punjab, where Oolitic beds occur much disturbed. 5. Some of the corals appear identical with some species found near Maree on the Indus, in a limestone containing the same fossils as those of Sheikh Bodeen which is decidedly an Oolite.

I have therefore, in consideration of these reasons coloured these beds as Oolitic, but there is a doubt about it. The country was so dangerous at the time we were encamped at Palusseen, that I could collect but very few fossils, and I have not yet had the good luck to discover a similar bed in British territory.

These coral reefs reappear in many places in the country of the Wuzeerees: at the entrance of the plateau of Rushmuk a great quantity of this bed was again seen, but the rock was different, though the fossils were identical; the limestone was extremely impure, full of small rounded grains of gravel, and so much invaded by iron that it is often quite brown, and often also spotted by the iron forming little dark nodules in the mass.

Again, near the hot spring of Sir-Oba, similar beds were seen resting on red marl, with here and there masses of gypsum. This gypsum is opaque, white and compact, and contains a great number of crystals of quartz, very fine in their form, and terminated at both ends by a six-sided pyramid. The same crystals occur at Maree and Kalabag in the gypsum which accompanies the rock-salt of these localities, and are there collected and sold to natives as ornaments, under the name of Kalabag diamonds.

One of the members of the nummulitic genus in the Wuzeeree Hills requires notice on account of its economical value. The Wuzeeree iron is obtained by the smelting of a brown shale, extremely rich in brown hæmatite; the beds of the shale are situated under the nummulitic limestone, and seem to replace the extensive beds of slate, with nummulites, seen in other localities. The quantity of the ore is enormous, whole ridges being formed of it. It is not quarried, as far as I could discover, but merely broken off the surface of the beds. It is first roasted, and becomes black and highly magnetic. It is then worked either with nummulitic limestone or pieces of the coral-reefs and smelted with charcoal in small furnaces identical to those seen in Kashmir. I found at Mackeen a house with two of these furnaces and heaps of charcoal, of iron-ore and of limestone, evidently collected for smelting, and I could thus identify the ore used by the Wuzeerees, though no information was to be obtained from the people. I have had, since, pieces of ore brought to me, at Bunnoo, by the Wuzeerees engaged in trade and who bring the pig-iron to the plains for sale, and it is exactly the same ore which I had seen at Mackeen, and which I had observed in situ as one of the members of the nummulitic formation. This shale is heavy, generally covered with a rusty powder; it varies in colour from reddish-brown to nearly black; it soils the hand, it is not calcareous, and the richest parts of it have a tendency to form concretions, or at least to assume a sort of concentric slaty cleavage. It is only smelted to a paste, not to a fluid, and is refined by hammering. The iron produced is soft and fine-grained, but apt to exfoliate, a defect which is evidently the result of the metal being half worn-out by the extensive hammering to which it is submitted.

The carboniferous limestone was found in situ in Wuziristan. But that such rocks do exist in the hills between the British border and round the central chain of the Afghan mountains, is proved by the boulders in the rivers which drain those countries. Major Vicarey found boulders of limestone containing carboniferous fossils in the streams near Peshawur; Dr. Fleming found "*Productus*-limestone" in the ravines which drain the Solimanee chain towards the east; and I have found in the bed of the Korum, a torrent which drains the southern slopes of the Sufed Koh, boulders of a black limestone containing *Productus cora* and *P. Humboldtii.*

64. In the Salt Range the carboniferous limestone is well developed and attains, according to Dr. A. Fleming, a thickness of 1,800 feet. It begins near Noorpoor in Long. E. 72° 30′, as a thin bed, which increases as it goes towards the west, and attains its maximum of development near Vurcha, in Long. 72°. It decreases again towards the Indus, and is not seen at all near Maree and Kalabag; but on the right bank of the river it reappears about six miles west of Kalabag, and is continued in the Chichalee range and the northern

end of the Speen or Lowa Gur. It appears to be identical, in fossils and in lithological characters, to the limestone of Kashmir. Dr. A. Fleming does not mention its ever resting on quartzite or volcanic ash, but supposes on the contrary that it rests on the Saliferian formation, which he, in consequence of this view, calls Devonian. Whatever little of the carboniferous limestone of the Salt Range I have myself seen, is too much disturbed to allow me to form an opinion; I certainly never saw any quartzite underlying the limestone in the Salt Range; but such quartzite exists in the Rottah Roh, and it is evident that the Rottah Roh carboniferous limestone, and that of the Salt Range are one and the same sheet of deposit, broken and separated by convulsions of a posterior age. This, however, does not prove much either way.

The long controversy about the age of the salt and gypsum in the Alps bids fair to be repeated in the Punjab. The Saliferian of the Salt Range has already been placed by successive observers in nearly every formation from the Devonian to the Miocene! In the Alps, geologists appear to have once become desperate at the fight, and M. Sismonda published in the *Comptes rendus de l'Académie des Sciences de Paris (Vol. III. p.* 113*)* the somewhat startling hypothesis that "in the Alps the shells of the Lias lived at the same time as the carboniferous plants"!!!... It is not a little curious resemblance that in the Maurieune, in Savoy, (the great field of contention,) the gypsum, quartzite, marl, &c., are much disturbed by local foldings and bendings, and appear to be placed under the carboniferous rocks *(terrain houiller).* Fortunately a thin, but very persistent and well-characterised bed, the *Infra-lias,* has enabled the geologists who have best studied this locality, to fix the position of the red marl, red and green shale, quartzite, gypsum, &c., in the Trias, and to show that the apparently inferior position of these Triassic layers was due to such great disturbances and reversions of strata as one may reasonably expect to have accompanied the surging up of mountains like the Alps. Less fortunate or less industrious than they of Europe, we have not yet found the *Infra-lias* in India, and we have not therefore got hold of the thread which led so successfully the Swiss and French geologists to a true understanding of the Alpine Saliferian.

I wish that I could have determined satisfactorily the age of the salt of the Punjab, before forwarding this paper to the Society; but I see at present but little chance of my being able to visit again and study the Salt Range within a reasonable time. My own impression, from what I have seen, is that the Saliferian of the Punjab is Triassic or Permian.

This Saliferian formation, (whatever its age may be,) plays a very important part in the economy of Upper India, and may possibly be made a great deal more of than at present. It gives a supply of salt which pays to the State a handsome revenue; it has been the original source of the Reh or Kullur of the soil, an impure and effervescing mixture of saltpetre, of soda and chloride of sodium, which renders fields barren and thus causes very serious losses to that same revenue. There can be little doubt that it contains some at least of the numerous minerals discovered in the Russian salt mines of Stassfust-Anhalt, and it is very possible that it will one day give some fertilizing material which will more than repay the loss caused by the Reh. It is a fine field for research, and only wants work bestowed upon it to yield valuable results.

Any one who has visited the Saliferian of the Punjab must have been struck by the much disturbed state of the beds. These appear as if they had been raised into a succession of small cones or "boursoufflures," and suggests at first sight the idea of the Saliferian having been at some time or another violently dislocated by eruptive gases and sublimated minerals. This is so marked in some localities that Dr. A. Fleming advances, as a possible hypothesis, that the salt may be of volcanic origin. But the stratification is generally so well defined (the courses of salt being separated by thin layers of red marl or of cellular gypsum) that we cannot regard the salt as intrusive; it is decidedly sedimentary. That the disposition of the salt gypsum, bipyramidal quartz crystals, &c., &c., took place under the influence of heat, due probably to hot springs, is pretty certain. For Charpeutin and de Beaumont have shewn that the gypsum was first deposited as anhydrite, and this anhydrite must of necessity have been precipited from hot solutions; neither do we see how sea water could deposit gypsum, unless submitted to a high temperature; whilst, high temperature being admitted, the precipitation of gypsum becomes easily explained, if we remember Mr. David Forbes's observation in Peru:

"The quantity of sulphates and more especially of sulphate of lime, "included invariably in these deposits, might, at first sight, appear to "the observer too great to suppose it due only to the evaporation of "the sea-water; but I believe that this impression will be dissipated "when he sees the enormous amount of gypsum removed in the form "of hard white cakes or sedimentary crust, from the boilers of the "large distilling machines in use along this arid coast, for producing "from the water of the sea a supply of fresh water for the maintenance "of the inhabitants, beasts of burden, and even the locomotive engines "of the railways along the coast. It appears not necessary to suppose, "as has been put forth, that the sulphates present have been formed "by volcanic exhalations acting upon the bed of salt."* What induces us readily to admit of the existence of very numerous and extensive hot springs during the Triassic epoch in the Punjab is, that even now-a-days the Saliferian formation is remarkable for the great number of hot springs it contains; indeed hardly a hot spring in the Punjab and the Himalaya is to be found unconnected with the Saliferian, and whenever we find Saliferian beds, we generally also find hot springs. This is true of the Salt Range, of the Rottah Roh, of Kangra,† of Rukshu in Thibet, &c. We may therefore conclude from these remarks that the salt, gypsum, &c., is sedimentary, though deposited under peculiar circumstances, viz., the presence and influence of hot springs. How then to account for the very disturbed state of the Saliferian beds, for these limited, local, fragmentary disturbances which give to the beds so elastic an appearance? Two ordinary causes appear to me sufficient to account for this: one is the transformation of the anhydrite into gypsum by absorption of water, a phenomenon which continues to take place now-a-days. This absorption of water and the consequent increase of volume of the gypsum brought about the swelling up of the beds in cones and "boursoufflures." Then the

* "The Geology of Bolivia and Peru," by David Forbes, with notes on fossils, by Professor Huxley and J. W. Saller, Esq., published by Taylor and Francis, Red Lion Court, Fleet Street, 1861, communicated to Geological Society in 1860.

† The saline springs of the Towala Mookhi and of Kangra-basa, in Kangra, issue from Saliferian ranges immediately covered by Miocene beds. Mr. Marcadieu has found that the water of these springs contains Iodine, in addition to the usual saline matter of the springs of the Saliferian formation in Upper India. Vide Report, No. 84, by M. Marcadieu. Sketches of Correspondence, Punjab, 1860.

second cause of disturbance began to act: the beds of salt are often dissolved and removed by water infiltrating through cracks in the rocks; a cavity is thus formed under the vault of rocks which covered in the salt and one day the vault falls in.

This process is to be seen now-a-days in actual existence, on a small scale, in the hillock of Maree on the Indus.

Thus, from the swelling of the gypsum by its transformation from anhydrite to common gypsum, and from the falling in of the vaults formed by this swelling, the beds of the Saliferian formation in the Punjab have a most broken and turned-over appearance.

Add to this that these beds have participated in the convulsions produced by the great final upheaval of the Himalaya, and you will have no difficulty in understanding how difficult it is to make out with certainty the stratography of these rocks, and how it is that the Saliferian appears here and there inferior to the Palæozoic beds. Before quitting the Saliferian formation, let us notice that the beds of it appear to have suffered very great denudation. We can easily understand that the red marl was very easily denuded, when we see how it crumbles into a powdery, friable, fluid earth, after a few days exposure to the atmosphere. It is on account of this denudation, on account of the very considerable amount of material which this formation gave to the Miocene and to the alluvium deposits of Upper India, that the presence of Reh or Kullur in the soil of the Punjab and the North-West Provinces is to be credited to the Saliferian. I shall say a few words about this again, when we explain how the Miocene was made up, in the next chapter.

As there is yet such incertitude about the age of the salt, I have called the formation "Saliferian," without entering it on the Map as belonging either to the Palæozoic or to the Mezozoic epoch.*

The carboniferous limestone is covered in, north of Vurcha, by an Oolitic formation of trifling thickness and containing Oxfordian forms.

* I have purposely avoided insisting on the mineral characters of the Saliferian formation of India, as it is now-a-days the fashion to undervalue very much these characters; but it may be as well to remember that in the Salt Range we have beds of gypsum full of rock-crystals of a bipyramidal shape; that the layers of gypsum are separated by calcareo-magnesian bands, having a cellular disposition (Cargneule of the Swiss, Rankwacke of the Germans) and that the salt is accompanied by a bright red marl without fossils. These several characters are found in the *Triassic* salt and gypsum of Switzerland, of Savoy and of Spain, and, I believe, in no other formation.

As the carboniferous limestone thins out in approaching the Indus, the Oolitic formation increases in importance and forms much disturbed hills, all the way from Moosa Khel to Kalabag. It is continued west of the Indus in the Chichalee Range and the northern end of the Speen Ghur; a little above Moola Khel it disappears under the alluvial, and does not reappear till Sheikh Bodeen, where, as we have seen, it attains a considerable thickness.

65. The salt and gypsum is continued on the west side of the Indus, in the hilly country of the Kuttuks, but it is there much covered by tertiary clays and sandstones. It crops out near Bahadoor Khel and along the course of the Teeree Towe. At the first named place the Saliferian forms an anticlinal arch; the salt, above fifty feet thick, is the lowest bed seen, and is very regularly stratified; above it is a thin bed of red marl, another of grey sandstone, also thin; then gypsum, about twenty-five to thirty feet thick; then a thin band of a limestone with minute debris of fossils, and which resembles lithologically the Oolitic bed of Kalabag and Maree on the Indus; then the dark, brown, sandstone which often forms the base of the nummulitic formation; some coarse and crumbling shales without fossils; and finally, a bed of limestone rich in nummulites, volutes, veneridae, &c., and about ten to twelve feet thick. This is at last covered by the marly lumpy clayey beds of Miocene. A fault running approximately W. E. through the Soordak Pass, has caused an upthrow of the beds on its southern side, and there the nummulitic limestone, much tilted up, forms a pretty high hill.

Along the Teeree Towe the Saliferian is immediately covered by Tertiary. As far as Lachee the rocks seen are Miocene sandstone, clay and conglomerates; thence to Peshawur the country is entirely covered by nummulitic limestone and shale, and the Miocene sandstone is only seen here and there in small detached beds and patches, which are evidently the remains of layers which have been mostly removed by denudation.

66. North of the Salt Range we have also a great extent of Tertiaries. Nummulitic limestone, shale and sandstone first covers in the secondary layers in the western portion of the range, but rests directly on the salt marl and gypsum in the eastern half of it. It attains a great thickness, where well developed, (4500 feet,) and forms

the summits of nearly all the highest hills of the Salt Range. It is continued to within two miles of Maree on the Indus where it thins out, but reappears near Kalabag, and is very well developed in the Chichalee Range and in the Speen Ghur. Near the Indus, all the beds of the Salt Range, excepting the Saliferian marl itself and the secondary strata where much locally disturbed, dip towards the N. E. On the western bank of the Indus, that is in the Chichalee Hills and the Speen Ghur, the dip is W. N. W. or N. W. This last dip is generally that of all the strata of the Kuttuk hills.

The nummulitic formation appears in the Salt Range as a thick belt which, beginning at the Mount Tilla near Jheelum, is continued to near Maree on the Indus, where it disappears for a little space, but reappears on the other side of the river, and is to be seen forming the bulk of the Speen Ghur to near Esokhel. The formation keeps a remarkably similar aspect the whole way. It is, from below upwards, composed* of — 1. Sandstone often coloured by iron, but generally dirty white or pale grey. 2. Very arenacious, thin bedded or lumpy limestone, with gasteropods, few and small nummulites and innumerable debris of oysters or gryphеæ. 3. Shales of various colours, with beds of lignite and of alum carbonaceous shales. The alum shales are only developed where the lignite is situated close to the Saliferian formation, and appear to be patches of lignite metamorphosed. 4. Argillaceous limestone, full of large nummulites, chama, cardita, crassatella, ostrœa, many gasteropods, very large echinodermata, &c., &c. 5. Shales often replaced by a clay-slate containing nummulites. The shales contain sometimes lignite and Rol (alum-shale), but the seams are made less well defined than in the lower shales. 6. Argillaceous limestone, extremely white in some places and containing the same fossils as layer 4; in the eastern portion of the Range it contains flints; it is often fœtid. 7. Chert, hard limestone, weathering rough and pitted; pale yellow or flesh-colour, brittle and

* Occasionally a bed of white soft fragile limestone is seen to form the base of the nummulitic formation. It is characterized by a planorbis which is tolerably abundant; but it contains neither nummulites nor any other fossil. It is found in lenticular beds of little extent, and rarely more than two or three feet thick. It suggests to the mind beds formed in pools or creeks among sandy islands and promontories at the mouth of a river. Whenever it occurs, I have found in the nummulitic limestone above it a great number of teeth and bones of fishes (sharks).

splintery. Shells fewer, nummulites small, but very abundant, especially the *N. variolaria,* whilst the flat and irregular *N. pushi* and *N. lœvigata,* so abundant in beds 4 and 6, are not to be found here, or are at least rare. A nummulite about the size of the *N. pushi,* but thicker, is, however, found pretty abundantly, though not in swarms like the *N. variolaria.* A ribbed cardita is the only bivalve which appears tolerably abundant.

67. Resting on the nummulitic formation of the Salt Range are thick beds of Miocene sandstone, clay and conglomerate. I have described in chapter I. how these sandstones form a great plateau between the Salt Range and the foot of the Maree Hill, and indicated that thay may be considered as the upper Miocene Bed, whilst the Maree Hills and the whole of the mountains between the Jheelum and the Pir Punjal chain are to be regarded as lower Miocene. The upper bed is rich in mammalian fossils, and is identical to the Sewalik formation. The lower bed is devoid of fossils,* containing only a few debris of plants, rootlets, small stems aud occasionally small niduses of lignite. The upper Miocene has probably been a great deal denuded; remains of the bed are, however, to be seen in the valley of Poonch; they are there rich in very well preserved fossils, teeth of elephants being common and very perfect.

68. The sandstones and conglomerates just mentioned form a great belt from the E. N. E. to the W. S. W. (see Map) and to the north of it appears another belt, having a similar direction and composed of nummulitic limestone and slate. It begins in Hazara in Lat. 34°, and forms all the superficial covering of the Hazara mountains as far as the Sirun river and as high north as Mausera, being about thirty miles in width as the crow flies. It proceeds from N. E. to S. W. towards Attock, keeping the same width and extending in that district from the Indus to Janika Serai. Crossing the Indus, it forms the whole of the Akora Kuttuck and Afreedee hills between Peshawur and Kohat, extending about sixteen miles south of Kohat. It has been followed as far as longitude E. 70°. The beds of this nummulitic formation have a general dip to the N. W. A similar

* It is said that one or two bones have been fouud in the lower Miocene, but this is doubtful; if they exist, they are at any rate very rare. Mr. Medlicott has pointed out a non-conformity between the lower and upper Miocene; he makes three beds of the formation.

nummulitic tract follows the foot of the Himalayan ranges along the southern versant of the Pir Punjal chain and its continuation to the S. E. It begins in the valley of Poonch; it is seen north of Rajaori, and the pebbles of the streams near Rajaori are often nummulitic limestone, though the parent-beds have not yet been discovered. I cannot say whether nummulitic beds are to be seen to the north of Tummoo, Basaoli, and Noorpoor or in Kangra, but they appear near Subathoo in long. 77° lat. 31°, and have further been just discovered by Captain G. Austen on the east of the Ganges in Kumaoon. But this nummulitic along the foot of the Himalaya is either much denuded or much covered up by Miocene, and does not make such a show on the surface as the other belt which follows the direction of the Afghan mountains.

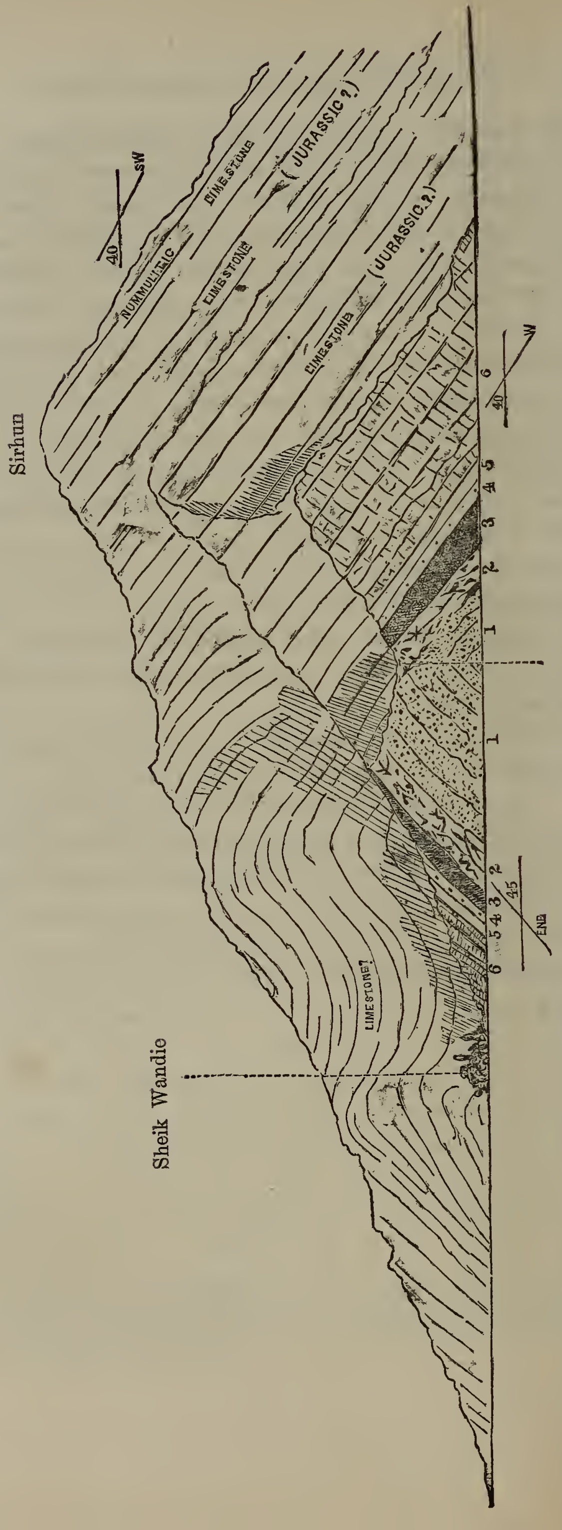
To the north of these zones of nummulite we meet the volcanic hills, which I have described in the first chapter.

69. The stratum of nummulite in Hazara, occasionally broken through, or faulted or denuded sufficiently to allow of older rocks making their appearance.

At the northern end of Mount Sirbun near Abbottabad, carboniferous limestone resting on volcanic rocks is quarried for building purposes. The limestone belongs to the Weean and Kothair groups and is thin-bedded, arenaceous, marly and occasionally conglomeratic. It is of considerable thickness and immediately covered in by limestone, the lower beds of which are so poor in fossils that it is impossible to identify them, the upper being nummulitic.

The following is a section near the small village of Sheikh Wandie, from E. to W.

(Section VII. of General Map.)



Level of the Abbottabad valley about 4700 ft. above the level of the sea.

Section of the Northern extremity of Mount Sirbun, near Abbottabad, from E. to W. bearing S. (not drawn to scale.)

1. Very compact and very hard Cornean rock, composed of a paste of white feldspar and grey hornstone in intimate combination. The joints and exposed surfaces are smooth and have a quartzy glimmering. In the paste there is often a partial separation of white feldspar in spots of a dull white colour. Splinters of the white spots can be rounded on their edges before the blow-pipe, but the grey paste of the rock appears to be more refractory, though there is certainly a softening of the mineral compound and a slight smoothing of sharp edges after long exposure to heat. It is a bed of very considerable thickness, stratified and much jointed.

2. White quartzite in a brecciated state, the pieces being recemented together by a grey feldspathose paste. It appears as if the bed had been broken after its formation and the fragments reunited by a feldspathose paste.

3. Very heavy, chocolate-coloured, clay-stone, with bands of quartzite.

4. Indurated clay, with round nodules, the size of a bean, of a black mineral having the lustre of jet, whitening to a milk-white colour before the blow-pipe, and finally melting with difficulty on thin edges; it belongs probably to the hypersthene group. The clay itself is grey, smooth and meagre.

5. Chloritic clay; grey, very smooth and soft to the touch; hardness of slate. It is full of ninute round grains of a semi-transparent mineral, grey like the clay, but a little darker. The clay becomes white and meagre before the blow-pipe; it is unaffected by muriatic acid, and does not form a pasty mass with water, either before or after grilling.

6. Limestone, at first extremely arenaceous and argillaceous, and presenting particles of dirty blue and brown colour. It becomes gradually conglomeratic and at the same time thin-bedded, the layers being made of layers of pebbles of limestone cemented by a calcareous sandy cement; the top of the layer appears to have been worn flat by the action of the waves, before the deposit of the next stratum took place, the pebbles appearing as sections on the surface of the bed. The next layer is a muddy limestone containing a few flat athyris, remarkable especially for three internal raised lines or ribs proceeding from the beak as far as the middle of the valve. But these shells are in a very bad state of preservation. This layer is only two feet thick, and is succeeded by another equally thin and containing numerous debris of gasteropods and corals. Then comes a black, sometimes blue-black limestone, extremely fœtid. The bluer portions are crossed by white lines intersecting each other in all directions and containing only debris of fossils.

The limestone forms altogether a bed of about thirty feet, when it is cut by a fault which causes it to be repeated, and a succession of faults directed W. N. W. to E. S. E. keeps the same limestone on the surface for more than half a mile, it becomes finally covered by nummulitic limestone.

This Mount Sirbun forms the left side of the Abbottabad valley. Following the slopes of this hill, we find beds of quartzite, similar to No. 2 of the above section, reappearing three or four times in short anticlinals; above it are beds of limestone containing a few fossils, principally casts of gasteropods. This limestone is often strongly oolitic in structure, but presents also the very unusual appearance of resembling beds of travertin which had been entombed in a calcareous mud after their formation, so that the cavities of the travertin have become filled up with a limestone less hard than the original deposit. I have usually regarded these beds as fresh-water origin near a low coast, and referred them, in a general and provisional way, to the Jurassic; of course this is doubtful.

70. On the lower road from Marree to Abbottabad, near the village of Sayd Kote, great disturbances are observed, and rocks of a geyserian nature make their appearance about half way between Sayd Kote and the Dowr river. They are principally a chocolate-coloured sandstone, becoming coated by weathering on the surface as well as in the joints, with a shining dark incrustation. It is much jointed and breaks in prismatic blocks. A great quantity of dark boulders of this rock may be seen in the bed of the river Dowr. It appears to be similar to some variety of dust-rock or sandy ash or earthy ash seen in Kashmir. It is capped by a bed of quartzite composed of large, opaque, angular grains of quartz, jammed together and cemented by a feldspathose white paste of which there is very little. Angular grains of black augite are sparingly disseminated in the rock. Under the brown sandstone is seen a thick bed of crumbling clay slate, very dark and foliated. This is the lowest bed seen. These three beds, viz., slate, sandstone and quartzite conform together in their dip and are capped by a patchy limestone of doubtful age, and interbedded with grey soft slate. There is much kunkur near the locality.

At Sayd Kote the limestones are wonderfully disturbed: beds having the appearance of Kothair limestone and containing a great number of gasteropods and *cyathophyllides* are seen repeatedly, as the road crosses nearly perpendicular beds which are much faulted. Nummulitic limestone appears to cover in directly the carboniferous (?) beds??

Again on the upper road from Murree to Abbottabad, at the bottom of the ravine under Doonga Gully, volcanic or rather geyserian rocks are to be seen. They consist of a very white and friable rock composed of acicular minute crystals of albite easily fusible before the blow-pipe and pressed and entangled together; there does not appear to be any cement to bind the small crystals together; the rock has a coarsely saccharine aspect and can easily be crumbled between the fingers. It rises in vertical and contorted bands, from half an inch to two and a half feet thick, amongst sands and disintegrated shales. It assumes very many remarkable colours, being sometimes flesh-coloured or reddish, and at other places azure-blue; its general colour is, however, snow-white; where it is blue, the shales near it are of the same colour. It is interbedded with thin beds of tufaceous limestone which have probably found their way there by infiltration. It is covered in by a rubanneous and dark slate, much disturbed, extremely cleaved and jointed and falling into small angular pieces. This slate appears similar to that seen near Syad Kote, and the feldspathose rock is intrusive. These two rocks are at the bottom of the ravine, on a fault, and form a little mound by themselves. There are no rocks to be seen in immediate relation to them, and the beds of the sides of the ravine appear to be entirely nummulitic.

From the examples given of volcanic rocks in Hazara, it seems evident that that district has participated in the great volcanic accumulation which preceded the carboniferous epoch, and that it has also been disturbed at a later date by intrusive volcanic action of a local and geyserian character.

71. Of Chumba, Kulu aud Kunawar, districts which occupy the hilly tracts south of the extension of the Pir Punjal chain towards the Sutlej, I know nothing.

72. Kashmir is continued to the south-east by the highlands of Lahul and Spiti which are situated in the same Himalayan parallel, viz., between the Pir Punjal chain or parallel and that of the Ser and Mer. Spiti has been pretty often visited by geologists, and we know that carboniferous and Jurassic fossils were brought thence by Dr. Gerard. Liassic fossils have also been found there. As for crystalline rocks, M. Marcadieu mentions much granite, and Captain W. E. Hay, granite penetrated by huge veins of ter-sulphuret of antimony and "other metals." Gypsum is reported as extremely abundant in Spiti, forming, it is said, whole mountains; and here I

would mention again that several hot springs are found in close vicinity to these gypseous beds.

But I must draw back here, and leave the ground to Dr. Stoliczka who has been for some time studying the geology of Spiti with great care and is preparing a work on the subject. Dr. Stoliczka has found in Spiti rocks of the following ages: Silurian, Carboniferous, Triassic (?), Liassic, Oolitic and Cretaceous. I have said before that most of the fossils from Spiti represented in Dr. Royle's Illustrations, are to be found in the Jurassic rocks of Sheikh Bodeen.

73. The great chain of Ser and Mer (called by Capt. R. Strachey, between the Sutlej and the Kali, the chain of Snowy Peaks, and by Cunningham, the western Himalaya or central chain of the Himalaya) appears to be, as far as I have been able to ascertain, made up of granite, gneiss, and other rocks of the plutonic and metamorphic groups. From the Nanga Parbat (26,629 ft.) to near the Sojji La pass, (11,300 ft.) the range is, I believe, mostly granite; it is traversed by the road of Skardo viâ Guzais, and Mr. Drew informs me that the range, (which here forms the southern boundary of the Deosai plain) is "chiefly granite, partly schist." The plain of Deosai is a singular plain or steppe entirely covered with debris and loose stones; it is tolerably flat, considering how it is situated, and has perhaps once been the bed of a gigantic glacier. It is surrounded by granitic mountains on the southern and western sides; the north end is bounded by mountains of schist and slate, and the eastern side is closed in by granitic hills which gradually pass, over Drass and Kurgyl, into volcanic rocks.

If we cross the Ser and Mer chain by the Sojji La, from Kashmir into Drass, we find near Baltal, a village on the Kashmir versant of the pass, that the carboniferous limestone ceases and is succeeded by beds of very coarse and micaceous slaty shales, often very sandy and always very thin-bedded. The specimens I possess of this rock show it to be identical with the sandstone and sandy coarse shales seen in the Zebawan and there interbedded with ash, agglomerate and slate. This rock goes on to nearly the top of the pass, where it becomes a dark and hard slate, having a metamorphic appearance. Then limestone reappears and is seen as far as Drass; it rests the whole way, as far as can be seen, on volcanic rocks and azoic slate. It is pro bably continuous, through Sooroo, with beds of limestone seen between Moolbek and Khurbu.

I do not know what sort of rock forms the summit of the Kun Non or Ser and Mer Peaks (23,407 ft.) but their north-eastern slope and spurs are composed of gneiss and schist; these metamorphic rocks extend as far as the Sojji La, where they are graduating into beds of the coarse slaty shales described above; on the north of the road it is continued by beds of slate and of sandstone extremely micaceous and resting on mica-schists, of which some specimens effervesce powerfully with acids. Beds of metamorphic white marble are also seen, but the great bulk of the mountains between Tillail and the Deosai is made up of granite, shist and mica-slate.

Following the great chain to the S. E. we find it crossed by several passes of which the Bara Lacha (16,505 ft.) and the Parung la (18,794 ft.) are the most celebrated and frequented. Mr. Marcadieu describes these passes as being principally through granitic rocks; but unfortunately Mr. Marcadieu does not seem to have enjoyed much his visit to these "*belles horreurs*" and he gives us little geological information, but many complaints, about these "delights of Satan," as he calls the mountains.

South-east of the Sutlej, the chain continues to be mostly granitic. It is studded with noble peaks, Porgyul (22,700, ft.) Baldang (21,400 ft.) Kamet (25,000) and Nanda Devi (25,700, ft.) all of them made up of granite, gneiss, and schist. But I must refer the reader to Captain R. Strachey's paper "on the geology of part of the Himalaya mountains,"* for the mountains south-east of the Sutlej.

74. Having crossed the Ser and Mer Parallel, we find ourselves in the great trough between this chain and that of the Kailas peak (which I shall call for convenience sake the Kailas chain) and we may hardly call this trough a valley, considering that it is a plateau from 10 to 12,000 feet high above the level of the sea; and yet it is a valley between the two great parallels which tower over it by some 10,000 feet more. It çomprises the districts of Deosai, Soroo and Drass, Ladak proper, Zanskar, Rukshu and in the S. E. the great plateau of Tibet through which runs the Sutlej and inhabited by the Hundes. This last or south-eastern portion of the trough is toler-

* Proceedings of the Geological Society of London, June, 1851.

ably flat, only a small volcanic peak rising here and there, detached and isolated, through the thick horizontal bone-beds of sandstone and conglomerate which fill up the valley.* But in the other districts, the trough is nearly entirely filled up by vast mountains, which occupy in the parallel valley of Ladak the same position as the catenated chains we have described in Kashmir do in the parallel valley of Kashmir; the chain formed by these mountains has been called by Colonel Cunningham the "Tso Moreri" chain, and has been raised to the position of one of the great parallel chains of the Himalaya, but it will best suit our purpose to consider it as an inter-parallel mass of mountains.

Deosai has been described already. Drass and Kurghyl are covered with volcanic rocks into which the granite of Deosai gradually passes. Mr. Drew tells me that he found near Kurgyl a rock composed exclusively of mica and felspar, graduating into granite. Some specimens I possess from Tashgam, half way between Drass and Kurgyl, are composed of a dark green hornblende which fuses with difficulty and swelling a little before the blow-pipe. Felspar is not conspicuous, but is probably intimately combined with the hornblende. But rocks undoubtedly volcanic are also seen, such as greenstone and amygdaloid. A considerable bed of limestone reposes on the volcanic rocks and appears to be the continuation of the bed seen near Drass. I do not know the age of this limestone. The Drass bed contains fossils which are, I believe, carboniferous, and I have coloured the bed now under consideration, carboniferous, assuming the continuity of the two beds to be true.

Of the mass of hills traversed by the road from Kurgyl to Le I know very little indeed. They are said to consist mostly of slaty rocks capped here and there by conglomerates and grits.

As we near the valley of the Indus in Ladak proper, near the village Kulsi, interesting beds appear. Resting on a hornblende rock or trap is a series of slate, light coloured limestone, conglomerate with rolled boulders of the same limestone, sandstone, shales and dark purple indicated clays. The dip is not very great and the several beds appear to conform together. The whole valley of the

* Proceedings of the Geological Society of London, page 306.

Upper Indus from Kulsi to Nodmo (and probably further east) appears to be excavated in this formation and the river flows in a fault of it or more probably in the centre of a denuded anticlinal.* The series of rocks (series of Upper Indus Valley) rest, on the North, against the granite of the Kilas Range. Captain G. Austen, to whom I owe these details, estimates it to be at least 3,000 feet thick, and mentions also its appearance in Rodok at the North of the Pang Kong Cho, resting there unconformably on slate. In the limestone layer of this series (about 150 feet thick or more) Captain Austen found a few fossils which he was kind enough to show me. They were very ill-preserved and fragmentary, but appeared to resemble some forms found in the Kothair bed in Kashmir; some cyathophyllides are certainly not to be distinguished from those represented at figures 56 and 57, Plate VII. Another fossil was supposed to be the radical end of a Calamite. To complicate matters, the fossils were declared by palæontologists at home to be *cretaceous.* The specimens are so bad, that I apprehend that this determination must have rested entirely on the *one* fossil which I took for a Calamite, and which was regarded, I suppose, as a Hippurite. My own impression is, that the limestone is identical with the Kothair bed of Kashmir, and therefore either the uppermost layer of the carboniferous or perhaps the lowest of the Triassic.

Above this Upper Indus series come the nearly horizontal grits and coarse sandstones which form the flats called in Ladak Chang Tang and Rang. The non-conformity between the Indus Series and the Chang Tang beds is not conspicuous, as that dips at a very low angle and these are nearly horizontal. There is also, I believe, a great similarity of lithological character between the two formations, one being merely the resettlement of the other. I conceive that some difficulty may be experienced occasionally to decide where one formation ends and the other begins. A few mammalian bones have been found in the Chang-tang sandstone, and there is but little doubt that this bed is similar to the sandstone and conglomerate of the Great Thibet plateau to the north of the Niti Pass. These high horizontal plateaux of conglomerate and sandstone are also observed

* A very great number of rivers in the Himalaya run part of their course in the centre of a denuded anticlinal.

in the Afghan mountains, where they are called in Pooshtoo Ragzhie. I have examined some of these ragzhies, of which the plateau of Rushmuk in Waziristan is a good example at an elevation of 7,000 feet, and I feel satisfied of their fluvio-lacustrine origin and of their age being posterior to the final upheaval of the Himalaya and Afghan mountains.*

Zaskar and Rukshu or Rupshu are interesting districts, on account of their lakes, numerous hot springs and borax mines. The country is an elevated labyrinth of mountains and valleys, having a mean height of 15,600 feet. The principal peaks are the Korsok Too (above 20,000 feet) and the Napko Gondo ; but there are great many other nameless peaks ; the passes are all a good deal above 17,000 feet. In Zaskar we find a great mass of gneiss and schist which appears to be the eastern extension of similar rocks which begin in Sūrū, and, after entering largely in the formation of the mountains of the highland of Zaskar, are prolonged eastward into Rukshu, where they graduate into beds of metamorphic slate on which rest fossiliferous rocks. The gneiss, schist, slate and limestone are all stratified and conformable together, and they all dip towards the S. S. W. The limestone appears to be the continuation of the bed of limestone seen in Sūru reposing on the gneiss and schist of the foot of the Ser and Mer peaks.

The occurrence of fossils in Rukshu had been noticed by several travellers, but little was satisfactorily known, and to Captain G. Austen is therefore due the credit of having first brought trustworthy fossils from Rukshu, and to him I am indebted for the following details :—

Two of the valleys of Rukshu are the Tso Moreri valley and the Pang-po-loomba ; they are separated one from the other by the ridge of the Korsok Tso, composed of granitoid rocks and of gneiss and schist. From the Pang-po-loomba (valley) one passes into the valley of the Tsa Rup (river) by the Pang-po-la (pass), towards Zaskar. This Pang-po-loomba (valley) and Pang-po-la (pass) are the localities where fossiliferous beds have been noticed. The

* Col. R. Strachey appears inclined to regard these horizontal beds of the Great Thibet plateau as contemporary of the Siwalik hills and a sea-formation. I believe that both hypotheses are untenable.

whole bottom of the valley is uneven and its southern portion is formed by beds of limestone in which both Captain Austen and Mr. Marcadieu found carboniferous fossils (No. 1.) At the foot of the Pang-po-la the carboniferous becomes covered by a muddy sandstone (No. 2) which is, however, not seen in situ on the northern slope of

Section across the Pang-po-loomba (valley) and Pang-po-la (pass) in Rakshu from a sketch by Captain Godwin Austen (approximate).

the Pang Po, but of which numerous debris fill the ravines. Above this sandstone is found Jurassic limestone (No. 3), all the way to the top of the pass, full of Belemnites, Ammonites, Rhynchonellæ and Terebratulæ. One of the Rhynchonellæ collected there by Captain Austen appears identical with a form very common in the middle Oolite of Sheikh Bodeen in the Punjab.

Having crossed the top of the pass and descending towards the Tsa Rup (river), the same bed of muddy sandstone (apparently) again crops out. It is there interbedded with thin beds of impure limestone, and in these beds were discovered a great many Belemnites in fine state of preservation. Mr. R. A. C. Austen, to whom the fossils of these parts were forwarded, pronounced some of them to be *Liassic*, but I do not know whether these liassic forms came from the muddy sandstone bed or from beds inferior to it.

On the other side of the valley of the Tsa Rup, some beds of limestone, much folded and bent, again appear, but they showed no fossils and their age is therefore unknown ; they rest against beds of slate much up-tilted and apparently unconformable to the limestone. At the back of the slate is the great mass of the Ser and Mer chain, attaining immense height and crossed by passes above 16,500 feet high.

75. The Tso Moreri is the largest of many salt lakes which form one of the features of Rukshu. It is 14 miles long and more than 15,000 feet above the sea. Its water is very salt and bitter, though Mr. Marcadieu affirms that it contains only one part of saline matter

in 10,000 parts of water ; the saline matter is sulphate of soda and sulphate of lime. Another lake, the Karso-Talao, about 6 miles long, is reported by the same gentleman to contain a great deal of chloride of sodium and sulphate of soda, with a little carbonate of lime and carbonate of soda. These two lakes are said to be surrounded by mountains of crystalline rocks, principally mica-schists and granite. But one of the most interesting subjects connected with the geology of Rukshu is the existence of borax in the valley of Puga. The manner in which it occurs as an efflorescence is too well known to require description here, but one cannot but regret that Mr. Marcadieu's report is not more geological ; indeed it can only be regarded as chemical, and the geology of the district is still a work to be done. I have never visited Puga, but, from the several descriptions of it I have read, I am satisfied that the borax ground is the bottom of a dried up lake. The analysis of impure borax collected at Puga shows it to contain, besides borax, sulphate of soda, sulphate of lime, chloride of sodium and carbonate of soda. These impurities are precisely the composition of the Kullur salt of the plains of the Punjab and of the saline matter of many hot springs and salt lakes of the Himalaya and the Salt Range, and it appears to me evident enough that the lacustrine mud which fills up the bottom of the Puga valley, is similar to the alluvial deposit of the Punjab. Boracic acid, which probably once rose freely to the surface of a small lake and was deposited in an uncombined state, is now arrested by the bed of lacustrine mud which fills up the fumarole and combines with some of the salts of soda. It appears therefore much to be regretted that an attempt was not made to estimate the thickness of the lacustrine deposit and that a few wells were not sunk into the borax ground and the waters and gases which might have been collected in these wells carefully examined ; possibly such researches and experiments might have led the way to an increase of the present supply, and to a system of collecting the borax or boracic acid sufficiently pure not to require refining.

76. In Ladak, Rukshu, Sooroo and Zaskar, no fossils were ever found, as far as I know, older than those of the carboniferous formation. But if we follow the great valley, between the Kailas Range and the Ser and Mer chain towards the S. E. we find, on the other

side of the Sutlej, great beds of limestone rich in Silurian fossils.* Mr. Salter has recognized the following genera among Captain Strachey's fossils :—

Cheirúrus.	Strophomena.	Cyrtoceras.	Chœtetes.
Lichas.	Orthis.	Litnites.	Crinoid Stems, &c.
Asaphus.	Leptœna.	Tentaculites.	
Calymène.	Lingula.	Murchisonia.	
Illœnus.	Orthoceras.	Ptilodictya.	

Mr. Salter, M. Barrande and M. de Verneuil, who saw some of the fossils collected by Colonel Strachey, agree that they indicate beds of Lower Silurian. We shall see that beds of Silurian also exists in the huge mountáins to the north of Skardo and near the Mustak Pass in the Korakoram chain.

But let us first relate what Colonel R. Strachey found in the high ranges south of the Sutlej.

The Silurian above mentioned rests on beds of slate without fossils, and this slate rests on schists, mica-schists and other rocks of the metamorphic group. Then above the Silurian limestone, some beds of carboniferous must exist, though they were not found in situ by the explorer ; *Producti*, *Athyris Royssii* and other well known fossils were found in loose boulders near the Niti Pass. I believe also that some of the shells placed by Colonel Strachey and Mr. Salter in other groups belong really to the carboniferous ; such is the *Chonetes* placed by Colonel Strachey in the Mushelkalk, but transferred to the carboniferous by Mr. Salter ; the *Ptilodictya Fenea* (Salter), the narrow variety, which I have found in carboniferous beds in Kashmir ; (it was naturally placed with the Silurian fossils by Mr Salter, on account of the *Ptilodictya* having been found as yet only in Silurian beds in Europe and America) ; the *Spirifer Stracheyii*, (Salter) placed among the Triassic fossils by Mr. Salter, and which is common enough in the Weean bed of carboniferous limestone in Kashmir; and lastly the *Spirifer Rajah* (*Spir. Keilhavii*,

* On the geology of part of the Himalaya and Tibet, by Capt. R. Strachey, Bengal Engineers, F. G. S. in Proceedings Geological Society for June 1851, also "Palæontology of Niti in the Northern Himalaya, being descriptions and figures of the Palæozoi and Secondary fossils collected by Colonel R. Strachey R. E." "Descriptions by T. W. Salter, F. G. S., A. L. S. and H. T. Blanford, A. R. S. M., F. G. S.—Calcutta 1865."

Von Buch), which has been removed from the Trias by Dr. Oldham, and declared to belong to beds anterior to that epoch.

There is therefore a strong probability that both the Zeeawan bed (*Productus semireticulatus*, *Athyris Royssii* &c.) and the Weean bed (*Spir.* f. *Stracheyii*, *Spir. Keilhavii*) exist in the ranges near the Niti Pass, but have been much denuded and broken in loose fragments along the section followed by Colonel R. Strachey.

Then comes what Colonel Strachey supposed to be Muschelkalk, and which Mr. Salter refers to the Keuper and Hallstadt bed of the Upper Trias. I cannot refrain from expressing a suspicion that a few of the shells referred to these beds do not really belong to them, and that fossils of various ages have been mixed, either from collecting them, without due care being paid to the strata in which they were respectively found, or from careless packing. There is such a great likeness between the figures of some of the Triassic Ammonites of Mr. Salter and those of the carboniferous ceratites of M. DeKoninck,* (see *Ammonites Blanfordii*, Salter, nov. sp. and *Ceratites Lyellianus*, Dekon. nov. sp.) that one finds it difficult to decide between these two great authorities. The species of ammonites figured in the Palæontology of Niti have nearly all the ceratite-like sutures usual in triassic ammonites in Europe, and therefore much resemble deKoninck's ceratites.

It may be advanced, on the other side, that M. DeKoninck's ceratites belong to triassic beds; but these ceratites are to be seen in the Rotta Roh associated to some of the fossils which I have given as characteristic of my Weean bed of the carboniferous in Kashmir and the Punjab; and a portion at least of this Weean bed would have then to be made over to the Trias. Unfortunately for this view, the mixture of Weean and Zeeawan fossils in some layers of the Rottah Roh (described in para. 60 of this paper), does not allow us to make the Weean anything but carboniferous, unless we are prepared to regard the *Prod. semi-reticulatus*, the *A. Royssii*, the *A. Sabtilita* and other such essentially

* "Description of some fossils from India, discovered by Dr. A. Fleming, of Edinburgh." By Dr. L. de Koninck, F. M. C. S., Professor of Chemistry and Geology in the University of Liege—Journal Geological Society of London, Vol. XIX. p. 1.

carboniferous fossils as occasional inhabitants of the Trias!!! If we are prepared to stretch the point so far, we may as well give up at once all idea of successive faunæ.

I have, since writing the above, found in the Rottah Roh, some beds containing a few fossils which appear Permian. I have not yet had time to examine the fossils with care; but should they prove Permian or Saliferian (St. Cassian),—and I have little doubt that they will be found to belong to either one or the other of these formations,—the presence of patches of such a bed on the top of the carboniferous would explain away, in a great measure, the difficulties I have now been considering.

I have said before that I believe the Saliferian of Upper India to belong to the Paikilitic formation, but that it has been found impossible as yet to *demonstrate* that such is the case. The discovery of one or two fossils may settle the question, if they were forms thoroughly well known as characteristic of the Indian Trias. The study of the fossiliferous Triassic beds in India is therefore of the greatest interest; but much care is required lest the mixture of Palæozoic and secondary types should take place in our packing boxes and not in nature, and we thus become accustomed to regard, as characteristic of the Trias, shells which really belong either to the carboniferous, or to the Lias and Oolite.

To Colonel R. Strachey, however, is due the honor of having first discovered fossiliferous Triassic beds in the Himalaya; and we may hope that much light will be thrown on the Indian fossils of that age by Dr. Stoliczka, in his expected work on the Geology of Spiti.

Over the beds last described, Colonel Strachey found Jurassic beds; but the relation between the Triassic and Jurassic beds could not be ascertained, owing to a great fault running parallel to the general N. W.—S. E. direction of the Himalayan ranges. The section exposed by this great fault is at least 5,000 or 6,000 feet in thickness, but the difficulties of the route prevented Colonel Strachey from examining it from top to bottom; the lowest beds were not examined. The *lowest which were examined* gave forms which Professor E. Forbes was inclined to identify with fossils which occur in the fuller's earth and cornbrash of England. No Liassic forms were discovered.

These inferior oolitic beds are capped by dark coloured shales containing belemnites and ammonites, and referred by Professor E. Forbes to the age of the Oxford clay. These shales are therefore the representatives of the several Jurassic beds we have already seen in several parts of the Himalaya and of the Punjab.

The oolitic beds are covered by grits, shales and limestone of unknown age, and finally by the great horizontal bed of what Colonel Strachey considers to be miocene (Siwalik) sandstones and conglomerates. I have said before that the identity of these sandstones, grits and conglomerates to the Siwalik formation is far from established, and that there are more reasons for considering them pleistocene, than for assuming them to be coeval with the deposition of the Sub-Himalayan tertiaries.

77. The Kilas Chain is of less elevation than the Ser and Mer, and its peaks are neither so numerous, nor so well known or so remarkable for their enormous mantles of snow. The principal summit is the Kailas (or Tise) peak, which rises to 22,000 feet above the sea, in longitude 81° 18′, and is therefore far to the S. E. of our Western Himalaya. As it is, however, the only well known peak of the Chain, I have called the whole chain from its name.

The Kilas chain begins near Mount Haramash, N. of Astor and N. W. of Baltistan, and is traversed near Skardo by the Shigar river which cuts a passage across the range. The summit, Mashkulla, (16,919) towers over the alluvial plain of Skardo, Shigar and Kuardo. This mountain is mostly granite ; its spurs show a great deal of metamorphic slate at a high angle of dip ; and the little hill close to Skardo, evidently an off-shoot of the Mashkulla, is composed of an imperfect shist. All along the left bank of the Shigar river, schists of various sorts, especially mica-schists, and micaceous slates, together with metamorphic marbles, form the great wall of mountains that bound the Shigar valley to the N. E. Following the road which leads from Shigar to the Thale valley, by the Thalé la (pass) Captain G. Austen discovered some beds of limestone, resting on the mica-slate, and I have coloured that bed of limestone Silurian in the Map. My reason for believing it to be Silurian is its proximity to limestone beds of similar appearance and position at the Mashabroom, and there, I believe, decidedly Silurian ; and also the fact that the discoverer of the bed found there a few fragments of fossils which he regarded as Palæeozoic, though different from any of the carboniferous forms which we found together in Kashmir. There is therefore presumption that this bed is Silurian, though of course it is merely a presumption. I have also assumed that a bed of limestone, seen to the South of Skardo, between that town and the Deosai (plain), is Silurian. We shall see the bed discovered at the Mashabroom, when we describe the Karakoram Chain.

From Skardo towards the S. E., the Kilas Chain appears to be nothing but a great granitic wall, along the foot of which runs the Indus. Near Lé in Ladak the range is crossed by the Digor La (pass), the road going through a succession of granitic rocks.

78. Between the Kilas and Karakoram Chains, we find the rugged district of northern Baltistan, the valleys of Saltoro, Nubra Shayokh and the Chinese province of Rodok. In the country of the Baltis, the Kilas and Korakoram Chains approach each other to within about 45 miles, as the crow flies, from range to range; whilst on the contrary the chains diverge as we proceed towards the S. E., the Korakoram chain having apparently a less southward direction that the other parallels of the Himalaya. In northern Baltistan, consequently, we find the country covered with mountains, cut with deep narrow valleys and mantled with immense glaciers;* in Radok on the contrary high plateaux are abundant, and form to the north of the Pang Chong Tso (lake) and Pang Chong La (pass) considerable plains, 14,000 to 15,000 feet above the sea, arid and rainless, often not presenting a shrub for several marches; high deserts on which roam a thin population of nomade Turkomans who graze shawl-wool goats on the scarce and far-between Aghil or grassy vales of these inhospitable regions.

There is no doubt that these high plateaux are similar in origin, age, and appearance to the great Thibet plateau through which runs the Sutlej, to the north of the Niti pass, and described by Colonel R. Strachey; and also to the Chang Tang and Rong plateaux of Ladak. All these high plateaux present a horizontal stratification;

* "On the Glaciers of the Mustakh Range," by Captain H. G. Austen, F. R. G. S., &c., read before the Royal Geographical Society, London, on the 11th January, 1864.

and it appears therefore impossible to regard them otherwise than as accumulations of debris washed from the ranges into the great troughs between these ranges, and therefore posterior to the great final upheaval of the Himalayas.

Very little is known of the nature of the rocks forming the ridges, ranges and spurs in Saltoro, Nuha and Shayokh. Dr. Thomson,* on native information (Izzet Ullah), tells us that the rocks of the Shayokh and Nuha valleys are in great part primitive limestone. " The limestone continues towards Rodok and the water of the Pang Gong Tso (lake) hold a sufficient quantity of lime to form a calcareous deposit which cements the pebbles together in patches of concrete at the bottom of the lake." The water of the Pang Chong Tso is sufficiently brackish not to be fit for drink, and it has a bitterness probably due to sulphates of Soda and of Magnesia. From the examination of a specimen of the calcacerous incrustation which is formed on the shore of the lake, I found that Magnesia is about as abundant as lime.

An extremely pretty species of Limnea or rather Physa once lived in the lake, and dead shells of it are abundantly found in the band of tufaceous deposit, a few feet above the present level of the water. These shells no longer exist in the lake (Austen). They have probably been destroyed by the diminution and concentration of the brackish water.

General Cunningham informs us† that the rocks of all the high ranges and peaks of Rodok are granite and gneiss, and this appears to be highly probable. Metamorphic rocks also abound ; the mountains near the Pang Chong Tso containing a great deal of mica-schists ; and crystalline marble is also found on the shore of the lake, apparently in immediate contact with granitoid rocks.

In the northern portion of Rodok some hot springs exist in a locality called Chong Chin Mo ; there water deposits largely a grey tufa which is composed of carbonate of lime, sulphate of lime and sulphate of soda. Such tufa is common near the warm springs of the saliferian in the Punjab. Its composition is also that of the saline impurities of the brackish lake of Tso Moreri in Rukshu, and

* " Ladak," by General Cunningham, R. E.
† " Ladak," by General Cunningham, R. E.

of the efflorescence which accompanies the borax at Puga. From the extensive beds of gypsum and impure salt found in Rukshu, little doubt can be entertained that the saliferian is there well developed, and by analogy it is to be presumed that the same formation is also to be seen in Rodok. Borax is said to be exported from Rodok in large clean crystals, but I do not know whence they are obtained; that it does come from Rodok appears however pretty certain; and that is another resemblance with Rukshu, and another reason for believing that the saliferian is probably well developed in Rodok, and is there accompanied by hot springs and fumaroles exhaling boracic acid.

I have never seen any fossil which had been brought from Rodok, Shayokh or Nuba; it is impossible therefore to say to what age belong the beds of limestone mentioned by Dr. Thomson. The beds are called "primitive limestone;" but as Jacquemont, Vigne, Thomson and others speak sometimes of fossiliferous limestone (such as the Manus Bal limestone in Kashmir) as "primitive," it is difficult to know for certain what is meant by that somewhat antiquated term.

79. The Korakoram Chain is a range of very great extent, beginning at the Pamer Steppes and reaching to the S. E. as far as the centre of Thibet in longitude E. 94° and as low as latitude N. 30°. The plateau near its south-western slope is from 15,000 to 17,000 feet high, and is an arid tract of horizontal alluvian covered with loose stones and supporting very little vegetation; more to the north it is a labyrinth of wild valleys. Near the Mashabroom mountain (above 26,000 feet) the soil of the valleys between the spurs is to a great extent covered by glaciers; where not so covered, it is often an indurated clay strewed with debris of pale limestone a good deal worn and weathered, and with globular cystideæ in very great abundance. Mr. Ryall, of the Great Trigonometrical Survey, gave me one of the pieces of limestone and some of the fossils. The limestone is an argillaceous dolomitic limestone, pale yellowish brown, with a few patches pale blue, weathering like frosted glass, and resembling a good deal of the rocks of the Weean and Kothair groups of carboniferous limestone. The *sphæronites*, however, point to a silurian epoch, these echinoderms having not been found as yet in formations posterior to the Wenlock limestone.

The *sphæronites* of the Mashabroom are probably a new species; they were found in considerable variety, from the size of a small walnut to that of a large orange; the largest were perfectly round and polished like a cricket ball, without warts, spines or facettes, pierced by numerous pores. Some of the smaller have the stems scarcely visible (fig. 6, Pl. VIII), and are covered either with large tracts set well apart or with smaller ones set closer; some spines are depressed or lenticular; all are pierced by innumerable pores, none shows traces of polygonal plates; mouth not to be seen in any of the specimens I have examined. (See figs. 5, and 6, pl. VIII and plate IX fig. 1.) The discoverer, not being a geologist, did not look for other fossils: the cystideæ were so numerous and so curious in appearance, that they gave quite a peculiar aspect to the ground.

The Mashabroom is stratified to its very summit, the beds being limestone and shales, dipping towards the S., at a moderate angle. This stratification is so well marked, that it can be distinctly noticed from a long way off. These sedimentary beds repose on metamorphic layers of mica-schist and gneiss. The limestone is extremely rich in magnesia, principally towards the base of the bed, where it passes into Steatite in patches (Austen). Some of the Serpentine and Jade (compact Tremolite) brought to Srinuggur and there worked into ornamental articles by the stone-cutters of that city, come, I believe, from the neighbourhood of the Mustak Range and of Mashabroom, though the greater quantity is supposed to be derived from the Yarkandkass valley and the Kuen-Luen Chain in Khotan. There can be little doubt that the limestone of the Mashabroom is the parent bed of the cystideæ found in the valley between two of the spurs of that mountain; and at least a portion of the limestone of Mashabroom is Silurian,

The following sketch-section embodies the information kindly given me by Mr. Ryall and Captain G. Austen.

Approximate vertical Section of the Masha Brum mountain, one of the great summits of the Korakoram Chain, from S. to N. bearing W.

1, granite; 2, gneiss and mica-schist; 3, sandy shales and coarse slate without fossils; 4, pale dolomitic limestone containing patches of Steatite; 5, pale ochre-coloured limestone, the probable parent rock of the Sphæronites found at the foot of the mountain.

To the north of the great glacier Baltoro is that portion of the Korakoram Range known as the Mustakh and crossed by the Mustakh Pass at an elevation of 18,400 feet. The whole S. Western face of this Mustakh is covered by enormous glaciers through which the rocky spurs of the mountains rise like islands and promontories. These rocks Captain Godwin-Austen found to be limestone dipping to the N. E., but he failed to find fossils in it, though he noticed traces and fragments of organisms. It is so very probable that these beds are a continuation of the limestone of the Masha Brum, that I have not hesitated to colour them in the map as Silurian. Of course, this requires confirmation. Unfortunately the difficulties of reaching even the foot of these gigantic mountains are nearly insurmountable.

80. I could not get any information on the nature of the rocks forming the remainder of the Korakoram Chain. The few European travellers who ever saw the chain, agree, I believe, in representing it as being mostly composed of granite.

On the other side of the chain we find, between it and the next parallel, *viz.* the Kuen-Luen Chain, the valley of the Yarkandkash (river), which extends from the Korakoram or Yarkand pass to Tashgurkhan, and the Akzai Chin or White Desert, which is continued towards the S. E., nobody knows how far. The valley of the Yarkand river and the Akzai Chin are separated one from the other by a low ridge of mountains similar to the masses of mountains found between the other great chains of the Himalaya. All we know of the valley of the Yarkandkash is that some mines of rock-salt occur there, and that both in the beds of the Yarkandkash and Karakash and in the the ravines of the neighbourhood, some pebbles are collected and used for cheap jewellery ; and these pebbles are either quartzy stones or rocks decidedly volcanic. There is apparently some analogy between these mountains and those of the centre of Rupshu and of Ladak. The Akzai plain is also very similar to the countries just mentioned, in at least the one character of being an elevated, rainless desert, spotted with small lakes, some fresh, and others salt.

It is superfluous to say that I know nothing of the Geology of the Yarkandkash and Karakash valleys and of the Aksai Chin ; neither is there anything known of the formation of the Kuen Luen or Piryukh Chain, except that it is reported to contain valuable copper and gold mines. Another small chain or range, half way between the Kuen Luen and Yarkand seems to be the last parallel of the Himalaya. Yarkand is supposed to be in latitude N. 38° and about 5000 feet above the sea. From the top of the Korakoram pass to the foot of the hills, the distance is approximately 110 miles, and the descent 13,000 feet or about 118 feet per mile, a mild slope for a mountainous country.

(To be continued.)

Contributions to Indian Malacology, No. VIII. List of Estuary shells collected in the delta of the IRAWADY, *in* PEGU, *with descriptions of the new species. By* WILLIAM T. BLANFORD, *A. R. S. M., F. G. S., Cor. Mem. Z. S. &c.*

[Received 14th November, 1866.]

A short visit to Calcutta, and access to various works on conchology which have, for some years past, been beyond my reach, have enabled me to prepare the following list of the species of mollusca collected by me in the Pegu delta during the early portion of 1862. In March and April of that year, whilst engaged in the Geological Survey of the country south of Bassein, I was compelled to traverse the net-work of creeks which intersect the Irawaddy delta in every direction, and, in so doing, I had many opportunities of searching for the various mollusca inhabiting the channels of brackish and salt water.

The western portion of the Irawady delta south of Bassein is of peculiar character. Instead of the endless alluvial flat which is usually alone met with near the mouth of large rivers, the country is frequently undulating, and even, in places, hilly; the hills being surrounded by plains of alluvial soil intersected by tidal channels. Rock not unfrequently occurs in these creeks, and affords a habitat for many mollusca which are not met with in the usual muddy flats.

The Bassein river itself, one of the numerous mouths of the Irawady, like the Mutlah and other great channels of the Ganges delta, is at present rather an arm of the sea than a river; as it receives no fresh water directly from the Irawady except during the height of the rains. In the cold weather the water is perfectly salt for many miles above the mouth, and marine animals abound. Thus for many days, during the time I was traversing the neighbourhood, the water swarmed with *Medusæ*. The volume of fresh water which pours into the Bassein river can at no time be very large, for the mollusca which inhabit the southern side of Negrais Island, some distance within the mouth of the river, are typically marine, comprising species of *Parmophorus*, *Triforis*, *Trochus*, *Chama*, &c., and not including any of the usual estuary forms *Assiminia*, *Amphibola*, *Neritina*, &c., whilst at Poorian Point and Pagoda Point, the two headlands which form the entrance to the Bassein river, precisely the same mollusca occur as along the Arakan coast near Cape Negrais.* At the mouths of those channels by which the mass of fresh water poured down by the Irawady reaches the sea, I do not think that any typically marine animals are met with, nor could they exist, for, in the height of the rains, I have found the water outside the mouth of the Rangoon river perfectly fresh and drinkable, and yet this is only a minor channel compared to the Chinabuckeer and the neighbouring branches, down which the great bulk of the water pours.

To the greater saltness of the Bassein river I attribute the presence of the numerous marine types mentioned in the following list. It will be seen that a few distinctly marine species were met with; the number, however, was small. There are also in the list two or three genera, forms of which do not appear to have been hitherto found in estuaries, *e. g. Tectura, Sphenia, Scalaria;* whilst, on the other hand, the genus *Scaphula* had previously only been met with in fresh water.

The fauna and flora of the Irawady delta appear to be twofold.† Farther from the sea, where the water is more or less brackish, the creeks are mostly narrow and deep, with steep banks, which are covered at high water, and bordered by an unbroken belt of salt swamp, in which grow high trees, chiefly of *Bruguieria gymnorhiza?* The views along the creeks, with their borders of dense high forest, are often of great beauty. This belt of salt swamp and high trees varies much in breadth, from a few yards to half a mile or more; inside it are either open plains, which, if uncultivated, are covered with high grass, or else rises, usually of gravel, occasionally of rock, which are covered with jungle.

The mollusks of this tract comprise *Neritina depressa*, *N. obtusa* and *N. Smithii;* the species of *Tectura*, *Modiola*, *Martesia* and *Sphenia* named in the following list are met with wherever rocks occur; *Scaphula* is found under stones, *Auricula* and *Cyrena* inhabit the salt swamp. *Teredo* perforates the dead trees. *Neritina cornucopia* is principally met with in this region, but is also found lower down the

* Amongst others, I found species of *Dolium, Ricinula, Ranella,* &c.

† I regret that my want of knowledge of botany and the paucity of the observations I was able to make upon the zoology, prevent me from entering fully into this subject. I can merely point out the fact that a distinction exists between the fauna and flora of the delta nearer to the coast, and that found further inland, and illustrate it in the single instance of the mollusca.

estuaries : *Littorina melanostoma* also occasionally occurs, but its home is nearer the sea.

Lower down where the creeks are broader, the belt of salt swamp is narrower in general, and a broad shelving muddy shore succeeds, the upper portion covered by a thick forest of *Avicensia*, while lower down *Nipa* palms frequently occur. The beauty of the wide creeks is greatly enhanced by the broad fringe of the bright green *Avicensia*, over the tops of which the summits of hills, covered with dense green forest, are frequently visible.* On the sloping muddy shore species of *Potamides, Assiminia, Amphibola, Plecotrema, Haminea, Stenothyra ; Arca granosa, Nassa planicostata,* and *Columbella Duclosiana* are to be met with. On the stems of the *Nipa* and on the mangrove bushes *Neritina crepidularia* and *N. cornucopia, Littorina melanostoma* and *L. scabra* are found in abundance.

I have only included in the present list those shells from the Bassein river which are found above Negrais Island, for the reasons already stated. I regret that the list is not more perfect, and that I am obliged to leave a few specimens undetermined. On the other hand the majority have been carefully compared, and the names quoted may, I think, in most cases, be relied upon. Immediately after leaving Pegu, I was in England for a few months ; and owing to the kindness of the late Mr. S. P. Woodward, of Mr. Arthur Adams, and especially of the late Mr. Hugh Cuming, who allowed me to compare my shells with the original types in his unrivalled cabinet, I was enabled to determine, not merely my estuary collections, but also a much more numerous series of marine species from the Arakan coast, in a manner which would have been simply impossible in India.

Unfortunately, during the years which have elapsed since these shells were compared, a few have been mislaid or lost during constant travelling in various parts of India. Still I hope that this list may have some value as a contribution to our knowledge both of the geographical distribution and of the habitats of mollusca. Several of the species named, and some of the genera have, so far as I am aware, never before

* So great is the height of the trees fringing the upper creeks, and so completely do they shut out all the surrounding country, that I was working amongst them for several days in ignorance of the existence of hills nearly 1000 feet high within 15 or 20 miles of me.

been shewn to inhabit the estuaries of India or Burma. Our estuary lists have hitherto been almost as imperfect as our catalogues of marine species; almost all that is known of the molluscan inhabitants of our deltas being due to the labours of Mr. Benson, who has described many of the forms found in the Ganges.

It is, of course, highly improbable that the present list is nearly complete. Only a very small portion of the Irawadi delta was examined, and that imperfectly. Still the number of species is considerable, and probably includes all those which are most abundant. A few forms since found by Mr. Theobald and Mr. Fedden will be noted in their place.

The classification employed is mainly that of Messrs. H. and A. Adams, in the Genera of Recent Mollusca. I have not, however, followed those authors in employing the obscure and forgotten generic terms of Klein, Montfort and others I have only deviated from their arrangement in one essential particular, viz., the transfer of *Assiminia* from the vicinity of *Helix*, from which it differs in every point of structure, to that of *Littorina*, to which it is closely allied. If it be objected that *Assiminia* is as closely related to *Cyclostoma* as it is to *Littorina*, I can only suggest that *Cyclostoma* be also relegated to the same position in the neighbourhood of *Littorina*.

Class GASTEROPODA.

Sub-class Prosobranchiata.

Family BUCCINIDÆ.

No. 1, **Nassa planicostata**, A. Adams.

Estuary of the Bassein river, creeping upon mud between tidemarks. Scarce.

No. 2, **Purpura bituberculcaris**, Lam.

Not common. Found in the lower part of the delta, with the next species.

Family MITRIDÆ.

No. 3, **Columbella Ducloziana**, Sow.

Found in abundance at one spot in the estuary of the Bassein river, amongst stones with mud. The specimens were unusually fine. I also met with this shell on the mud flats of Ramri Island, coast of Arakan.

Family SCALARIADÆ (*Scalidæ*, H. and A. Adams.)

No. 4, **Scalaria**, sp.

A minute species, apparently new. As I possess but a solitary specimen, which is not in the best possible order, I hesitate to describe it. It is one of the smallest forms known, measuring only 3 millimetres in length. It was found under stones in the Myittaya creek.

Family CERITHIIDÆ.

No. 5, **Cerithium (Vertagus) obeliscus**, Born.

A single specimen was found at Port Dalhousie.

No. 6, **Potamides (Tympanotonos) alatus**, Phil.

No. 7, **Potamides (Tympanotonos) euriptera**, A. Ad.

Both this and the last species are met with abundantly on mud between tide marks, not far from the sea. They also occur on the sea coast where it is muddy.

No. 8, **Potamides (Telescopium) fuscus**, Chemn.

Common on mud between tidemarks, where the water is completely salt.

Besides the above, a species of *Cerithidea* has been found by Mr. Theobald in the estuaries of Burma. I did not meet with it.

Family LITTORINIDÆ.

No. 9, **Littorina melanostoma**, Gray.

Very abundant upon "mangrove" trees, close to high water mark.

No. 10, **L. scabra, L.**

Occurs with the last, which appears to pass into it. Two varieties of this form occur, one more coarsely sculptured and more stoutly keeled than the other.

No. 11, **L. zic-zac**, Chemn.

Syn. *L. undulata*, Gray.

This species is frequently found on the sea coast, especially near mouths of rivers. In the estuary of the Bassein river, it occurs together with true estuarine forms. It is met with on stones and dead wood, close to high water mark.

Family ASSIMINIIDÆ.

No. 12, **Assiminia rubella**, W. Blanf. pl. II. fig. 11. 12.

A small roundly ovate, dull red species, which occurs abundantly near Port Dalhousie, on mud between tidemarks. It is a characteristic *Assiminia*, though much shorter and rounder than the Bengal species *A. Francesiæ*, Gray, and belonging in fact to a different section of the genus. It is closely allied to some Singapore species and also to *A. marginata*, Leith, which inhabits Bombay, but may be distinguished from all by the double marginal impressed line below the suture.

The animal is deep red, with a black spot upon each of the lobes into which the proboscis is divided. The eyes are at the top of the short tentacles.

Family RISSOIDÆ.

IRAVADIA, n. g.

Testa imperforata, turrita, spiraliter costata, solida, epidermide tecta: apertura ovata, integra, antice obsolete effusa; peristomate recto, extus variciformi-incrassato, intus dilatato.

Animal? Operculum?

Shell imperforate, turrited, spirally ribbed, rather thick, covered with an epidermis. Aperture ovate, without a canal, slightly effuse in front; peristome straight, not sinuate, with an external varix, and slightly expanded within. Animal and operculum unknown.

No. 13, **Iravadia ornata**, n. sp. Pl. II. fig. 13. 14.

Testa turrita, decollata, subcylindrica, (junior elongato-conica), solida, spiraliter costata, inter costas confertim verticaliter costulata, sub epidermide olivaceâ vel ferrugineâ albida. Anfr. superst. 3-4, *rotundati, superi tribus, penultimus quatuor, ultimus sex costis spiralibus ornati, hoc juxta aperturam paulo ascendente. Apertura sub-verticalis, elliptica, intus alba, (in testâ juniori postice angulata), antice subangulata et in testâ adultâ obsolete effusa, in juniori subcanaliculata; peristoma extus incrassatum, nodoso-variciforme, nodis costis spiralibus congruentibus, intus vix expansum. Operc.?*

Long. $4\frac{1}{2}$, *diam.* $2\frac{1}{2}$ *mill.*

Shell turrited, decollated (the young shell elongately conical,) thick, spirally ridged, with close vertical costulation between the ridges, white, with a brownish or olive epidermis. Whorls apparently about 6, when perfect, but only 3 or 4 remain in all the specimens collected; body whorl with 6 spiral ribs, of which 4 only appear on the penultimate whorl, and 3 on the upper whorls, the lower ribs being concealed. On all the upper whorls the 2nd and 3rd ridges are the strongest. Those near the suture, both above and below, are less strongly marked, and are occasionally obsolete. On the last whorl the uppermost ridge near the suture is alone fainter than the others. The body whorl ascends a little towards the aperture, which is subvertical and nearly elliptical. The anterior canaliculation is obsolete in the adult, but it is well marked in the young shell. Peristome much thickened, externally variciform, the varix being nodose in consequence of the spiral ribs of the body whorl being continuous upon it. In young specimens the lip is grooved inside, the grooves corresponding to the external ribbing, and slight remains of this grooving may be traced in the adult shell.

I had at first classed this shell as a *Rissoina* on account of the obsolete canal, although it differs in essential characters from any species of that genus. I am indebted to my friend Dr. Stoliczka for calling my attention to the great distinctions which exist between the present form and *Rissoina*, and some of which equally serve to distinguish it from *Rissoa* and all other genera of the group. *Iravadia* differs from *Rissoina* in possessing an epidermis, in having spiral sculpture, in the peristome neither being sinuate above, nor projecting below, and in the columellar margin being simply curved in front and not excavated. From *Rissoa* it is distinguished also by its epidermis and sculpture, by the obsolete channel in front of the aperture, which, in young specimens, is quite as distinct as in *Rissoina*, and by the absence of any tendency to the columellar tooth or fold, which is so conspicuous in the typical species of the genus. The characters of the sculpture, epidermis, and aperture serve equally to separate the present form from *Alvania*, *Onoba*, *Ceratia* and other genera of *Rissoidæ* : *Hydrobia* and *Amnicola* alone have an epidermis, but both are smooth shells without a variciform peristome.

It is unfortunate that no specimen of the operculum has been preserved. The few shells found were collected during a hurried journey in a boat. The species was only met with at one spot, under stones, amongst some rocks in a creek leading into the Myittaya, a branch of the Bassein river. Several specimens were obtained, but when an opportunity was afforded of examining them at leisure, the opercula had disappeared. In the absence of the operculum, I should be disposed to consider the genus as more nearly allied to *Rissoina* than to any other, and such naturalists as may refuse generic rank to *Iravadia*, may perhaps best class it as a subgenus or section of that genus. It may have affinities with a curious species from Peru (*Rissoina sulcifera*, Trosc.) figured by Schwarz von Mohrenstern in his monograph of *Rissoina* in the Denksch. k. k. Akad. Wien, xix, 182, Taf. 10, fig. 83, and the differences between which and all other *Rissoinæ* are pointed out by that author.

The curious little shell dredged by Mr. A. Adams in the seas of Japan and described by him as *Vanesia sulcatina* in the Annals and Magazine of Natural History for 1861, Ser. 3, vol. viii, p. 242, may also possibly have some affinities with *Iravadia*.

No. 14, **Stenothyra monilifera,** Bens. Pl. II, fig. 15.

I found two specimens of this species at Port Dalhousie in the Bassein river. The type was first obtained by Mr. Theobald at Mergui and Rangoon, and the shell has since been found in Cochin China. As the species does not appear to have been figured, I add an illustration of it.

Family NERITINIDÆ.

No. 15, **Neritina Peguensis,** n. sp. Pl. I. fig. 1—16.

Testa globosa, oblique ovalis, solida, confertim oblique subsinuate rugata, interdum spinigera, epidermide fusco-olivaceâ, minute flavo-punctulatâ, aliquando maculis oblongis subcurvatis flavis infra suturam ornatâ, vel fasciis subobsoletis spiralibus circumdatâ, induta, sub epidermide cærulea vel rubella, albido-maculata. Spira vix exserta, plerumque erosa, sutura elevato-compressa. Anfr. circa 3, superi planulato-concavi, ultimus superne ad suturam appressus, supra peripheriam aut carinatus, spinisque distantibus munitus, vel obsolete angulatus, subtus rotundatus. Apertura intus lactea ; peristoma semiovale, areâ columellari planulatâ, luteolâ v. sordide albidâ, minute denticulatâ, plicâ unicâ majori intrante supramedianâ munitâ, antice edentatâ. Operc. extus planum, albidum, margine externâ nigrâ, intus rubrum.

Maj. diam. 19, *min.* 15, *alt.* 19 *mill. Hab. in rivulo ad Promontorium Negrais.*

Var. minor testâ magis rotundatâ, spinis omnino carentibus, fig. 13—16. *Maj. diam.* 14, *min.* 11, *alt.* 15 *mill.*

Hab. ad Portum Dalhousie.

Shell globose, obliquely oval, solid, closely obliquely and rather sinuously wrinkled, sometimes bearing spines, covered with a dark epidermis. Colour generally dark olive with minute yellow specks, occasionally with oblong splashes of yellow below the suture; these generally curve backwards, and are sometimes, but rarely, of large size. Some shells are surrounded more or less obsoletely with yellow bands. Beneath the epidermis the shell is pink or bluish spotted with white. Young specimens are frequently pink, with yellow specks, in front of each of which is a black streak like a shadow. The spire is barely exserted, apex obtuse, and generally eroded, the erosion extending frequently down the spire, and often a portion of the outer surface of the last whorl itself is wanting; suture raised, compressed. Whorls 3, the upper ones frequently wanting, but when present, flattened or subconcave. Last whorl concave and compressed against the suture above, then either carinate above the periphery and bearing short subdistant spines, or else obtusely, more or less obsoletely angulate. Below it is always rounded. Aperture milky within, peristome semioval, columellar area flat, yellow or dirty white, minutely denticulate, except in front, and having a prominent re-entering tooth just above the middle. Operculum pinkish white outside, exterior margin black, red inside.

The nearest ally to this form with which I am acquainted in *N. obscurata*, Recluz, which has a more expanded mouth, and more deeply emarginate columellar area, the whorls appear also rather differently shaped above.

The present species is eminently variable. The type occurred in abundance close to the beach in a small stream which descends from the hills close to Cape Negrais; specimens were especially abundant in a brackish pool at the beach, spinous and spineless shells occurred mixed together, and the presence or absence of spines is evidently of no importance. The spineless variety from Port Dalhousie was found in the salt water of the Bassein river, abounding along the strand between tide marks.

To illustrate the variation of this species, several specimens have been figured.

Specimens collected by Mr. Theobald in Arakan illustrate the gradual passage, by absolutely insensible gradations, of this form, into the very distinct *N. retifera*, Bens. of the Ganges delta.

No. 16, **Neritina obtusa,** Benson.

Scarce. I obtained two specimens on limestone rock at Thamandewa in the Bassein river.

No. 17, **Neritina Smithii** Gray.

Less common than in the estuary of the Ganges.

I have another species of *Neritina* belonging to the typical section from the estuary of a small stream running into the sea just north of Cape Negrais. I have been unable to identify it with any known species, and it may possibly be new.*

No. 18, **Neritina (Dostia) depressa,** Benson, pl. I, fig. 17,18, 19.

There are specimens of this shell amongst my Irawaddy collections: I think they are from Rangoon. The species is generally found in fresh or slightly brackish water, while *Neritina crepidularia* and *N. cornucopia* are chiefly met with nearer the sea, where the water is more salt. In Bombay Island, however, I have met with *N. depressa* on the sea shore.

No., 19, **Neritina (Dostia) crepidularia,** Less. Pl. I. fig. 20, 21, 22.

This shell and the next are found rather abundantly upon trees growing in places covered by water at each tide, and especially upon *Nipa* palms. *N. crepidularia* frequently occurs upon the sea shore, as well as in estuaries.

No. 20, **Neritina (Dostia) cornucopia,** Benson, pl. I. fig. 23, 24, 25.

Locally abundant. The shells found by me in Pegu differ slightly from the type, which is scarce in the Hoogly at Calcutta. In the latter, the apex of the shell is very nearly in the same plane as the edge of the peristome, sometimes actually so and touching it. In Pegu specimens, the peristome is free from the apex. The difference is very trifling, and there is slight variation in this character in specimens from the same river. In other respects, the shells appear to agree excellently.

I learned from Mr. Benson some years since that *Neritina melanostoma*, Troschel, is identical with *N. cornucopia*, the latter name having priority.† The figures of the former in Philippi's Abbildungen

* Further examination shews it to be one of the forms already referred to as intermediate between *N. Peguensis* and *N. retifera*, B. It is smooth like the latter.

† *N. melanostoma* was published in Wiegman's Archiv for 1837, p. 179; *N. cornucopia* was described by Mr. Benson in this Journal for 1836. Vol. V. p. 748.

are poor, but the specimens were from Bengal, and they present no essential difference from immature shells of *cornucopia*, so Mr. Benson is doubtless correct. Reeve in Conch. Icon. quotes *N. melanostoma* as a synonym of *N. crepidularia* and ignores *N. cornucopia* altogether. Von Martens (Malakoz. Blätter, 1863, X, 127.) shews that the colour of the columella and lip is sometimes white and sometimes black in several *Neritinæ* of the *Dostia* section.

The fact very probably is, that we have in this case an example of a phenomenon not uncommon in the animal kingdom. Two distinct races spring up side by side, arising from one type, and in the original locality do not change their form, but although they breed truly, they are only distinguishable by some slight constant distinction. As both, however, migrate into distant regions, the difference becomes greater, and at length both become so diverse, that no question can remain as to their being in common natural history talk, "distinct species." Thus while *Neritina cornucopia* and *N. depressa*, inhabiting the Ganges delta, are scarcely distinguishable from each other by any more important character than the colour of the aperture, the same shells in Pegu have varied so much, that each differs from the other at least as much as it does from their congener *N. crepidularia*. In other places the race representing *N. cornucopia* may be perfectly undistinguishable from *N. crepidularia*, as appears to have been observed by v. Martens in Singapore. It is highly probable that the origin of species through variation takes place in space as well as in time. More observations on this question are desirable.

Figures of the three forms occurring in the Pegu delta are added.

Family PALUDINIDÆ ?

No. 21, **Larina ? Burmana,** n. sp. Pl. II, fig. 1.

Testa ovato-globosa, imperforata, tenuis, castanea, striatula, nitidula. Spira conoidea, apice erosula, sutura valde impressa. Anfr. 5, *rotundati, sensim descendentes, ultimus tumidus, subtus rotundatus. Apertura vix obliqua, subelliptica, superne angulata ; peristoma rectum, tenue, marginibus callo tenui junctis, columellari expansâ. ? Operc. corneum. Long.* 11, *diam.* 8 *mill. Apertura* $7\frac{1}{2}$ *mill. longa,* 6 *lata.*

Shell ovately globose, imperforate, thin, translucent, smooth, brownish, horny. Spire conoidal, apex eroded, suture deep. Whorls 5 (perhaps more in adult specimens), rounded, obsoletely striated, regularly descending, the last tumid, rounded beneath. Aperture nearly vertical, subelliptical, angulate above. Peristome thin, straight, margins united by thin callus, columellar margin narrowly expanded.

The operculum of this peculiar species was unfortunately lost, and the animal was not observed. In the hurry of travelling, the specimens were placed in a box and forgotten, until the fleshy portions were too much decayed for examination. About half a dozen individuals were found under stones in the Myittaya creek, in the same place which yielded *Iravadia ornata* and other forms.

Mr. A. Adams, who very kindly aided me in determining some of the species contained in my Pegu collections, suggested that this shell might possibly be a second species of the genus *Larina*, established by him for an Australian shell, the animal of which also is unknown. In appearance this shell somewhat resembles a *Lymnea*. It is not impossible that it may have affinities with *Amphibola*. I have a distinct impression that the shells possessed a horny operculum, or I should have been disposed to class them in the *Velutinidæ*.

Family TECTURIDÆ.

No. 22, **Tectura fluviatilis,** n. sp. Pl. II, fig. 2, 3, 4.

Testa depresso-conica, rotundato-ovalis, tenuis, epidermide fusco-olivaceâ induta, lineis radiantibus, striisque confertis minutis concentricis decussata, intus cæruleo albida, interdum fasciâ concentricâ lacteâ, vel etiam omnino hoc colore versus marginem saturata, ad apicem ferruginea. Apex subcentralis, erosa.

Major diam.	$21\frac{1}{2}$	*min.*	20	*alt.*	6
,,	20	,,	17	,,	$5\frac{1}{2}$
,,	14	,,	12	,,	4

Shell much depressed, conical, subcircularly oval, thin, covered with a very dark olive epidermis, always eroded at the apex, marked with fine radiating raised lines and with close and minute concentric striæ of growth; inside the shell is bluish white, sometimes with one or more milky concentric bands, or the whole interior is milky, except the apex which is invariably ferruginous, the area so coloured having some correspondence to the amount of external erosion, and the colour being evidently due to a deposition of shell inside to protect the animal as the external portion is corroded away.

This species is found on rocks, rarely on trunks of trees, in many of the creeks near high water mark, in brackish water. It was not met with near the sea, where the water was very salt.

The foot is large, filling the cavity of the shell, muzzle broad, tentacles long and fine, mouth not notched beneath. It does not appear to keep to one place and form a hole for itself like some *Patellæ*, but it is very sluggish in its movements.

Sub-class OPISTHOBRANCHIATA.

Family BULLIDÆ.

No. 23, **Haminea tenera,** A. Ad.

Not common. In Bombay this species abounds upon mud flats. The animal is red.

Sub-class PULMONIFERA.

Family AURICULIDÆ.

No. 24, **Auricula Judæ,** L.

This species is completely blind, as has been noticed by von Martens (Ueber die Landschnecken der Molukken, Malakoz. Blätter; 1863, X. 126) and as is shewn in Eydoux's drawing copied in Mrs. Gray's mollusca. The same is the case with all other species of the same group which I have examined. In some instances, *e. g.* the Bombay species, which has received, I believe, a MS. name from Mr. Benson, the eyes may be detected beneath the skin by looking very carefully. (Von Martens observed this in one instance in *A. Judæ.*) Such eyes can, however, be of but little use as percipient points to the animals. There is, however, one group of true *Auriculæ*, typified by *A. subula*, Quoy and Gaimard, in which the eyes are normally developed, the same as in *Melampus*, *Cassidula*, and other *Auriculidæ*. A small species of this type inhabits Bombay. The forms belonging to this sub-division appear also distinguished by a more elevated spire. Further observations are, however, necessary before a division of the genus can be proposed on these grounds, as there appears great probability that the two forms pass into each other.

I found specimens of *A. Judæ* alive under the bark of dead trees, on muddy banks of creeks, in places overflowed by the tide. Unquestionably, so far as my experience goes, none of the Eastern *Auriculidæ* (*Auricula*, *Cassidula*, *Melampus*, *Pythia*, *Plecotrema*) are land shells, all are met with in places overflowed by salt or brackish water at every tide. They are in fact true estuary shells.

Some of the specimens of this species collected by me shew an almost complete passage into *A. dactylus* Pfeiffer, as described and figured in *Novitates Conchologicæ* I, 15, pl. V. fig. 15. 16. This species is stated by Mr. Theobald to be found at Mergui (J. A. S. B. for 1857, xxvi. 253.)

No. 25, **Auricula nitidula,** n. sp. Pl. II. fig. 5, 6.

Testa non rimata, subfusiformi oblonga, solida, nitidula, sub epidermide olivaceâ alba, lineis impressis confertis verticalibus minutissime rugata, aliis spiralibus granulato-decussata, sculpturâ infra suturam magis impressâ. Spira conoidea, apice eroso, sutura impressa. Anfr. 5 *convexi, ultimus vix descendens,* $\frac{2}{3}$ *longitudinis subæquans, basi rotundatus. Apertura verticalis, plicæ parietales* 2, *supera parva, profunda, alia obliqua, plica columellaris haud valida, diagonalis : perist. crassum, marginibus callo tenui junctis, dextro superne vix sinuato, intus callo elevato incrassato.*

Long. 28, *diam.* $12\frac{1}{2}$ *mill. Apertura c. perist.* 19 *mill. longa, intus* 5 *lata.*

Shell not rimate, subfusiformly oblong, solid, smooth, having a greasy lustre, white, epidermis olive, covered with minute granulations produced by the intersection of vertical and spiral impressed lines, both very close and the former sinuous, the sculpture being most strongly marked below the suture. Spire conoidal, apex eroded, suture impressed. Whorls 5 convex, the last nearly $\frac{2}{3}$ of the whole length, scarcely descending, rounded at the base. Aperture vertical with 2 parietal plicæ, the upper one small, far inside ; the lower strong, oblique ; columellar plica moderate in size, diagonal ; the peristome thick, the margins united by a thin callus which is somewhat expanded upon the penultimate whorl, the right margin scarcely sinuate above, and thickened inside.

This species which is found very rarely with the last, exactly resembles it in general form, but has rounded whorls and finer sculpture, besides being of much smaller size. The animal is white, while that of *A. Judæ* is mottled. *A. nitidula* somewhat resembles *A. Chinensis* Pfr. which, however, is much less attenuate below, and differs in the form of the aperture, &c.

But two or three specimens of this form were met with. In Mr. Theobald's lists of Burmese shells, *A. glans,* Bens. is mentioned. I can find no description of this species, and cannot therefore say if it be the present form or not.

No. 26, **Plecotrema Cumingiana**, n. sp. Pl. II. fig. 16.

Testa subrimata, subelliptico-ovata, solida, punctis impressis crebris, lineas spirales confertas formantibus, striisque incrementi obliquis ornata, ferrugineo-fusca. Spira conoidea, lateribus vix convexiusculis, apice erosa, sutura lævi lineari. Anfr. 4 *superst., superi planulati, vix discreti, sulcis spiralibus punctatis* 4 *notati, ultimus ad peripheriam subangulatus, subtus compressiusculus. Apertura vix obliqua, plicis parietalibus* 2, *superiori brevi obliqua, alterâ intrante, extus bifidâ, plicâ columellari subobliquâ; peristoma rectum, pone limbum acutum intus callosum, margine dextro tridentato.*

Long. 5, *diam.* 3 *mill. Apert.* 3¼ *mill. longa.*

Shell subrimate, subelliptically ovate, solid, marked with close spiral lines, formed of thickly set punctiform impressions, and with oblique striæ of growth; reddish brown in colour. Spire conoidal, the sides barely convex, apex eroded, suture flat. Whorls 4 remaining, the upper flat, scarcely distinguishable, marked with 4 spiral dotted lines, the last whorl subangulate at the periphery, somewhat compressed below. Aperture very slightly oblique, with two parietal folds, the upper short, oblique, the lower re-entering, externally bifid, the columellar fold sub-oblique; peristome straight, margin sharp, but inside the sharp edge thickened and bearing 3 teeth within the right margin.

This species was rather scarce, crawling on mud in company with *Assiminea rubella*. It is distinguished from its allies, *P. striata*, Philippi, and *P. punctostriata*, H. and A. Adams, by its low spire and minute sculpture. In naming it after the late Mr. Hugh Cuming, I adopt the only means in my power of acknowledging my obligations to that gentleman for the very liberal manner in which he allowed me access to his collections, for the purpose of comparing and identifying my Pegu shells.

Besides the above *Auriculidæ*, I have received a *Pythia* which appears to be a variety of *P. trigona*, Troschel, from Mr. Theobald and Mr. Fedden, who both met with it on the Arakan coast, not far north of Cape Negrais. It is singular that I did not meet with species of either *Cassidula* or *Melampus*, as I have reason to believe that both inhabit the Irawadi delta or its immediate vicinity. Mr. Theobald has sent me *Cassidula aurisfelis*, Brug. from Arakan.

Family AMPHIBOLIDÆ.

No. 27, **Amphibola Burmana,** n. sp. Pl. II, fig. 7—10.

Testa aperte umbilicata, naticoidea, tenuiuscula, castanea, periomphalo plerumque saturatiori, nitidula, subsinuate striatula, infra suturam dense peroblique striata, lineâ unâ elevatâ spirali, interdum obsoletâ, superne haud procul a suturâ signata. Spira conoidea, apice vix obtusa, sutura profunda. Anfr. 4 *rotundati, ultimus tumidus. Apertura ovata, superne recte angulata; peristoma vix interruptum, breviter adnatum, tenue, marginibus approximatis, callo tenui junctis, dextrali superne sinuatâ, basali rectâ, columellari breviter reflexo, umbilicum partim tegente. Operculum corneum, paucispirale, nucleo basali, sinistro.*

Alt. 10, *diam.* $9\frac{1}{2}$ *mill., apertura* $7\frac{1}{2}$ *longa,* $5\frac{1}{2}$ *lata.*

Shell openly umbilicated, naticoid, rather thin, orange-brown, darker around the umbilicus, smooth, marked with subsinuate lines of growth, closely and very obliquely striated just below the suture, with a single raised spiral line, which is sometimes obsolete, on the upper portion of each whorl. Spire conoidal, apex subacute, suture deep. Whorls 4, rounded, the last swollen. Aperture ovate, rectangulate above; peristome scarcely interrupted, free, except for a very short distance, from the last whorl, thin, margins closely approximate, united by thin callus, right margin rather deeply sinuate above, basal straight, columellar turned back near the umbilicus, which it partly conceals. Operculum horny, paucispiral, nucleus basal, sinistral.

This is, I believe, the first instance in which the presence of *Amphibola* has been indicated in the Indian or Burmese seas or estuaries; nevertheless, it is very common. I found, in Mr. Cuming's collection, specimens of the same form as that above described, which were collected in Malacca by Dr. Traill, and a smaller form, scarcely separable as a race from the above, abounds in Bombay harbour.

The present species is nearly allied to *A. fragilis*, Quoy and Gaimard, but is thinner, with a lower spire. It was found abundantly crawling on mud, between tidemarks, in company with *Assiminea rubella* and *Plecotrema Cumingiana.* The animal was difficult to make out, as it consisted of an indistinct translucent mass. There were no tentacles, and the eyes were on very short lobate pedicels. The animal differs considerably from the figure of that of *Amp. fragilis*, as copied from Quoy and Gaimard by both Adams and Mrs. Gray.

Class CONCHIFERA.

Family PHOLADIDÆ.

No. 28, **Martesia fluminalis,** n. sp. Pl. III, fig. 1, 2, 3.

Testa ovata-conica, valde inæquilateralis, antice hemispherica, postice sensim acuminata, extremitate membranacea, albidâ, tenuis. Valvæ versus margines epidermide crassâ, coriaceâ indutæ, pagina antica juxta cardinem costulis confertissimis, sinuatis, concentricis, lineisque radiatis elevatis decussantibus pulchre ornata, subtus glabra, postica concentrice striata. Callum trilobato-peltatum, medio divisum. Valvula dorsalis rudimentaria, cornea.

Lat. $12\frac{1}{2}$, *long.* 6, *alt.* $5\frac{1}{2}$ *mill.*

Shell ovately conical, white, thin, inequilateral, anterior extremity hemispherical, posterior regularly acuminate and membranaceous at the extreme end. Valves near the edges covered with a thick coriaceous epidermis, which in places, and especially towards the posterior extremity, extends beyond the margin and forms a membranaceous fringe, uniting the valves more or less. Each valve is divided into two parts by a line passing obliquely from the hinge to the ventral margin and inclined slightly backwards; in front of this line the shell near the hinge is decussated with very close sinuate concentric and subdistant radiating costulation; near the ventral margin it is smooth. Behind the oblique line the valves are concentrically striated, more or less indistinctly. The callus covering the hinges is trilobate and divided by a fissure in the centre; dorsal valve rudimentary, horny, commencing at some distance from the hinge, increasing in breadth backwards, but very narrow throughout.

This species appears most nearly allied to *M. rivicola*, Sow., which was found perforating floating logs in a river in Borneo. The present species is blunter and shorter, and *M. rivicola* is destitute of the sculpture on the anterior portion of the valves.

M. fluminalis was found boring in soft argillaceous sandstone, in creeks far from the sea, where the water was brackish. The external orifice in the stone is very minute, and must have been made by the shell when very young. Inside, the burrow exactly fits the shell, so that the only possible motion is rotation upon the longest axis of the shell.

The epidermis appears normally to cover the posterior subdivisio of the valves, but it is always deficient, except towards the margins.

No. 29, **Teredo ?** sp.

All the dead trees in creeks in the Irawady delta are perforated throughout by a species of *Teredo* (?) I either omitted to take specimens, or else have lost them since, and I can now find none to which to refer. It is possible that this shell may be the *Teredo thoracites* of Dr. Gould,* described in Vol. VI, of the Proceedings Boston Society of Natural History, and on which he subsequently, in Vol. VIII, proposed to found the subgenus *Calobates*, characterized by the "pallettes" (stylets) being "stilt shaped, bony." Dr. Gould's specimens were from Tavoy, but he does not mention if they were fluviatile or marine.

Family CORBULIDÆ.

No. 30, **Sphenia perversa,** n. sp. Pl. III. fig. 4, 5, 6.

Testa oblongo-ovata, parum inæquivalvis, valvâ dextrâ majori, tenuiuscula, alba, concentrice irregulariter striata, antice rotundata, postice acuminata, demum transverse truncata, ad extremitatem epidermide coriaceâ, rugatâ induta ; margo dorsalis subrecta, ventralis antice convexa, postice vix concavâ. Processus cardinalis valvæ sinistræ (non dextræ) elongato-lamelliformis.

Lat. 11, *long.* 6, *alt.* 4 *mill.*

Shell oblong, slightly inequivalve, broadest at the umbo, somewhat acuminate posteriorly, and very much more so in young specimens; thin, white, irregularly striated, the posterior end covered with a thick coriaceous epidermis which is vertically furrowed. In the young shell the epidermis covers all the shell except the beaks; it is thin except along the dorsal and posterior margins, where it is thick and vertically sulcated. The dorsal margin is nearly straight, the ventral rounded in front and slightly concave behind in old shells, straight or nearly so in young specimens. There is a lamelliform process in the hinge of the *left valve*, in front of the cartilage.

This shell was met with in burrows in stone, apparently the holes of *Martesia* which had perished, at least they did not appear to have been formed by the present species. It was met with at a considerable distance from the sea, in company with *Martesia fluminalis*.

In every respect, except the position of the lamellar tooth in the hinge of the left valve instead of the right, the shell appears to be a true

* Otia Conchologica pp. 222, 241.

Sphenia. I scarcely think that the exceptional character justifies the creation of a new genus, as the characters of the animal unfortunately were not noted. The practice of establishing genera for single species on insufficient grounds is so objectionable, that it will be better to err in the opposite direction. When the animal has been examined, should it shew distinctions from *Sphenia*, it will be easy to propose a new generic or subgeneric appellation.

No. 31, **Corbula**, sp.

A single valve of a very thin species of *Corbula* was found on mud above Port Dalhousie.

Family TELLINIDÆ.

No. 32, **Sanguinolaria diphos**, L.

This shell lives at a depth of about 4 feet in the mud. I found it abundantly in a marsh overflowed by every tide and where I should never have suspected its existence, had not my Burmese coolies pointed it out and shewn me how to capture specimens. Burmese, being omnivorous beings, are far better acquainted with the hiding places of various animals than the natives of India are; amongst other dainties they eat *Sanguinolariæ*, and the process for catching them which they shewed me was ingenious. The first thing was to cut a very thin slip of bamboo, about 5 feet long and not more than $\frac{1}{5}$ inch in diameter, and to make a small barb at the end. This they thrust down all the small holes in the mud, many of which corresponded to the siphons of the *Sanguinolariæ* below. Now and then the bamboo went through a *Sanguinolaria*, as he lay vertically with his valves open below the mud; of course the bivalve immediately closed his valves upon the intruder, and was ignominiously dragged out by the bamboo, his exit being aided by digging when he approached the surface. The only objection to the plan is, that most of the specimens are slightly injured, as the shell closes with such force upon the bamboo as to break the thin ends of the valves. Some specimens were brought up in which the bamboo had been absolutely thrust down the siphon, thus literally impaling the *Sanguinolaria.* The siphons are of great length, considerably exceeding the shell.

No. 33, **Macoma ala**, Hanley.

No. 34, **Scrobicularia angulata**, Chem.

I find both the above shells recorded in my list. I cannot now come across the specimens, and I am under the impression that they were found dead in salt water marshes on the Arakan coast, and not in the delta, but they are both so common in all Indian estuaries, that it is equally probable that I found them in the Bassein river.

Family VENERIDÆ.

No. 35, **Chione Ceylonensis**, Sow.

I have mislaid my notes as to the exact locality of this species also. I think it was found at Dalhousie. In a backwater on the Arakan coast, I found an allied, but undescribed species of the same genus.

No. 36, **Artemis**, sp.

Of this I have a single immature specimen. It may be the young of *A. excisa*, Chem. but has not the sculpture of that species, nor its angulate posterior slope.

Family CYRENIDÆ.

No. 37, **Cyrena Bengalensis**, Lam.

Mangrove and other salt water swamps along the edges of creeks, amongst roots of trees and brushwood, common.

I am inclined to refer the shells I obtained to the above form, of which I suspect some others since described are merely varieties. *Cyrenæ* vary greatly with age, besides being eminently variable in form. Thus some of my specimens exactly agree with *C. turgida* Desh., but I cannot help believing that they are merely immature specimens of the thicker form which I refer to *C. Bengalensis*.

Family MYTILIDÆ.

No. 38, **Mytilus smaragdinus**, Chem.

Found in creeks below low water mark. I do not think it is generally known that the flesh of this species is very delicious. Some were brought to me along with a quantity of oysters, and the Burmese told me that the mussels were the better eating of the two. Not having much faith in Burmese palates, I preserved the shells and threw away the soft parts of the *Mytili ;* but as a trial, I had two or three cooked with the oysters. I found that the Burmese were quite right, though the oysters were by no means unpalatable.

No. 39, **Modiola emarginata**, Bens.

A dwarf variety of this species occurs in salt water creeks.

Family ARCIDÆ.

No. 40, **Arca (Anomalocardia) granosa, L.**

This very common species was only found at one spot in the Bassein river. It was living in mud close to the surface, under stones and roots of plants. The same species abounds in mud, amongst stones, in Bombay harbour, and is collected for food by the natives.

No. 41, **Scaphula deltæ**, n. sp. Pl. III., fig. 7-10.

Testa tumida, perelongato-rhomboidea, sub epidermide crassâ, fuscâ, posticè radiatim liratâ albida, lineis minutis elevatis confertissimis decussata, ante carinam costâ unicâ latâ, planulatâ, aliquando obsoletâ, a natibus ad marginem decurrente, munita, intus cærulescens, antice rotundata, postice oblique truncata, margine ventrali antice convexâ, postice vix concaviusculâ (testæ junioris rectâ). Carina perelevata, acuta, valvas in paginas duas dividens, anticâ tumidâ, posticâ concavâ. Area nitida, sub lente striatula, ligamento rhombeo solum antice induta. Dentes cardinales postici breves, obliqui, ab extremitate remotiusculi.

Lat. 10 *long* $3\frac{1}{2}$ *alt.* $6\frac{1}{2}$.

„ 8 „ 3 „ 5.

Shell very tumid, elongately rhomboidal, (the ventral and dorsal margins being parallel as in *S. celox*) covered with a thick, dark epidermis, which is rather rough and radiately ribbed behind the keel. Beneath the epidermis the shell is white, and decussately very minutely sculptured, one flat broad rib, scarcely raised, and occasionally obsolete in old specimens, passing from the umbones to the margin just in front of the keel. This is scarcely distinguishable until the epidermis is removed. The valves are bluish within, rounded in front, obliquely truncated at the posterior margin; the ventral margin is convex anteriorly, subconcave posteriorly, being straight for the greater part of its course in young shells, but becoming slightly concave, at the spot where the byssus passes out, in old specimens. The keel is very high and sharp, separating the valves into two subdivisions, the anterior of which is tumid, the posterior concave. The area is polished and striated rather obliquely, the ligament diamond-shaped and covering only the anterior portion, about $\frac{1}{3}$ to $\frac{1}{2}$ the length, of the area. The hinge teeth are oblique, but less so than in either *S. celox* or *S. pinna*, and the posterior teeth are much farther from the extremity of the shell than in either of those species.

The great distinction between this species and the other two previously described is in the far greater tumidity of the valves, which are nearly twice as broad in their diameter from side to side (of the closed valves) as they are from the dorsal to the ventral margin. The proportion of the two diameters in the present species averages about 12 : 7. In *S. celox* it is 12 : 10½ and in *S. pinna* 12 : 9½.* The last named species is of a totally distinct form, being much wider posteriorly than in front, so that it is sub-trigonal in shape instead of rhomboidal. Its posterior hinge teeth, also, are near the extremity, and so oblique as to be almost parillel to the hinge line, while in its smooth, thin epidermis, marked concentric sculpture, and convex posterior subdivision of the valves, it differs widely from *S. deltæ*. The ligament of *S. pinna* covers a greater proportion of the length of the area, (about ⅔,) than does that of *S. deltæ*. It is much narrower in proportion to its length, as is indeed the entire area, corresponding to the smaller tumidity of the valves. *S. celox* approaches more nearly to the present species, but is thinner and much less tumid, has its posterior hinge teeth more oblique and nearer to the extremity, and differs widely in sculpture.

S. deltæ was found under stones in creeks, adhering by a byssus. It was not met with near the sea. It is the first species of the genus that has been found in brackish water, both of the forms described by Mr. Benson being from large rivers far above the influence of the tide.

Mr. Benson mentions the occasional occurrence of a raised rib in front of the keel in *S. celox*. I have several specimens, which I received from Mr. Theobald, shewing this peculiarity. It differs entirely from the flattened subobsolete rib of *S. deltæ*.

Figures of all 3 species are added to illustrate the difference between them.

Family ANOMIAIDÆ.

No. 42, **Anomia**, sp.

The specimens of this shell have unfortunately been mislaid. I only obtained two or three specimens, and it is extremely difficult to make out the species of this genus.

No. 43, **Anomia (Ænigma) ænigmatica**, Chem.

Occasionally found adhering to stumps of trees in salt water creeks.

Family OSTREIDÆ.

No. 44, **Ostrea**, sp. (? 2 sp.)

A large form occurs in the creeks below low water mark. A smaller kind is met with between tide marks in mangrove swamps and creeks, attached to wood or stones. I unfortunately omitted to take specimens of either.

* Measured from authentic specimens of each species.

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Part II.—PHYSICAL SCIENCE.

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On the Jungle products used as articles of food by the Inhabitants of the districts of Manbhoom and Hazaribágh.

By V. Ball, Esq. B. A.

Geological Survey of India.

It is perhaps not generally known that throughout Manbhoom and Hazaribagh, as well as in many of the adjoining districts a considerable number of the poorer classes of the people depend solely upon the jungle to supply them with the means of subsistence for from two to three months of every year. In time of famine the number so dependent is of course greatly increased.

In some of the more jungly parts of these districts, where the cultivation round the villages is very limited and deficient, nearly the whole of the inhabitants who have survived the past famine, can have had little else but the roots and fruits of the surrounding jungle upon which to subsist. While passing through some of these villages last season, I was told that but few deaths had occurred in them.

On the whole I am inclined to believe that people living in such villages are more independent and less affected in every way by famine than those, who residing in the centre of cultivation, have no jungle readily accessible. Were a census to be taken, it would probably be found that the relative proportion of deserted houses and villages, the result of the famine, to those still inhabited, would be much greater in the open, cultivated parts of the district than in the densest jungles. Indeed the jungles may be regarded to a certain extent as the saving of the lower races of the population; did they not afford nutritious food in abundance, the result of a famine like that of 1866-7, would probably be not merely decimation, but utter depopulation throughout extended areas.

It is not to be supposed that even those who are in the habit of using this description of food regularly, for a greater or less portion of every year, regard it as in any degree an equivalent to rice. Many have spoken to me of eating *Mhowa*, which is by far the best of these products, as being only better than suffering from absolute famine, and they always consider themselves legitimate objects of charity, when they can say they are living on it alone.

The list which is appended to this paper, includes nearly 80 distinct species of plants which furnish articles of food. Owing to the difficulty of identifying the fragmentary specimens which were all that I could in some instances obtain, it has been impossible to make it fully complete. I believe, however, nothing of importance has been omitted.

To S. Kurz, Esq. curator of the Herbarium in the Botanic gardens, I am indebted for considerable assistance which has enabled me to bring forward this paper sooner and in a more correct form than would have been otherwise possible.

The species mentioned are of course of varying importance, some being merely edible, and in a few cases injurious if eaten in large quantities; while others, as the *Mhowá*, *Sál*, *Bier*, *Bur*, *Pipál*, *Singárá*, *Chehúr*, various roots of the species of *Dioscorea*, and many of the varieties of Sag (leaves) may be considered as *boná fide* staple articles of food.

Bassia latifolia, Roxb. *Mhowa*, H. & B.

The *Mhowa* is found in Bombay and Bengal; those who have not visited the more remote portions of one or other of these presidencies, can hardly realize the importance of this tree as a source of food to the poorer classes of the natives, more especially to such improvident races as the Bheels, Coles and Sonthals.

In the districts of Manbhoom and Hazaribagh, *Mhowa* groves as well as stray trees in the jungle are on the whole abundant. All the trees, with the exception of a few in the neighbourhood of roads, are the property of the zemindars, and are rented out by them at prices varying chiefly with the bazaar *nirik* or price of rice.

As the crop of *Mhowa* approaches ripeness, the corollas, becoming fleshy and turgid with secreted juices, gradually loosen their adhesion to the calyx and fall to the ground in a snowy shower. The duty of collecting the fallen blossoms is chiefly performed by women and children; at dawn they may be seen leaving their villages with empty baskets, and a supply of water for the day's use.

Before the crop has commenced to fall, they take the precaution to burn away the grass and leaves at the foot of the tree, so that none of the blossoms may be hidden when they fall. The gleaners generally remain under the trees all day, alternately sleeping and collecting the crop; the male members of the family, visiting the trees once or twice during the day, bear off the produce in *banghys.*

It often happens that the people who collect come from a considerable distance, in which case they erect with the branches of *Sál* a temporary encampment of huts in which they live until the crop is all gathered in. In front of each of these huts a piece of ground is made quite smooth and hard, for the purpose of spreading out the crop to dry.

When perfectly dry, the blossoms have a reddish brown colour, and in size they have lost three-fourths of their original dimensions and about half their original weight. It is the custom with some of the natives, before spreading them out to dry, to pull off the little ring of foliaceous lobes which crowns the fleshy corolla.

It is very difficulty to collect trustworthy statistics regarding the amount of yield of the *Mhowa* trees. I have been told, and it has been repeated to me several times, that a first class tree will yield as much as thirty *cutcha* maunds of 12 chittacks to the seer, or about $\frac{6}{7}$th of a ton; in other words, an average daily fall of two maunds is said to continue for 15 days. This estimate I believe is more than double what it ought to be.

The rent of the trees varies much with the abundance of them in the district, the quality of the previous rice crop, and various other circumstances affecting the demand and supply. In parts of Hazaribagh, I have known ten small trees to be let for a rupee, while a fine large one would sometimes alone bring that amount. In Manbhoom I have been pointed out trees for which a sum of from two to three rupees was charged, but I have also heard of trees being hired in the same district for four annas.

As do the trees, so the saved crop varies much in price, the limits being, as far as I can make out, from 2 to 8 maunds for the rupee; but when, as is perhaps most frequently the case, the exchange is in kind, the mahajuns only give a small quantity of salt and three or four seers of rice for a maund of *Mhowa.* In parts of Manbhoom, I have been told that during the famine, the price of *Mhowa* was from 12 to 20 seers for the rupee.

Two maunds of *Mhowa* are stated by some to furnish a months' food to a family consisting of a father, mother and three children. It is, however, seldom eaten alone, being much more frequently mixed with the seeds of *Sál*, SHOREA ROBUSTA, *Roxb.*, or with some of the leaves of the plants mentioned in the accompanying list which are collectively called *Ság.* The cooking is performed as follows. The *Sál* seeds, having been previously well dried in the sun, are roasted and then boiled alone; the *Mhowa* flowers are then also boiled, and the water is thrown away; so far having been cooked separately, they are then mixed and re-heated, sometimes a small quantity of rice is added. It is the custom to cook but once in a day, and each member of the family helps himself whenever he feels hungry.

When fresh, the *Mhowa* has a peculiar luscious taste with an odour somewhat suggestive of mice; when dried, it possesses some resemblance to the inferior kinds of figs. Cooking renders it vapid and utterly devoid of flavour. On distillation the newly dried flowers yield an highly intoxicating spirit called *darú;* this, before being sold, is diluted with ten times its quantity of water, and is then sold at the rate of two pice for about a quart.

Considering the really useful nature of this tree, it would be most desirable that whenever new lines of road are being made through any of the districts in which it thrives, it should be planted on either side, so that the poorest might avail themselves of the crop without having to pay rent to a zemindar or landlord.

If the yield of an average tree amount to 6 maunds, that is to say, enough to supply a small family with food for three months, there can be no question of the immense amount of food which in time of famine a row of trees planted along a road passing through the country would afford. Although the natives rigorously protect such trees as exist, I am not aware that they do anything to increase the number.

SHOREA ROBUSTA, Roxb. *Sál*, H. & B.

Under the head of *Mhowa*, the seed of this tree has already been alluded to. Where possible, the *Mhowa* and *Sal* are mixed in the manner above described, but in some places even *Mhowa* is not to be obtained, so that the *Sal* seeds are roasted and eaten alone. With many of the Sonthals, *Sal* is probably a regular article of food, and not merely a "*dernier ressort*" to be used in such a year as 1866-7.

FICUS INDICA, Roxb. *Bur*, B. & H.—F. RELIGIOSA, Linn. *Pipal* B. & H.

The figs of both these species especially those of the former are eaten every year by the poorer classes of natives. In one place last year I observed a number of wretched half-starved ill-clothed women and children, with a few still more wretched men, picking up the figs which had fallen from a banyan tree: they did not even knock the fruit off the tree, but were become so poor-spirited by hunger, that they were contented to collect the windfalls.

ZIZYPHUS JUJUBA, Linn. *Bier*, B. & H.

The fruit of this tree though not at all to be compared in importance with *Mhowa* as an article of food, is nevertheless much used in parts of these districts where *Mhowa* is not abundant; it may frequently be seen spread out to dry on the roofs of cottages. There are two varieties at least of *Bier*; one is a small bush with the appearance of which few who have travelled in India can fail to be familiar; the other is from the same original stock, but has been vastly improved by cultivation and is always found near villages.

This fruit is sold in the bazaars, and when not quite ripe, has the pleasant acidity of an apple.

BAUHINIA VAHLII, W. & A. *Chehur* B. & H.

The pods of this gigantic creeper which, passing from tree to tree, forms the festoons peculiar to tropical jungle scenery, are most eagerly sought for by the natives, so much so, indeed, that it was with difficulty that I succeeded in obtaining botanical specimens. They are plucked just before they become ripe; so that in order to open them, it is necessary to place them in a fire; on being sufficiently heated, they open with a loud report, and the carpels at once twist into curls which no amount of pressure can remove. The seeds are easily detached and are eaten at once.

TRAPA BISPINOSA, Roxb. & T. QUADRISPINOSA, Roxb. *Singhárá*, B. & H. *Punboje*, Sonth.

Both these species of *Singhárá* are well known to many Europeans. With the natives they form a favourite article of food. I have frequently seen from 20 to 30 persons, men, women and children groping in a half dried up tank for *Singhárá*, *Paludinas*, and small sluggish fish, which latter are caught by dragging on shore the weed in with they lie concealed. From the produce of a morning's collection of these miscellaneous substances a *tarkári* is made, which is perhaps the only food upon which a family have to subsist for the day.

In drawing up the following list, two systems of arrangement were possible, either to enumerate the species under their respective natural orders, or under headings indicating the part of the plant used; this latter form has been adopted, as it renders the list more accessible to those not familiar with botanical terms. The order in which the species are arranged is approximately that of their relative importance.

List of Jungle products used as articles of food.

Seeds.

Names.	Bengali.	Hindustani.	Remarks.
Shorea robusta, *Roxb.*	Sál.	id.	Much used by the Sonthals; occasionally roasted and eaten alone, but more frequently boiled up with the dried flowers of *mhowa.*
Bauhinia Vahlii, *W. & A.*	Chehúr.	id.	Sometimes stored, but more frequently roasted and eaten close to the spot where found.
Mucuna imbricata, *D. C.*	Kusee.	id ?	
——.— prurita, *Hook.*	Alkússa.	Kiwách.	
——.— nivea, *Buch.*	Khamach ?	?	Sometimes cultivated.
Terminalia Bellerica, *Roxb.*	Bhæra or Bora.	?	Kernels if eaten in excessive quantity are said to produce intoxication.
———— Catappa, *Linn.*	Bádám.	id.	Seeds used as a substitute for almonds.
Fuirena ciliaris, *R. Br.*	Band-kobi.	id.	Seeds of this used as a sort of meal and are probably sometimes ground into flour before use.
Cassia fistula, *Linn.*	Bunderlati.	Amultás.	Placentæ between the seeds used to make sherbet.
Nelumbium speciosum, *Willd.*	Moolum Puddoo.	Bansera.	
Ventilago calyculata.	?	?	Seeds eaten in the same way as those of Sal.
		Fruits.	
Bassia latifolia, *Roxb.*	Moul or Mhowá.	Mhowá.	The fruit is dried in the sun and eaten in times of scarcity, and the seeds yield an oil which is used as a substitute for *ghee.* (See flowers.)
Buchanania latifolia, *Roxb.*	Piál or Piár.	id.	Fruit collected and sold in bazaars.
Mangifera Indica, *Linn.*	Am.	id.	Tree occasionally found wild in the jungle; use of fruit well known; seeds softened by steam and eaten in times of famine.
Spondias mangifera, *Pers.*	Amará.	id.	Fruit eaten raw when ripe; pickled when unripe.
Zizyphus jujuba, *Lam.*	Bier.	id.	Is dried and stored. A cultivated variety yields a much larger fruit.

Fruits—continued.

Names.	Bengali.	Hindústani.	Remarks.
Zizyphus Œnoplia, *Mill.*	Siá-Kol.	Makoi.	A small black fruit having a slightly tart taste.
——— rugosa, *Lam.*	?	?	
Ficus Indica, *Roxb.*	Bur.	id.	Are much eaten in time of scarcity by the very poorest Sonthâls and Coles.
—·— religiosa, *Linn.*	Pipal.	id.	
—·— glomerata *Roxb.*	Doomur.	?	
Carissa carandas, *Linn.*	Kurumea or Benchi.	Karroná.	Is capable of much improvement by cultivation.
Trapa bispinosa, *Roxb.*	Páni-phul or Singhárá.	Singhárá.	Are procurable in large quantities in some of the tanks. They furnish a very wholesome food.
—·— quadrispinosa, *Roxb.*			
Eugenia Jambolana, *Lam.*	Jamún.	id.	Fruit is collected and sold in the bazars.
Diospyros Melanoxylon, *Roxb.*	Keond or Kaned.	id.	Ditto.
——— exsculpta, *Ham.*	?	?	
——— embryopteris, *Roxb.*	Makúr-kendi.	?	
Olax scandens, *Roxb.*	Koko-aroo.	?	
Ægle Marmelos, *Corr.*	Bael.	id.	Chiefly used for making sherbet, but are also prepared in other ways.
Feronia elephantum, *Linn.*	Kuthbel.	Koet.	
Tamarindus Indica, *Linn.*	Tetal or Tentar.	Emle.	Dried and exported in large quantities.
Alangium decapetalum *Lam.*	Bágh-ankúra.	id.	Fruit somewhat astringent.
Flacourtia sapida, *Roxb.*	Katái.	id.	
——— cataphracta, *Roxb.*	Páni-zali.	...	
Phyllanthus emblica, *Linn.*	Ourá.	id.	Used for making pickles.
Bauhinia variegata, *Linn.*	Catchuá.	id.	
Mimusops elengi, *Linn.*	Bohl or Bakal.	Moulsere.	
Semicarpus anacardium, *Linn.*	Bellá.	id.	Acrid, except when perfectly ripe.
Erycibe paniculata, *Roxb.*	?	?	

Schleichera trijuga. *Willd.*	Khusm.	id.	Both ripe and unripe fruit are eaten.
Boswellia serrata, *Colebr.*	Sálgá.	?	
Karivia umbellata, Arn.	Rakhalsusa.	?	
Coccinia grandis, *W. & A.*	Tela-kúcha.	?	

Flowers.

Bassia latifolia, *Roxb.*	Moul or Mhowá.	Mhowá.	Extensively used throughout the district. Is generally cooked with *Sál* seeds. Price varies from 10 seers up to 8 maunds for one rupee.
Bauhinia variegata, *Linn.*	Catchná.	id.	Used in *tarkáris*, or vegetable curries.
Butea frondosa, *Roxb.*	Pulás.	id.[1]	Stamens and young pods occasionally eaten.

Leaves (*Ság.*)

Antidesma diandrum, *Tul.*	Muttá.	id.	Trees or shrubs.
——— ghœsembilla, *Gartn.*	Umtoá.	id.	
Flacourtia sapida, *Roxb.*	Benchí.	Katái.	
Tamarindus Indica, *Linn.*	Tetul or Tentár.	Emle.	
Bauhinia purpurea, *Linn.* ?	Koinár.	Purenposi.	
Olax scandens, *Roxb.* ?	Bhadwilá or Koko-aroo.	?	
Cassia Sp. ?	Chakúra.	...	
Oxalis corniculata, *Linn.*	Amrool.	Umtha.	Herbs.
Marsilea quadrifoliata, *Linn.*	Susné.	id.	
Amarantus viridis, *Linn.*	Batwá.	?	
——— spinosus, *Linn.*	Kántá.	?	
Alternanthera sessilis, *R. Br.*	Sáronchi.	?	
Trichodesma Indicum, *R. Br.*	Hetmurria or Chota Kulpa.	?	
——— Zeylanicum, *R. Br.*	Burra Kulpa.	?	
Mollugo spergula, *Linn.*	Ghíma.	?	
Spermacoce hispida, *Linn.*	Burdmutta.	?	
Polygonum plebejum, *A. Br.*	Myá or Kaet.[1]	?	

LEAVES.—*continued.*

Names.	Bengali.	Hindustani.	Remarks.
Colocasia antiquorum, *Schott.*	Kachú.	Ulwa.	Herbs.
Cissampelos, Sp. ?	Poe.	?	
Marsdenia tenacissima, *W. A.*	Herina.	?	
Jussieua repens, *Linn.*	Dhabnee.	?	
Leucas Sp. ?	Dhurup.	?	
Polycarpon depressum, *Kurz.*	Cheera.	?	
		STEMS.	
Bambusa stricta, *Roxb.*	Karáil.	Kopar.	Base of stem and young shoots are eaten. The native names given are those of the stem, not of the plant itself.
Phœnix acaulis, *Buch.*	Jungly-kájúr.	...	Interior of stem (sago.)
Nymphæa Lotus, *Linn.*	Salúk.	Sirke.	Leaf stalks. And underground stems.
Vitis quadrangularis, *Wall.*	Hurjora.	...	Young shoots.
		ROOTS.	
Dioscorea, Sps. ?	Bengo-aloe Dola-aloe Dudha-aloe Kondre. Genti.	?	These roots furnish considerable nutriment and are extensively used throughout the country.
Nelumbium speciosum, *Willd.*	Moolum Puddoo.	Bansera.	These are capable of being ground up into a useful flour.
Scirpus Kysoor, *Roxb.*	Kesúr.	id.	
Cyperus rotundus ?	...	...	
Curcuma, Sp. ?	Kewa.	?	
		FUNGI.	
Geaster, Sp. ?	Kukúri-Chatú.	?	
Agaricus, Sp. ?	Kanchutak.	?	

Kashmir, the Western Himalaya and the Afghan Mountains, a— A Geological paper, by

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Bengal Medical Service, with a note on the fossils by
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(Continued from page 50, of No. III. 1867.)

Chapter IV.—*General Remarks, Geognostic History, and Conclusion.*

81. In the preceding chapters I have often insisted on the parallelism of the several chains of the Himalaya; this parallelism is at once evident by reference to the map. Between the great parallels, we have seen that smaller, catenated chains make their appearance, filling up, as it were, with their spurs and branches, the great troughs formed by the principal parallel ridges. All the peaks and sinuosities of these catenated chains appear to present the same arrangement, viz. a highly crystalline and porphyritic variety of volcanic rock, passing gradually into others less crystalline, such as Trachyte, Felstone and Greenstone, and finally covered by ash, cinders, agglomerate, laterite, and compact azoic slate: these beds of ejecta, together with their interstratified layers of slate and sandstone, are all conformable to the fossiliferous strata by which they are covered, and have behaved like those at the final upheaval of the great system. But the more crystalline rocks, the several porphyries, the hornblende rocks, &c. do not appear to have been displaced laterally in any way to the same extent as the stratified layers; they rather seem to have been upheaved from underground as a solid mass, breaking through the beds of superficial trap and of volcanic ejecta. A similar disposition is likewise usual in granitic mountains, the granite supporting gneiss, schist, metamorphic slate and marble, and these being covered by fossiliferous rocks.

To explain the cause of this arrangement, let us consider what is the section of a volcano, as far as it is known at present from a study of active and extinct ones. We have under the surface of the country, in which the volcano occurs, enormous masses of trachyte, becoming more and more crystalline and prophyritic as we proceed deeper, and probably passing gradually into granite. In some volcanoes this mass is perhaps upheaved during their activity, but what is upheaved above ground is certainly but a small proportion of what remains underneath. This mass is covered by the materials which have flowed out and have spread themselves on the surface, either under the sea or in the open air. A great deal of this fluid material does never reach the surface, but finds its way into the cracks and fissures of the trachyte and porphyry. The portion which flows on the surface, whether in the air or under water is a lava; on the top of and interbedded with the lavas, scoriæ, ashes, cinders, dust, broken rocks and mud, thrown into the air or into the sea by volcanic discharges, are arranged in gentle slopes on the sides of the volcanoes and in flat strata further off. Now, let us suppose that the volcanic activity becomes dormant or ceases: we shall have under the spot where the volcano once broke out, great masses of melted and metamorphosed matter solidifying into various sorts of trappean rocks, while on the surface, stratified and fossiliferous beds will be deposited on the top of the lava and ashes. Should then the whole district be submitted to an expansive force acting from within outwards, this force will be first and most intensely felt by the great mass of underground porphyry and trachyte, which will be forced up and break through whatever covers it; the beds of basalt and amygdaloid through which it is forced, will be displaced and thrown aside or on their flank, dragging with them the stratified beds of cinders and fossiliferous strata. If instead of one volcano, we have many, situated not very far apart, we shall have the superficial rocks thrown into endless confusion by the upheaval of the many masses of porphyry and trachyte, which once formed their bases. The surging up of these masses of crystalline rock will of course diminish very materially the space occupied by the lavas, the cinders and the fossiliferous rocks at the time of their deposition; and these have therefore no other alternative but to be broken in pieces, and these pieces to be raised more or less towards a vertical position, according to the quantity of rocks to be packed in a given space. Thus, for example, near the Kaj Nag range, we have vast deposits of felstone well hemmed in, on the south, by an enormous thickness of passive tertiaries. When the huge mass of porphyry of the centre of this system of mountains received its last upheaval, it took possession of a great extent of ground formerly covered by the felstone ; and this in its turn did its best to push the tertiaries further south, but this it only partially succeeded in doing; and as there was much felstone and little room for it, the bed broke into pieces and these pieces became packed edgeways.

82. Granite may be considered as the solidified matter of a volcano seated so far from the surface of the earth, that it never broke through its covering while the minerals were in a fluid or viscid state. It is the remains of a "blind volcano." Humboldt has described volcanic action, "the reaction of the interior of the earth on the external crust." This crust has to be broken through to allow of the escape of some of the internal matter; where the earth's crust resists the upward pressure, no crater is formed, no true volcano appears ; but the melted matter remains imprisoned under the crust, and there gradually solidifies under great pressure. The solidification will necessarily be made more slow at a great depth, than it would be near the surface and near a rent which allows of the evaporation of the intermolecular water to take place; and it is the slowness of the cooling, the pressure sustained during the period of cooling, and the retention of intermolecular water and gases which cause the melted minerals to crystallise as granite and not as porphyry, greenstone or basalt.

83. In regard to their geographical disposition, volcanoes can be classified into "central" and "linear." The "central" are those which arise by themselves and appear not to be connected with any other volcano; the "linear" are several outlets arranged along a probable fissure in the earth's crust, and the fissure is often parallel to one or many other fissures similarly indicated by a line of volcanoes; or two fissures may cut one another obliquely, as we see in the Lipari Islands.

84. Applying the above general remarks to the volcanic rocks of Cashmir, we first notice that previous to the carboniferous epoch, there existed linear volcanoes arranged in a direction parallel to the present general direction of the Himalaya, viz. N. W. and S. E. ; these volcanoes are now represented by the summits of Kaj-Nag and of the Kistwar and Badrawar and the peaks of the catenated chains of Cashmir. These volcanoes vary much in importance, but no doubt can be entertained of their general great activity, if we remember the enormous amount of ejecta which they have thrown out. The well

stratified arrangement of these ejected materials, especially those which are ejected in a loose and fragmentary condition, the amygdaloidal nature of nearly all the ash-rocks and some of the slates, and the existence of these slates interstratified with the volcanic rocks, justify the idea that some of the volcanoes were islands and others subaqueous craters, in a sea of moderate depth, and it requires no great effort of the mind to picture to ourselves an archipelago of fire-emitting islands in the Silurian sea.

At what time the volcanoes first out broke out, it is not at present possible to determine; they appear to have subsided at the beginning of the Carboniferous epoch; and though phenomena related to volcanic power, in the most general acceptance of that term, were not wanting during and after the Carboniferous epoch, yet it is certain, as far as we at present know, that no regular volcano ever existed in the western Himalaya after the great Silurian volcanoes had become extinct.

85. It has been remarked in many parts of the world that, when a volanic district is, after the extinction of all craters, so disturbed that fissures are formed in the crust of the earth, these fissures do not pass through the old volcanic accumulations, but rather at a little distance from them. This has been explained by supposing that the masses of porphyry, trachyte and other once melted rocks,which have been ejected in the original volcanic fissures and amongst the rocks near this fissure, have so much strengthened the crust of the earth in the site of that fissure, that a new fracture takes place anywhere rather than across or along the old crack. If instead of one old crack we have many parallel cracks, the new fissures will then naturally take a direction parallel to the old fissures and will be situated between them. This has been the case in the Himalayas, and the great lines of fracture which were formed at the last upheaval, are none of them along the catenated volcanic chains, but between and parallel to these chains. But the catenated chains or lines of linear Silurian volcanoes determined the direction of the great lines of fracture which were formed at the last upheaval. We see therefore in the Himalayas great lines of fracture running N. W. and S. E., these fractures present a downthrow on the S. W. and the beds of rocks north-east of them form the great parallel chains of the Himalaya. The general dip of all these chains, and indeed of all the

great beds of rock in these mountains, is towards the N. E.; an explanation of the cause of this dip will be given hereafter.

86. We have said that granite may be considered as the consolidated materials of "blind volcanoes;" that is, the cooled down masses of fluid or viscid matter propelled by internal tension towards the surface of the globe, but not with a force sufficient to overcome the resistance offered by the earth's crust. The soundness of this hypothesis appears supported by the metamorphic influence of granite over immense tracts of country: the conversion of shales, limestone, and sandstones and other rocks into gneiss, schist, marble and quartzite can only be explained either by supposing these shales, limestones, and sandstones to have been plunged deep into the bowels of the earth, there to be metamorphosed,—or else to have been the lid, covering and keeping under waves of fluid mineral matter. Now, the first supposition necessitates the assumption of very great disturbances of the earth's crust, of such disturbances as we cannot conceive or imagine by the analogy of anything we now see in the rocks of the surface of the globe. Neither is the idea of superficial stratified beds being plunged to a great depth into the earth, agreeable to the universal observation of a forcing-out power acting from the centre to the surface. The other supposition does not present the above-named objections: immense masses of melted matter may have approached sufficiently near the surface to have imparted great and continued heat to the deepest stratified beds, and may have underlaid great tracts of country, without disturbing, to a very great extent, the position of the strata which they metamorphosed. Hence do we find beds of gneiss, schist and marble retaining great regularity of stratification for very many miles; so much so, that it has been possible to classify these metamorphic rocks in regularly superposed formations, and to ascertain non-conformity between these beds, proving beyond a doubt their successive deposition.* It is impossible to understand how these beds could have preserved their relations, over a great extent of country, if it had been submitted, at one time, to a "*bouleversement*" so terrific and complete as to have plunged them under the solid crust of the earth, and, at another time, to the great upheaval necessary to bring them up again to the surface.

* The great example of this is Sir W. Logan's Laurentian formations in Canada.

It is hardly necessary to add that the rolling of this great wave of melted minerals, under a certain part of the earth's crust, would set all the deep-seated waters to boil, would sublimate certain metals and elements, and that steam at a great heat, and occasionally impregnated with various vapours, would add its metamorphic influence to that of the heat disengaged from the molten granite underneath, and would here and their percolate and alter certain distant beds which would have otherwise escaped metamorphosis.

It has been advanced that steam alone was sufficient to account for the metamorphism; to me it appears inadequate to the work, when we come to consider the extensive beds of metamorphic rocks seen in several parts of the world. No Geyser, ever so hot, has yet been reported to have changed shales in its vicinity into gneiss or crystalline schists, though, I admit, the influence is often evident enough in beds of limestone. On the other hand, we know that dykes of greenstone, of basalt, or of amygdaloid have often converted sandstone into hornstone or quartzite, and slate clay into flinty-state or jasper. It appears therefore evident, that heat is one of the most powerful, if not the principal agent of metamorphism; it appears also necessary that the heat should be long sustained to produce such a great extent of metamorphosed beds as those we are considering, and that it should be equally and uniformly distributed. It does not appear likely that this persistent and uniform heat was supplied by bursts of vapours, nor indeed have we any analogy in the present days of large tracts of country being sensibly modified by the permeation of steam. The slow cooling of a mass of molten mineral under pressure would be admirably adapted to the work of metamorphosing the superincumbent crust, over several hundred square miles of country.

If the hypothesis advanced just now be accepted, we have no difficulty in understanding the graduating of granite into volcanic rocks; it is indeed what we would naturally expect to see, wherever subsequent upheavals have exposed extensive granitic and trappean regions.

To facilitate the application of these remarks to the Himalaya mountains, let us make a theoretical section from the south-west to the north-east across the Silurian Archipelego of Kashmir and the sea to the north-east of it.

Theoretical Section for the S. W. to the N. E. across the Silurian Archipelago of Kashmir.

This theoretical section shows us a succession of volcanic islands or maritime or sub-aqueous volcanoes of which the base is a mass of melted matter, destined to solidify as porphyry, trachyte and other volcanic rocks, whilst the melted materials situated further from the vents are to solidify as granite. Over the granite, we find the crust more or less intact, though metamorphosed into gneiss, schist and marble; over the porphyries and trachytes we find that it has been removed and torn up by the ejecting power of the melted mass making its way to the vents. Over and between the volcanoes, we find a very thick bed of ashes, broken stones, agglomerates and lavas. Over the granite we find, after the gneiss and schists, stratified deposits of Silurian shales and limestone. After the extinction of the volcanoes, we find the whole sea-bottom covered with the fragments of animals of the Carboniferous period; and thus do we see in Kashmir the Carboniferous limestone resting conformably on the volcanic rocks, and not disturbed by their intrusion.

Of course many changes, oscillations, denudations and depositions took place between the extinction of the Silurian volcanoes and the great final upheaval of the Himalayas; but these changes do not appear to have been on a sufficiently grand scale to have affected, to any great degree, the lithological features of the earth's crust, in the portion of the globe we are considering. At the final upheaval, a series of new fissures were formed and are represented in the diagram above, and the position assumed by the several slices, between these fissures, is represented by the dotted outline. There are many more parallel fissures, I have no doubt, but they did not cause a great upthrow of one of their edges, and have therefore little to do with the general configuration of the Himalayas.

The position of the fissures, *between* the old volcanic lines, and not *on* them, has produced the phenomenon that nearly all the highest peaks of the Himalaya are not situated on the chain to which they belong, but a little distance from it. The fissures, taking place in the weakest parts of the crust, followed the old valleys between the lines of volcanoes, and the volcanic masses are therefore superior to the chain formed by the edge of the fissure by the height these volcanic masses originally possessed. It is also reasonable to admit that the movement of upheaval was more powerfully felt by huge masses of prophyry, trachyte, granite, gneiss, &c., which cannot be easily compressed or folded, than by the flat beds of dusts, slates, lavas, ashes and fossiliferous rocks.

87. Glancing now at the Afghan mountains, we find that their chains have a steady direction from the north-east to the south-west. We find also that, as far as has been ascertained, the dip is invariably N. W. or W. N. W.; that is, presents the same phenomenon as in the Himalaya, of the beds of rock rising towards the plains of India. This dip is that of all the rocks of the trans-Indus districts; it is that of the beds in Verziristan, and of most of the nummulitic strata in Hazara, and indeed, wherever it has been possible to examine it, it has been found to be north-westerly. We cannot therefore refuse to admit, that the strike of the Afghan mountains meets the strike of the Himalayas, and the dip of the latter being North-easterly and that of the former North-westerly, we are justified in concluding, that the whole of these huge mountains forms one and the same system of upheaval; that a tremendous dome or swell did surge up in the region of our Silurian volcanic archipelagoes, and that the Himalayas on one side and the Afghan mountains on the other are faulted slopes of a gigantic oblique anticlinal!

A true anticlinal it cannot be called; it is more properly the result of an incalculable force pressing outwardly the crust of the earth and endeavouring to raise it into a dome; and as such a dome could neither be raised nor settled down again without much fracturing of the crust of the earth, the lines of fracture followed the direction of the old volcanic lines, and on one side ran N. W.—S. E. (Himalayas) and on the other N. W.—S. E. (Afghan mountains).

No good explanation has yet been advanced of the general N. E. dip of the Himalaya; none has even been attempted of the N. W. dip of the Afghan mountains. By placing the axis of the dome between these two masses of mountains, and considering these mountains as the opposite jambs of an oblique anticlinal, the singular dip of both is satisfactorily explained.

88. Pl. XI. is intended to give an idea of the great fissures of the Afghan-Himalayan system of mountains.

We must not forget that the fissures went through portions of the crust, having a much greater power of resistance in some places than in others, being here brittle, there tenacious, here rigid and there easily bent; and we must not expect too much regularity in the fissures, but be prepared for occasional deviations from the general direction. The Miocene beds, which present the greatest uniformity of formation, have everywhere the most regular strike, in spite of their numerous foldings and faults; the great beds of felstone are also tolerably regular in their general dip, and so are the great beds of Carboniferous limestone in Kashmir, though of course the smaller beds, especially those close against high summits, have a local dip and strike. The interminable masses of metamorphic schists, described by travellers in several parts of the Himalayas, have also a steady N. E. dip, and Captain R. Strachey tells us that in that portion of the Himalayas which he examined, the N. E. dip was the general one. On the Afghan side of the oblique anticlinal the Miocene again presents the greatest regularity, and the Nummulitic formation nearly equals it; the dip of both these formations is very steadily towards the N. W.

Another cause which has no doubt contributed to break the uniformity of the parallelism of the chains is the pressure, in some places, of such enormous accumulations of volcanic porphyry as we see at the Kaj-Nag and in Kistwar and Badrawar. These centres of volcanic rock appear to have been very huge; they were undoubtedly solidified long before they became upheaved, as they were formed during the Silurian epoch, and did not receive their upheaval until the Tertiary period had been nearly run out. They were, therefore, raised up bodily as solid masses, and they had been too huge to arrange themselves in the general parallelism of the fissures. I have represented them in the plate as huge centres of volcanic action, regarding them as too enormous to be displaced by even the force which has uplifted the great dome of the Afghan-Himalayan system; they were merely forced up. The Sufed Koh and the Koh-i-Baba in the Afghan mountains occupy a similar position in relation to the parallel chains; the first named is probably a volcanic mass, and I have assumed that the other is likewise a porphyry centre. It is probable that certain granite masses have acted in a like manner; but it would be of little profit to speculate about those masses, knowing at present nothing positive regarding them.

The fissures just described being once formed, we have no difficulty in understanding how the slices of crust between them were compelled to remain in an oblique position, viz. dipping N. E. and N. W. respectively, when the settlement took place, if we remember, that a great deal of granite, lignite, porphyry, trachyte, &c. buried under the surface before the upheaval, had now been forced up and occupied a great portion of the room; unable to find space enough to resume a horizontal position, these bands of the earth's crust became impacted in the position we now see them.

89. Coming down from the high regions of the Himalaya and of the Afghan mountains to the Salt Range and the hills of the district of Bunnoo, we notice the interesting phenomenon of the tilting up of the angular extremity of the piece of crust that had been broken off, between the converging fissures of the Sub-Himalaya and the Sub-Afghan hills. This crop-fracture is just such as we see near the point of an angular piece of a window-pane which has been starred by a blow. The dip of the Salt Range and the Bunnoo hills is consequently disposed in a somewhat converging manner, such as is indicated by the arrows in Pl. XI.; the crop fracture is not a straight line; it is a succession of segments of a circle, and the dip of each segment is converging more or less towards the centre of its circle.

It is, however, possible that this breaking of the tip of the triangular piece of crust is only apparent, and that the segmentary and converging dip of the beds may be due to a complexity of resultant forces, at the place where the N. W. and N. W. dips meet.

To the south of the Salt Range extend the vast plains of the Punjab, Ajmeer and Marwar, covered mostly with clay and sand, often a desert without a hill or even a mound to relieve the monotony, and with hardly a pebble to be found for some hundreds of miles. So far south as Lat N. 27° these great plains extend without a break, and then we find the volcanic rocks of Central India, supporting here and there beds of sandstone with mammalian bones* similar to those which are so well developed in the Sub-Himalaya and Sub-Afghan ranges. Whether the whole, a portion, or none of the volcanic rocks of Central India are contemporaneous to those of the Himalaya, I know not,

* Bones of extinct mammals have been found in the Valley of the Nerbudda. South of Lat. N. 21°, no Miocene has ever been found.

though it is highly probable that some at least belong to the same epoch. I think it would be a most interesting point to study, whether the Central Indian Mountains participated in the great upheaval of the Afghan-Himalayan system, and to what extent they did so. Such a subject is not, however, to be discussed here, *en passant.* We must know more of what is buried under the alluvial sands and clays of the Punjab and the desert of Ajmeer, before we can decide on the relations of the Himalaya and Central Indian Mountains. The study of the Miocene beds appears the most likely sort of research to lead to interesting results. Could we once show satisfactorily that the plains of Northern India have been one day, and that not long ago (geologically speaking) a rugged country covered with Miocene hillocks and ridges, we should soon get an insight into the participation of the Central Indian Mountains in the great Afghan-Himalayan upheaval, and also into the nature of the soils and sub-soils of Upper India.

90. Let us now endeavour to sketch a geognostic history of the Afghan-Himalayan system of mountains, in accordance with the observations and hypotheses recorded in this paper.*

In the days of the Silurian epoch, the centre of Asia may be assumed to have been a sea uniting the Arctic to the Indian Ocean. In the middle of this sea, an archipelago of volcanic islands and subaqueous volcanoes existed, displaying great activity and ejecting into the sea an immense quantity of matter.

The position of these volcanoes and subaqueous vents is now represented by the porphyritic masses of Kaj-Nag, of Kistwar and Badrawar, by the summits of the catenated chains of Kashmir, &c., &c. The volcanoes were linear in their arrangement; one line, that of Kaj-Nag, Badrawar and Kistwar being continued far towards the south-east; and it is probable that the peaks of Chor, of Dodatoli and others in the same districts, are volcanic peaks on the same fissure. Another line or rather series of lines is that of the catenated chains in Kashmir, with a probable S. E. extension in the range of mountains which separate Lahool from Chumba. Another line again is that of Drass and Karghyl, at the back of the Ser and Mer

* A few unavoidable repetitions which occur in this portion of the paper will, I hope, be excused.

chain, and which is continued far towards the S. E., forming numerous and considerable volcanic mountains which appear as islands and promontories above the flat plain of the great Thibet plateau, through which the Sutlej runs.

These lines or fissures had a direction N. W.—S. E. and were all parallel, but the activity of the volcanoes was not the same on all the lines or in different parts of each line. Thus, in the line of Kaj-Nag and Badrawar, Chor and Dodatoli, the north-western end of the line is eminently distinguished and marked by very numerous and very long volcanoes, whilst the eastern one only gave passage to a few vents separated from each other by considerable intervals. On the other hand, (on another line) in Ladak, the volcanoes appear to have been small and few, whilst the eastern ends of the fissures appear to have been marked with many volcanoes of great size and activity. No volcanoes appear to have existed in that portion of the Silurian sea, where we now have the high mountains of Kailas and Karokoram; but where the Kuen Luen chain was at a later age to appear, it seems, that one or two lines of linear volcanoes did exist at the beginning of the Palæozoic epoch.

How long, how many thousands of years these volcanoes kept at their work, it is impossible even to guess. Their activity was immense, and it appears that in the waters which bathed the shores of the volcanic archipelago, too many outlets kept continually pouring out hot ejecta and noxious vapours to have allowed life to be present. We have seen that there is considerable evidence of the sea-bottom having been frequently heated enough to become cellular and amygdaloidal, and a reference to the section of the Tukt-i Suliman in Kashmir will, I think, leave little doubt of the frequency, the violence and the abundance of the discharges of lava, of lapilli, of ashes, and of hot liquid mud. We therefore find no Silurian fossils in Kashmir, and the slates and sandstones which are interbedded with the volcanic ejecta are completely deprived of fossils. This want of organic life did not, however, affect those portions of the sea which were sufficiently distant from the subaqueous craters and volcanic islands to escape the destructive effects of ejected materials; and we find, therefore, in the Karokoram chain and also in the Himalaya, between the Sutlej and the Kali, large beds of Silurian rocks with the usual fossils. These rocks are, as we have seen, slates and shales which have until now proved azoic, but covered in by limestone rich in forms of the older Palæozoic period.

I need hardly say that the azoic slates, shales and sandstones which are interbedded with the ashes and amygdaloids in Kashmir are of Silurian date; if we wish, therefore, to colour a map of Kashmir solely in regard to the age of the rocks, we should have to colour all the ashes, slates, &c. Silurian. As the volcanic ejecta much predominate in quantity over the azoic slates and sandstone, I have not coloured the mass solely by age, but rather in view of the nature of the rocks.

But the Himalayan lines of insular volcanoes were not the only ones in that portion of the Silurian sea which we are considering; other linear volcanoes were directed from the N. E. to the S. W. in the longitudes and latitudes where we now find the great Afghan mountains. We know very little of these mountains: we have seen, however, that volcanic rocks of a granitoid appearance form the ranges of hills between Yeusofzaie and Bonneyr, and that clinkstone, granular and porphyritic, is quarried at Jellalabad. Dr. Bellew also tells us that he noticed volcanic rocks amongst the southern spurs of the Sufed Koh.* He also mentions that sharp earthquakes are frequent in the valley of the Korum, and it is reported by the Povindas who trade through the Gulwaira Pass, that a city situated at the back of the Suliman chains has been destroyed by a terrific earthquake. I need not point out the usual relation of severe earthquakes with accumulations of volcanic porphyries, in countries where no active volcanoes have been known to exist for several geological ages past. Then we have seen that the summits of the main chain of mountains, in the Vuzeeri country, are mostly composed of volcanic rocks; but the greatest amount of evidence is

* After crossing the hill-pass of Hazrah-Shutur-Gardan, the road lies through a gorge, and a stream or rivulet flows to the westward; in the bed of this rivulet pebbles of porphyry, hornblende and syenite (?) were seen; the surface of the soil was also covered with similar pebbles............Near the top of the Shinghai Kothul, the volcanic rocks were again seen: Dr. Bellew says: "The surface was strewed with great blocks and fragments of porphyry and syenite, the latter was of various shades, from yellowish-green to greenish-brown, and its fragments shone with a vitreous lustre and broke with a similar fracture." *Chapter II. Narrative of a Mission to Kandahar.* The above description of syenite does not look much like syenite, it is nearly certain that the rock observed was a hypersthene rock.

derived from the boulders brought down by torrents and from those formerly carried down and now imbedded in the Miocene conglomerates which fringe the base of the Afghan mountains. These boulders and pebbles are mostly greenstone, felstone, trachyte, and porphyry identical with the Himalayan hornblende rock; and that peculiar variety of amygdaloidal greenstone, pierced with gas-vents, which has been described at No. 4 of the section of the Tukt-i-Suliman in Kashmir, para. 18, occurs in great abundance. (See also Pl. x. figs. 1. 1*a*.)

There can be, therefore, no possible doubt that the Afghan mountains were at the Silurian epoch an archipelago of volcanic islands and subaqueous volcanoes; indeed, they were merely another group of the same great archipelago; but the fissures or lines on which the vents were situated had a direction N. E., S. W.

Towards the end of the older Palæozoic epoch, the volcanoes appear to have subsided in violence, and allowed the waters of the neighbouring sea to cool. They did not do so, however, until they had ejected so much lava, scoriæ, lapilli, ashes, and debris of the inside of the earth that a great bar, a bar going from the North-west to the South-east and studded with the island-cones of half extinguished volcanoes, had been formed across the sea. A similar bar was produced by the Afghan group of volcanoes, directed N. E., S. W. and the two bars formed a gigantic V, with the angle pointing to the north. On these bars the sea was shallow; neither was it likely to be very deep between the two branches of the V. The end of the great activity of the volcanoes appears to have been marked by the breaking out of a great number of fumaroles or hot springs, depositing an immense quantity of silica, and forming thick beds of quartzite, sometimes pure and clear as glass, sometimes white and opaque as porcelain. We must not forget also, that all analogy points to a general rising of the sea bottom at the north-east of the Himalayan volcanic bar, not as a break, but as a gradual and slow upheaval of the earth's crust under the pressure of viscid granite.

But even these last efforts of the great volcanoes, these bursts of vapours and hot waters, became rare and intermittent, and animals made their appearance in the creeks and bays of the sea between the islands. It was then the dawn of the Carboniferous epoch, and all over the great bars of volcanic debris a calcareous mud was deposited, teeming with the remains of animals, with the glimmering shells of the *Producti*, with large flat *Orthidæ*, and innumerable *Bryozoa* and numerous *Encrinites* which grew luxuriantly on the half chalky, half clayey, fœtid bottom of well protected island seas, gulfs and channels. And so it went on for years and years, until the sea became too shallow for *Producti* and *Orthidæ* to live in, and too easily disturbed to its very bottom to suit the delicate *Bryozoa*. These animals retired to greater depths on either side of the great bar, and in their stead appeared small *Cucullæ*, globular *Terebratulæ*, with here and there, on sandy banks, colonies of large *Cardiniæ* or *Anthracosiæ*, gibbose and smooth *Aviculo-pectens*, or radiated ones of great size. In calm waters, flat and large species of *Goniatites* basked in the sun in company with small *Orthoceratidæ* and large species of *Bellerophon*. Earthquakes were, however, frequent and terrible, raising and depressing large tracts of sea-bottom, folding and undulating the newly formed beds of limestone, so that most of the shells are found broken, and many of them are deformed to a wonderful extent.

Many changes occurred in the sea: clay and sand had been brought down in large quantities from the volcanic islands, and many of the creeks and inland seas were turned into swamps. Long shelving coast-lines extended from island to island, and many groups of the great archipelago were probably united by a low land into larger insular countries. The genera *Cucullæa*, *Cardinia* and *Aviculo-pecten*, and small *Brachiopoda* disappeared; and in their stead myriads of *Gasteropoda*, especially the *Pyramidellidæ*, living with numerous corals, made their appearance. As the islands joined more and more into larger dry lands, and approached nearer to a long strip of land supporting numerous peaks of extinct volcanoes, the rain-fall increased more and more, sand, mud and gravel accumulated in thicker beds at the mouth of the mountain torrents which now became rivers, and on the swampy shores forests of calamites and other trees grew up, whilst, out at sea, the mollusks and other animals continued to thrive at various depths, according to their kind. What has now become of these forests of calamites? Have they been buried in sands by oscillations of the coast and converted into coal? If they have, has the coal been denuded at a subsequent period? or has some portion of it escaped removal and does it now lie concealed under newer formations? There is no doubt that great denudation has taken place repeatedly in the Himalaya and subordinate hills; yet basins nicely protected by eruptive or metamorphic rocks, bottoms of valleys or down-thrown beds might have escaped removal. Not a trace of true coal has yet been found in the Himalayas, the Punjab or the Afghan mountains, excepting (geologically speaking) the few grains of coal which fill in the cellular tissue of the lepidodendron-like plants described in para. 43, as having been found in one of the layers of the Wean group. This is not very encouraging; but any person who has observed what a thick mantle the Miocene sandstones and the old and new alluvia form over the older formations, would not expect to find coal cropping out in a conspicuous manner. If coal does exist, it will be one day discovered, no doubt; but the discovery will be made by patient and careful study, and not by digging at random with a pickaxe wherever something black is observed. It may be said with truth that the means hitherto employed, by Government or persons interested in the search for coal, have been such that not the smallest reasonable chance of success could be anticipated.* But all this is foreign to our subject.

91. The end of the Palæozoic epoch or beginning of the Secondary period was marked by new volcanic action, trifling indeed, if we compare it to the intensity of volcanic power displayed during the Silurian time, but yet highly interesting. I allude to these local outbursts of hot vapours, gases and waters, charged with several minerals, which have taken place in many distant places of the Himalayas and their dependencies. The action is geyserian rather than volcanic, as no true volcanic rocks, that is, no lava, no scoriæ and no ash appear to have been discharged by these vents. The existence of this force is mostly manifested by the metamorphism it has caused in some of the upper beds of the Carboniferous limestone, and by the peculiar way it twisted rocks, then soft, in a manner which appears now incomprehensible, and totally abnormal to the surrounding layers. In some localities, however, it seems that the waters, erupting through the calcareous mud, were so rich in felspars, that this crystallised in

* This remark applies only to the Punjab and the mountainous districts studied in this paper.

minute crystals which now form a sort of intrusive band of a friable incoherent rock.

When this geyserian action subsided, the Palæozoic animals had died out.

92. I now enter upon debatable ground. I have said before, that the salt, gypsum and red marl of the Salt Range—and I need hardly say the gypsum and red marl of Spiti, the gypsum of Rukshu (and that of Rodok ?), and most probably the salt of the Yarkandkash valley, and also that of the Lataband mountains in Badakshan, all belong to the same epoch and have probably a common origin. I have said before that, this Saliferian formation has been placed by Dr. A. Fleming in the Devonian. Dr. Jameson makes it superior to the Carboniferous; Major Vicary and M. Marcadieu believed it to be Miocene or Pliocene; some will have it volcanic, others sedimentary; but nobody gives a good and well defined section of the relations of this formation to the rocks above and below it.* This is much to be regretted, and I will not increase the confusion by discussing here the reasons which make me believe that the salt and gypsum of the Himalayas belong to the Trias or the Permian. My opportunities of observing the Saliferian formation have been few and of short duration, and I have no good section to give in support of my opinion. I shall therefore refer the reader to the note to para. 64, and proceed with the next formation.

93. Whatever had taken place beeween the end of the Carboniferous epoch and the beginning of the Jurassic, it appears tolerably evident that the Jurassic sea bathed the shores of a long strip of land or succession of large islands, very similar to those which the Carboniferous sea had bounded. The Jurassic sea does not appear to have been much deeper than the Carboniferous one had been; the same impurity of the limestone is noticed, the same admixture of sand and clay with the calcareous matter, the same rarity of clean drifted sands, the same prevalence of thin-bedding, false-bedding and continual

* Dr. A. Fleming gives some sections in his Report on the structure of the Salt Range; but only two of these show the relations of the salt marl to the Carboniferous limestone, and in one, sect. No. VIII., a number of more or less theoretical faults are introduced which, if placed at the base of the mountain limestone escapements, would then make this rock inferior to the salt. Another section, No. VII. shows an anticlinal across a ravine, and then the salt marl appears indeed to be placed under the Carboniferous limestone.

change of the nature and weight of materials. All these conditions, and the frequency of ripple marks, indicate a shallow sea easily influenced by heavy outpours of muddy waters from the land. The thickness of the Jurassic rocks vary veries much, and the extent of the beds is limited to very small areas, compared to those of the Carboniferous. This is probably due to the deposition taking place in creeks of a deeply indented coast, and in great part to the oscillations of the land and sea bottom, causing in some localities repeated denudation of materials newly deposited, and in others a steady sinking and consequent thickness of formation. The fossils being frequently much deformed, is a good evidence of these oscillations having taken place.

The Jurassic beds have always been considered conformable to the Carboniferous. I am inclined to believe that this conformity is only apparent. The dip of both formations is generally great, seldom under an average of 45°. In such highly up-tilted beds, a difference of a few degrees is not easily appreciated, unless a careful measurement is taken, and I fancy that most writers have been satisfied with an approximation. However this may be, there is no doubt that the Jurassic limestone presents, in very many places, indeed in most, the appearance of having sustained very sharp local upheavals, soon after the end of the Secondary period, but of little extent; and here again we find the salt, gypsum and red marl always underlying these sharp and dome-like anticlinals. We remember how Sheikh Bodeen is thrown into a succession of short, gothic, arch-like anticlinals; and that under the Jurassic beds the Saliferian are to be seen, perfectly conformable to the limestone and following it in all its oscillations. At Maree on the Indus, a similar appearance occurs: thick masses of salt, gypsum with bi-pyramidal crystals, quartz, red marl and magnesian mud stone more or less cellular, support a very sharp anticlinal of Jurassic limestone; and the Saliferian and Jurassic are conformable not only in general dip, but in all the details of the fold. Moreover, both the Silurian and Jurassic dip S. (2 or 3 degrees E.) and N. (2 or 3 degrees W.) on both sides of the anticlinal dip, which are not the usual ones of the other rocks of that portion of the Salt Range, the Nummulitic and the Miocene dipping N. E.

Whether these local upheavals are merely due to the swelling of the gypseous beds from the change of anhydrite into common gypsum by absorption of water, is more than I can say. The Saliferian beds would naturally break, dislocate and lift up the superincumbent Jurassic when swelling itself into undulations. We should thus obtain undulated beds of Saliferian and Jurassic. Let such undulated layers be submitted to the lateral pressure which must have accompanied the great upheaval of the Afghan-Himalayan system, and we have the undulations folded into arches and sharp bends.

The Saliferian and Jurassic have been very much denuded, their debris being extremely abundant in some beds of conglomerate and sandstone of the Miocene, especially on the western side of the Indus, in the districts of Kohat and Bunnoo.

94. There are but few traces of the deposits which may have taken place between the Oolite and the Nummulitic, and I have never myself seen any cretaceous rocks in the western Himalaya* or the Afghan mountains, neither have I found any pebbles with cretaceous fossils in the conglomerates of the Miocene. From the development of considerable vegetation in the shales near the base of the Nummulitic formation, it is evident that a steady rising of the land went on during the time of the upper Jurassic and Cretaceous periods, and with such a rising we would naturally associate the great denudation of the Jurassic beds, soon after their deposition. Little doubt can be entertained that during the Cretaceous period, the Himalayan and Afghan islands had become united into a continent of considerable extent, traversed by chains of extinct volcanic ridges, and therefore receiving an abundant rain-fall which caused great denudation. We know how quickly volcanic mountains decay, when once they have ceased to receive fresh supply of ejecta. I believe that the cretaceous beds which have been found in and near the Himalaya are very limited in extent, even more so than the Jurassic beds. The small horizontal area of these Secondary beds contrasts widely with the great superficial extent of the Carboniferous, the Nummulitic and Miocene formations; and yet when they do occur, the Jurassic beds at least have considerable power. A continent with a deeply indented coast appears to be indicated by these peculiarities of the Secondary beds.

* Dr. Stoliczka has found Cretaceous rocks in the mountains of Spiti. *Editor's note.*

95. The Nummulitic epoch must have been a long one, if we can judge by the thickness of its deposits. There does not appear to have been any violent volcanic action, nor any great and sudden movement during the period, but there was a great deal of very slow and probably imperceptible oscillation. Thus we first find the base of the Nummulitic to be generally a sandstone without fossils,* this is gradually impregnated with calcareous matter, becoming a sandy, very impure limestone, full of shallow water fossils and containing only a few very small species of Nummulites. This has been therefore a period of slow and trifling sinking of the land, and it is probable that the sea never covered it by more than a few feet. Then the oscillation went the other way, and the land appeared again, and was covered by forests. Another slow sinking brought on a fresh incursion of the sea, which soon covered the forests (lignite) with a layer of limestone, full of large Nummulites and other shells. The depth of the sea was greater than before the growth of the forests, but it probably did not much exceed 20 fathoms. Another movement upwards again exposed the land, and again forests grew and formed thin seams of lignite. Again the land sank and the sea covered in the lignite-beds with calcareous mud. At first the depth was trifling, little exceeding 20 fathoms, but the sinking continued to the end of the Nummulitic period, and the limestone assumes more and more the appearance of a deep-sea formation as we get higher up the series. It is, however improbable that the volcanic mountains of the great bars of the Himalaya and Afghan mountains were ever covered by the Nummulitic sea, as no nummulite has ever been found amongst the central chains;† but that sea filled up the whole of the space between the arms of the great everted V formed by the Himalayan and the Afghan chains, and probably also bathed the outside shores of the arms of the V. This slow, gradual and long continued sinking of the land, during the deposition of the Upper Nummulitic formation, accounts for the appearance of no great depth in rocks which have

* Sometimes a fragile limestone with *Planorbis*, and probably fresh-water. See note to para. 66, chap. iii.

† Dr. T. Thomson reported having observed Nummulitic Limestone in Little Thibet at an elevation of 16,500 feet. But I much doubt the accuracy of the observation, and cannot help imagining that the Thibet nummulites are, like those of Manus Bal, weathered encrinite rings. See "*Introduction,*" *page ii.*

a very considerable thickness ; the sinking was, however, greater than the amount of deposit could compensate, and the rocks have therefore the appearance of a tolerably deep sea formation at the top of the Nummulitic series. Then again, we have a long and steady rising of the land, and in consequence a great denudation going on, a denudation which has caused the removal of a great deal of the Nummulitic formation, in localities where sea-currents, high-tides and other unfavourable circumstances assisted in the work of destruction. It is curious to notice on the top of the Nummulitic limestone, how the surface of the rock has been broken by the waves ; how the fragments have been rolled and rubbed and then glued together again. This appearance is always seen as a bed of transition between the Nummulitic and the Miocene. A considerable time must have elapsed between the end of the deposition of the bed and the breaking up of it, as we must allow time for its solidification. But at any rate, here, at the beginning of the Miocene epoch, we had the Nummulitic limestone forming a nearly horizontal and far-reaching sea-coast, covered with a very thin sheet of water, rolling and polishing pebbles. But this conglomeratic layer is thin, and we very soon see a large quantity of mud and sand, and pebbles of far distant rocks, brought down to the sea.

96. Let us consider the kind of map we have at the beginning of the Miocene epoch, and we will have no difficulty in understanding the formation of the Miocene sandstone and conglomerates of the Sub-Himalayan and Sub-Afghan chains. We have an immense expanse of sea, north of the tropic of Capricorn, between the latitudes 90° W. and 90° E., for, in these days, the Andes had not yet surged up and most of South America was under water, as well as nearly the whole of Africa, Arabia, Persia and India. There were probably groups of islands where these continents now stand, but the immense, dry, thirsty plains and plateaux of these countries were then under the sea. There was therefore no impediment to the regular play of the Trade Winds, no monsoons or winds deviated by the rarifying power of arid deserts, but especially no chains of mountains to dry the S. E. trade-winds before their arrival at the equator, and their ascending to become upper currents with a direction to the N. E. At the tropic of Cancer, these winds, still charged with the whole of the

humidity they had sucked from the sea in the Southern Hemisphere, descend again and become under or lower currents, keeping their N. E. direction.* Before proceeding far, these winds meet a couple of ranges of mountains forming a great everted V, opening to the south, and on these ranges they poured such a quantity of rain that a denudation began to take place to an amount nowhere else exemplified. The only approach to this rain-fall is that now observed in Patagonia, a high country which happens to be situated in the Southern Himisphere, somewhat in a position analogous to that of the Himalaya in the Northern Hemisphere during the Miocene epoch. In Patagonia "Captain King found the astonishing rain-fall of "nearly thirteen feet (151 inches) in forty-one days; and Mr. "Darwin reports, that the surface water of the sea, along this part of "the South American coast, is sometimes quite fresh, from the vast "quantity of rain that falls."†

We are now therefore prepared to anticipate a formation composed of coarse debris of the older mountains, washed down by violent torrents; we understand how it is that the waters of the sea lost their saltness, and that marine shells deserted these regions, and are therefore not to be found as fossils, or are at any rate excessively rare. The continual and violent rushing of streams, charged with mud and boulders, did not allow of the development of fluviatile animals; and thus we find the lower Miocene a mass of clay, sand and large boulders, in beds considerably false-bedded and totally free of fossils, with the exception, in a few protected localities, of some bulrushes imbedded in salt. These torrents occasionally tore up forests from the mountain sides in their headlong course, and thus it is that we find here and there small niduses of semi-carbonized wood, interred in the sandstone. The masses of conglomerate, accumulated in certain places, are of tremendous size, and probably mark the exit from the hills of the principal torrents of the Miocene Himalaya. The deposit of this coarse debris of the old volcanic chain and of the several deposits which had become gradually accumulated round it, attains a thickness of no less than 5,000 feet, and probably in some places much more. This mass of

* See for a general explanation of the routes of the winds and the causes which alter these routes, the work of Captain Maury, L. L. D., U. S. N. entitled, "The Physical Geography of the Sea and its Meteorology."

† Maury's Physical Geography of the Sea and its Meteorolgy. Page 129

clay, sand and boulders could not fail to convert the sea, which we have seen was shallow, into dry land, and thus we have this overlapping of the Upper Micoene on the edge of the Lower which is represented at para. 11. The Lower Miocene was itself exposed to the denudating influence of the rain, and boulders of Lower Miocene sandstone are common in the Upper Miocene.

The Upper Miocene appears to have been altogether a fresh-water formation; I mean, an accumulation of materials brought down by rivers of large size, which, in all probability, wandered through the flat plains of the lower Miocene, and extended in deltas and marshes and creeks, just as the Ganges and the Indus are observed to do now-a-days. We may fairly imagine these Miocene tracts to have resembled closely a modern Indian plain traversed by large inundating rivers—a thick jungle of high grass and small trees for the elephant, the mastodon, the monkey. and a host of other animals to dwell in, and on the sides of the large meandering rivers, wastes of sand and clay, shallow pools and quicksands for the delight of the crocodiles, the tortoises and the hippopotamus. On sands left dry by changes in the course of the rivers, or piled up in undulating hillocks by the winds, grew thinly planted trees, such as we now see in the sandy tracts of Scinde, to feed and shelter the camel, the giraffe, and innumerable deer of various species; and on intermediate lands, good pasture supported the horse, the ox and sivatherium.

In the districts of Rawul Pindee, of Jheelum, of Bunnoo, of Kohat, the Upper Miocene has a thickness of more than 2,000 feet; but in the Rajaori and Poonch provinces of the Maharajah of Jummoo's kingdom, the bed attains a much greater thickness.

Any one who travels through the plains of the Punjab will notice the great quantity of cows, of oxen and horses seen loose on the sand near every village, and will remark at the same time, that when a stream has cut through the sand and thus exposed a section, not a bone is seen buried under the surface. If, however, he comes to a marsh, such as the one near Guriwall, in Bunnoo, he will observe that the bones will remain perfectly preserved in the thick mud, saturated with *kullur*,* which forms the bottom of the

* Impure Sulphate of soda, with a little carbonate of soda and chloride of sodium, which impregnates, more or less, nearly the whole of the soil of the Punjab, and effloresces on the surface after rain or irrigation.

marsh. Now this *kullur* appears to have existed in the soil of the Upper Miocene, as the sandstones of that age are often covered with an efflorescence of that salt; and, indeed, that now seen in the alluvium is derived from the disintegrating, decaying and washing away of the Miocene beds. The fossil bones are always found either in a dark clay-stone, which has a bitter taste when applied to the tongue, or in a light-coloured sandy claystone. It is therefore highly probable that the existence of a marsh or swamp is necessary to the preservation of bones and their fossilification. This accounts for the bones being found in beds of limited extent, whilst for many miles not one is to be discovered; but it also brings additional evidence that the Upper Miocene was deposited as a growing delta, similar to the Sunderbunds of the Ganges and to the creeks of the mouths of the Indus.

What a singular landscape this belt of land must have presented! If we remember that at least seven different species of elephants roamed in these jungles, some much larger than the living one, and with tusks nine feet and a half long; that the dinotherium had a skull three feet and nine inches in length; that the mastodon was 17 feet long from the tail to the end of the tusks; that the sivatherium was a gigantic four-horned antelope-like animal; that the crocodiles were much larger than they are at present, and that the tortoises had a shell measuring 20 feet across; we may wonder indeed at the strange appearance which the jungles must have presented!!

I have called this fossiliferous formation Upper Miocene. In placing it in the Miocene, I have adopted the general opinion of geologists, but it may be Pliocenic and not Miocenic. I have not succeeded yet in discovering shells in these beds, and without shells it is impossible to fix with certainty the age of the formation.

I have forgotten to notice, that during the whole of the Miocene epoch there was a slow and steady sinking of the land. This sinking allowed of the accumulation of materials to the great thickness I have indicated, but unlike that which took place during the Eocene period, it was not sufficient to keep the country under the sea, the quantity of sand and clay and boulders, deposited by the rivers, being more than adequate to compensate for the sinking. The country, however, by the sinking was kept to a very little height above the sea level, and the inundations of great rivers added continually to the thickness of the deposit.

97. There is no evidence of any violent action having taken place during the Eocene and Miocene epochs. There had been risings and sinkings of the whole country, but these were imperceptible to the senses, and were probably not more active than the same phenomena which now occur in many parts of the world, unknown to the inhabitants. The belt of flat land had increased to a good breadth, and the coast had become sufficiently distant from the mountains to enable the animals to live in peace and plenty, away from the storms and torrents of the hills, when the whole of the portion of the earth we have been considering was raised into an immense vault, by the forcing up of granite assisted by gases. When the gases condensed or escaped, the arch settled down by fracturing its sides, and these faulted sides of the arch are now, what we call the Himalayas and the Afghan chains of mountains.

When the settle-down began to take place, and the sides of the arch or vault were being broken, the direction of the linear volcanoes of the Silurian epoch compelled the new fractures to conform to it. On the eastern slope of the vault, the fractures ran from N. W. to S. E., on the western slope from N. E. to S. W. As is generally the case in an anticlinal, the highest portion of the vault settled down again to a level much lower than the sides, and we have therefore, in the northern Punjab, low hills, whilst on each side we have mountains towering to the sky.

It is not necessary to enter here into all the details of the complications which the masses of porphyry, trachyte, granite and other rocks, which had been cooling ever since the middle of the Palæozoic epoch, caused in the upheaval of the Afghan-Himalayan vault and in its settle-down. These details have already been sufficiently indicated in paras. 81 to 87. But I will insist on the effect of these masses being forced up like wedges through the rocks which covered them, and by their filling up a great deal of the space once occupied by these covering rocks, they compelled these last to be either folded or broken into pieces and packed edgeways.

It is not necessary to imagine that the top of the vault was raised to the same height as we now see the great peaks of the Himalayas.

In the settle-down, the parallel zones, into which the sides of the vault were broken, would naturally assume an angle of dip much greater than was that of the vault previous to its fracture, as the sides of the vault, in coming down again, would be submitted to considerable pressure, and therefore much redressed. It is not unlikely, therefore, that it is the effect of this pressure which has caused, in many mountains of the Himalayas, the appearance of younger rocks dipping under older, of felstone under porphyry, of schist and gneiss under granite.

The geologist must naturally expect to find a great many complications amongst these immense mountains. The view I have endeavoured to explain is a general one, and will, I hope, be better substantiated when we know more of the countries of the Afghan-Himalayan system. With a little thought, I entertain a hope that the geologist, in finding apparent contradictions to what I have advanced, will always be enabled to discover the cause of the complication, at first apparently irreconcileable to my hypothesis.

There is one more remark to be made. The direction of the Silurian linear volcanoes of the Himalaya not being parallel to that of the Afghan chains, we have not a true anticlinal, but an oblique one. At the northern end of the axis of this oblique anticlinal, we have therefore a pressing of the sides one against the other, whilst at the southern end, we have a wide divergence of the ridges : at the northern end of the axis, we have the chains abutting one against the other, and thus supported at a great height ; at the southern end we have the central beds unsupported and sunk down very low when the settle-down took place ; hence the high plateau of Pamer at one end and the low plains of India at the other. Again, when the Himalayan slope of the anticlinal was settling down, many of the great masses of porphyry, schist and gneiss resisted the general tendency to dip N. E., and caused a local fault to take place. This fault acted as the axis of an anticlinal for the locality immediately surrounding the mass of porphyry, schist or gneiss ; and we find therefore such huge masses assuming the dip of the western branch of the Afghan-Himalayan anticlinal, or dipping N. W. Hence, the singular phenomenon, long ago noticed by Captain R. Strachey, that some of the great peaks of the Himalayas dip N. W., whilst all the beds round them dip N. E. It is also this same obliquity of the anticlinal which has caused these numerous transverse faults observed in the Himalaya, which have a general direction from N. to S., and with the beds crushed one against the other at the northern end, whilst the fault gapes at the southern extremity.

All these phenomena, and several others which strike the naturalist as he travels through these mountains, appear to me to prove without a doubt, that the upheaving force was not applied at one certain point or along one certain axis, but that the whole country, now covered by the Afghan and the Himalayan mountains, was forced up into an immense dome or arch, which broke along certain lines determined by pre-existing volcanic zones, and settled into an oblique anticlinal, of which the slopes are sliced by a succession of parallel faults.*

98. It is a question of considerable interest to determine, with some precision, the epoch at which the great and last upheaval of the Himalaya occurred. We know that it was after the great mammals had become developed; and the extraordinary number of mammalian species found in the Sewalik hills would naturally induce one to consider a portion at least of what I have called the Upper Miocene as older Pliocene. The Aralo-Caspian formation or steppe limestone, a brackish water deposit, has been placed by Murchison and DeVerneuil in the older Pliocene; and one cannot help thinking that these shallow but immense inland or inter-insular seas must have existed previous to the final upheaval of the great mountains of Central Asia, and that it is indeed movements connected with this final upheaval, which have dried up the steppe-limestone and reduced these great seas to their present dimensions.

On the other hand, we have seen, that there exist in Thibet and in Ladak great beds of horizontal deposits, unconformable to the beds on which they abut, and containing fossil bones. Captain R. Strachey appears inclined to believe these beds to have been deposited previous to the upheaval of the Himalaya; but I think the hypothesis is not tenable, as it is impossible to understand how a " true sea-bottom

* The hypothesis (advanced, I believe, by Professor Ansted in his "Ancient World") that the rising of Central Asia caused a depression in the Indian Ocean, marked by the coral islands of the Lacadives, the Maldives, the great Chagos bank and some others, is ingenious; the depression, however, requires proving by actual observations.

could have been uplifted from under the sea to an elevation of 15,000 feet," without losing its horizontality, whilst not only the beds on which the "true sea-bottom" rested, but the probable contemporaneous beds of the Sewaliks (according to Captain Strachey's hypothesis only,) are dipping N. E. at a high-angle. Captain H. Strachey describes the same bed, where it extends into Ladak, as old alluvium, and mentions its containing fossil bones of extinct mammals. Captain Godwin Austen calls these beds, in Ladak, Rodok and Skardo, a fluviatile deposit. The bed is not limited to the belt of country situated between the Ser and Mer (Snowy Peak Range) chain and the Kailas chain. It is well developed in Rodok, near the Pang Chong Lake and up to the foot of the Korakoram chain, and it is very probable that the great Desert of Aksai Chin is a similar bed. I have said, in another place, that I believe these horizontal beds to be identical to the Ragzaier or elevated plateaux of the Afghan mountains. How were they formed?

In order to answer this question, let us consider what was the physical topography of the Himalayas soon after their final upheaval. There was not much difference in the configuration of the great ocean between the tropics; if we are to believe the geologists who have studied the Andes, these mountains had not yet appeared; the great plains of Africa, Arabia, Persia and India, were still under water; the mountains of the Indian peninsula may have appeared (and did probably appear at the time of the Himalaya's last upheaval) but were separated from the Himalaya by a considerable sheet of water; the great inland sea now represented by the desert of Gobi was not yet dry,—in short, there was little cause to diminish the humidity of the winds which blew from the south, and there was nothing to change their old direction. But the Himalayan and Afghan mountains were very different from what they had been. Instead of low ranges with volcanic peaks which did not probably soar above 5,000 or 6000 feet, we have now an immense wall, some hundred miles broad and 25,000 feet high, with deep longitudinal valleys offering no exit and much embarrassed by detached rocks and debris. The humidity of the winds which produced the tremendous rains of the Miocene period was now deposited as snow. Huge glaciers appeared and filled the longitudinal valleys, and the rivers which ran from them began to deposit a sediment which, in time, formed the great flat plateau of Thibet, Rodok, Aksai Chin, &c. &c. Thus we see the altered physical conditions which were brought about by the difference of elevation of the Himalaya, before and after its final upheaval. Before the upheaval, the humidity was collected as rain, and the mountain debris was washed to the coast by boisterous torrents; but after the upheaval, the humidity was collected as snow, and the mountain debris was quietly collected in the great valleys, under the cover of glaciers.*

All the while, a different action was going on in the outer or low Sub-Himalayan ranges. There the humidity continued to fall as rain and great denudation was the result. The same process of land gaining over the sea, which I have described at the Miocene epoch, began to form the plains of India; this process is still in operation now-a-days, but necessarily its power diminishes in intensity as the sea-coast becomes more distant from the hills and the course of rivers becomes longer. It is the process which is now anxiously watched by the pilots of the Hooghly, and which no engineering skill can avert: the sandbanks advance in the sea, the river-bed fills up, more dry land appears and what was yesterday a dangerous shallow out at sea, to-day is the shore of the delta, and to-morrow will be far inland.

As the plains of India extended, the rain-fall of the Himalaya diminished. Even if we suppose the humidity of the winds to have been the same as before, we must deduct from the Himalayan rain-fall the amount of rain which fell in the plains. But we know that the humidity of the rains had also become less; the Andes had surged up and the South-American continent had appeared; the plains of Africa, Arabia, Persia and Central Asia were gradually appearing above the waters, and instead of the trade winds, the monsoons were establishing themselves. There was therefore a great diminution in the snow-fall on the Himalayas, and the glaciers began to decrease and to expose a great deal of the plateau on which they had gradually raised themselves. It is easy to understand how this decrease of snow-fall

* The filling up of the great parallel valleys of the Himalayas by mud and boulders, under the cover of the glaciers, is analogous to the filling up of depressions of the surface by the glacial drift in some parts of Europe. The glaciers of the Himalaya, soon after the great upheaval, were too huge and too general to have had a ploughing and scouring action on the valleys.

must have been very gradual, if we keep in mind what brought on that decrease; and as the glaciers retreated, animals advanced and soon populated the high plateau of the Himalaya. These animals have left their remains interred in the clayey grits of these elevated lands. It may appear strange that elephants once lived at such a great height, and in a climate so cold, but the osseous remains found in the elevated plateau of Mexico belong to true elephants of extinct species,* and the Siberian mammoth which was covered by a warm fur, lived on the leaves of conifers and roamed over the ice-drift. There is therefore no doubt that these animals had a great plasticity of organism, and could adapt themselves to very extreme climates.

The mammals discovered in the plateau of Thibet and Ladak, all belong to extinct species. On the other hand, all the shells which I have been able to collect in the old alluvium found near the foot of the Sub-Himalaya belong to living species, and it is therefore most probable that the older alluvium of the plains of India, and the high plateau of the Himalayas belong to the post-pliocene epoch.

From the above considerations, and the present state of our knowledge, it appears that the Afġhan and Himalayan mountains suffered their last upheaval during the pliocene period.

99.—The description of the deposition of beds subsequently to the great upheaval has been given incidentally in the preceding paragraph; the glaciers began to melt, great lakes were formed in several localities. The Kashmir valley is a good example, Rukshu is another, and so is Abbottabad valley. These lakes at first fed large rivers, and both lakes and rivers had a considerable power in carrying mud, sand and boulders, and thus raising their beds by several hundred feet; but as the water-fall diminished, the lakes and rivers diminished also, and the rivers soon began to cut for themselves deep ravine-like beds in the middle of their ancient bottoms, leaving on each side a great river-terrace.

Before the rivers had lost their great volume, however, and while they filled the whole of their original beds, they floated icebergs of sufficient dimensions to carry blocks of stone of great size. The Salt-Range for a time intercepted the free passage of the waters towards the south and a shallow lake filled the whole country between it and the

* Cosmos, Otte's translation, Vol. I. page 280.

Munee Range.* On this lake floated the icebergs brought down by the rivers, drifting gradually to the south, and finally grounding near the Salt-Range or averted by it. Thus we see between Jubbee and Nikkee large erratic blocks, being porphyry, resting on the top of the old alluvium; and we find similar but smaller blocks imbedded in horizontal taluses of debris which have been piled up in horizontal layers against the hills of Maree on the Indus. These blocks are not water-worn, but present either flattened or scratched surfaces; the ground all over that district is covered with boulders of porphyry, greenstone, felstone, &c. but these boulders are well rounded and are easily traced to disintegrated beds of Miocene conglomerate. The erratic blocks are very different in appearance, and have the striking, or somewhat odd and *déplacé* aspect peculiar to erratics. One of them, three miles south of the village of Thrapp, measures 6 feet 4 inches by 7 feet 4 inches and 5 feet. There are four or five smaller blocks near it, but none are rolled; they are all of the gneissoid porphyry of the Kaj-Nag. The largest presents the very singular appearance of having its greatest flat surface (not vertical) marked with a number of cup-like holes of various size, from 6 inches across to the size of a walnut, and from $1\frac{1}{2}$ to 2 inches deep. There are from 70 to 75 of these cups. They resemble wide rounded holes or cups, as water would make by dropping. Whether these cups are a glacial effect, or have been made by a race of men for some unknown purpose, is, what I am unable to decide. I am inclined to the first hypothesis.

Erratic blocks near Thrapp.

100. The oldest indications of Man having become an inhabitant

* The damming of the water behind the Salt Range and the Chitta Range was the cause of that thick deposit of silty mud now cut by ravines, which has been the source of so much difficulty and expense in making the great Trunk Road between Jheelum and Attok. A similar damming occurred in the Huneepor valley and several other localities, but to a less degree.

of the Himalayas is, at present found in the Upper Lacustrine deposit of Kashmir (see note to para. 44). This deposit contains a very great many fragments of pottery, bones of goats, and pieces of charred wood. It is much older than the Buddhist ruins of Avantipoor, and attests the presence of man in the valley during the period which elapsed between the first and the second lake. The Buddhist ruins were not built until after the second lake had been drained. But though we may call the race of men who lived in Kashmir before the second lake historically ancient, they cannot be considered so geologically: a cowry has been found* in the deposit, and this evidence of a currency indicates at once an amount of civilization and trade far removed from the state of the primitive races.

(To be continued.)

Experimental Investigations connected with the supply of water to Calcutta, Part III.

By D. Waldie, Esq.,

F. C. S. &c.

(Continued from page 8.)

[Received 1st March, 1867.]

The present communication is intended to give an account of the results obtained in prosecuting the investigations indicated by the title, the first of which have already appeared in this Journal. To some of the results given in the original paper objections were raised, which were examined in a subsequent article, entitled, " Supplementary Observations, &c.," these being founded on experiments made during the month of September last. Since that time the enquiry has been continued, with the view of more fully examining these objections, of supplying certain deficiencies, of correcting some errors, clearing up some obscurities, and generally rendering the enquiry more complete.

I propose also to endeavour to correct some misapprehensions which seem to have arisen, and indicate points of importance which do not

* The cowry was discovered by Captain Godwin-Austen while we were examining these lacustrine beds together. I saw Captain Austen dig it out of the clay with his penknife.

appear to have attracted the attention that was due to them. I shall also draw my own conclusions from my results, stating at the same time with what amount of confidence they are made.

Inorganic constituents.

In the original communication, on account of an unforeseen and unexpected source of error which vitiated some of the results and therefore rendered the series incomplete, only a general view of the relative proportions of alkaline and earthly salts at the different seasons, taken from the tables in Dr. Macnamara's Report, was given. It may be of interest to state the nature of the source of error, then only hinted at. It occurred in the case of the waters of December and February, greater part of which had been kept in green glass stoppered bottles till the month of April, which, on analysis, gave results so peculiar as to excite surprise. The same peculiarities were found in some of the analyses of the river water of August, in even a more marked degree. After not a little perplexity and trouble, it was ascertained that this arose from the action of the water on the glass, dissolving the glass in such proportion as altogether to vitiate the result as regards the proper constituents of the water; it having been ascertained that the silica, the alkalies, and the lime of the glass were all added in notable proportion to the constituents of the water. It was the very large proportion of the silica obtained that first drew attention to the subject. Not being specially connected with the object of this paper, it is not necessary to notice it more particularly than to observe that there can be little doubt, but that it is due in great part to the increased activity given to the solvent action of the water by the high temperature of the climate, though indeed it occurred to a sufficiently decided degree even during the coolest months. There is probably little doubt that this circumstance has in many cases introduced error into water analyses unobserved. The analyses, in the present case so vitiated, were rejected and new ones instituted as the season gave opportunity.

For the purpose of comparison, the most complete plan would be, to ascertain the amount of each basic and acid constituent and state these in detail. A very general, or rather the general plan hitherto followed by chemists, has been to allot the acids and bases to each other, it may be by some conventional plan or according to some favourite theory, and represent them in the state of neutral salts. And as each chemist may follow his own particular plan, the same analysis may be represented in very different ways. As it is simply impossible to say in what way the acids and bases are united to one another in solution, it is very much better to state them separately; and I was glad to find that Professor Dr. W. A. Miller expressed the same opinion in his paper formerly referred to. But for general purposes a full statement of each constituent is unnecessary, and when numerous samples have to be examined, is very laborious. It is generally sufficient to classify them, or select a few of the most important and characteristic constituents or properties. In the case of the mineral constituents, their total amount, the quantity of chlorine or of sulphuric acid, the proportion of earthy salts, that is, of lime and magnesia to the alkaline salts, are, singly or together, all more or less suitable according to the nature of the water to be examined. The soap test formerly noticed is a very favourite method, from the ease of its execution. I have applied it in some cases, though the nature of my enquiries led me generally to have recourse to other methods.

The following table gives a view of the constitution of the river water at the various seasons, classified in a way that seems to me very suitable for comparing different samples. The principal mineral constituents are the alkalies, potash and soda, and the earthy, lime and magnesia,—soda being the most abundant alkali, and lime the principal earthy constituent. These bases are combined with carbonic acid in much the larger proportion, and in smaller proportion with hydrochloric acid, sulphuric acid and perhaps organic acids. The carbonates of lime and magnesia are kept in solution by excess of carbonic acid, and when the water is boiled or evaporated to dry dryness, by far the greater part, indeed all except a very little of the lime and magnesia, are separated insoluble. These remarks apply to the river water proper; during the hot season, when tidal influence prevails, the constituents of seawater make their appearance; then sulphuric acid is increased a little and magnesia still more; and hydrochloric acid and soda (or chlorine and sodium as common salt) are largely increased in quantity.

TABLE I. For 100,000 fluid grains.

River Waters of		Total Mineral salts.	Alkaline salts as Chlorides.	Earthy salts as carbonates	Silica.
9th June, Chandernagore, above tidal influence,	Ebb,	17.04	4.22	14.69	2.53
14th June, at Baranagar,	Ebb,	30.00	13.96	15.10	4.00
" " " "	Flood,	124.10	112.30	34 25	3.70
6th July,	Ebb,	12.63	2.08	5.20	*4.49
31st August, 1865,	Ebb,		1.50	7.71	*2.7
21st August, 1866,	Ebb,	14.10	1.70	6.60	*5.60
19th November,	Ebb,	15.40	2.77	12.62	1.50
9th January, 1867,	Ebb,	24.15			
" " "	Flood,	25.35			
30th January,	Ebb,	24.95	4.22	20.45	2.16

In Table I. the alkalies are exhibited as if they were all in the state of hydrochlorates of potash and soda, or more correctly chlorides of potassium and sodium, chloride of sodium or common salt being the best type of such compounds, and the one most familiar to us, and practically most important. The earths are exhibited as if they were all in the state of carbonates of lime and magnesia, these compounds being also the most familiar ones. By this arrangement, the relative proportion of these constituents at different seasons can be easily compared. I am not aware that this plan has been used before, but it seems to me a good one, particularly when combined with the results given in Table II.

* Silica mixed with more or less clay.

TABLE II. For 100,000 fluid grains.

River Waters of		Hardness, equal to grains of Carbonate of Lime. Total	Permnt.	Chlorine calc. as chloride of sodium.
21st August,	Ebb,	7.8	*2.9	1.58
10th November,	Flood,	9.6		1.79
19th November,	Ebb,	12.7	1.4	.95
9th January,	Ebb,	18.4	2.1	2.63
" "	Flood,	22.0		4.97
30th January,	Ebb, Deep,	18.5	2.5	1.28
" "	Surface,	20.7	1.7	3.40
20th February,	Ebb.,	20.3		5.63
" "	Flood,	21.6	2.6	11.48
2nd May, 1866,	Ebb,	20.0	2.1	15.50
" " "	Flood,	31.4		55.50

This table shews the indications of the soap test already noticed in the first paper. The total hardness is the effect produced on soap by all the salts of lime and magnesia present, and all the carbonic acid and silica; the permanent hardness is that left after boiling, and is produced chiefly by the lime and magnesia not separated in the insoluble state, but still remaining in solution. Another column exhibits the proportion of Chlorine calculated as if it were all in the state of chloride of sodium or common salt. The chlorine is in small quantity except when tidal influence prevails.

So far as regards mineral constituents, the water of the Hooghly at Calcutta varies greatly according to the season. Compared with the waters supplying London, the solid contents during the rainy season are much smaller, and the total hardness much less; and even in January and February, these are somewhat under those of the London waters. As regards permanent hardness, the Hooghly water is very decidedly superior to the London waters probably all the year round, except possibly during the hot season at flood tide, though that latter point is at present somewhat uncertain. But the temporary hardness is easily removable; and for economical use, except during flood tide

* It mnst be remembered that these results are for 100,000 grains water. For an Imp. gallon of 70,000 grains multiply by 7 and move the decimal point one place to the left.

of the hot season, as regards mineral constituents, the product of the Hooghly may be considered very good water. It will be compared with the Calcutta tank waters afterwards.

Organic constituents.

The attempt made by experiments with artificial mixtures to imitate the composition of the waters of the hot season, and ascertain the probable amount of change in the organic matter by keeping, as narrated in Part II. " Supplementary Observations," was not continued, partly because all the circumstances of the case could not be imitated, and partly because the plan did not seem to be considered satisfactory to those who objected to the correctness of my results in this particular. It appeared to be better to continue the observations, taking care to avoid delay in the process for estimating the organic matter more particularly. Besides, recently the objections to the correctness of my results have been in a great measure withdrawn,* and it is hardly necessary for me to do anything more in the way of directly answering objections, as it was never my object to criticise the labours of others, but simply to state my own, carefully obtained by methods of procedure the most correct and reliable known, up to the present time.

In the original paper I considered the various methods of ascertaining the nature and amount of organic matter in water, and discussed their several merits; and a few further remarks will now be made on the same subjects. The amount of organic matter by weight came first in order, but I shall at present postpone it, until the plan of oxidation by permanganate of potash has been noticed.

This plan has come greatly into favour, chiefly I suppose from its facility of application, a very valuable recommendation, provided its other merits be assured. In the original paper I gave it a qualified and guarded approval; the result of numerous experiments made since has not increased my estimate of its value, nor has that experience, and reflection thereon, led me to concur in the generally favourable estimate in which it is held. It is said " that it is not improbable that " the substances most readily oxidised, are just those most likely to be " injurious in their effects upon those who drink the water." This is Dr. Miller's remark. Others " believe" that the most pernicious are

* Indian Medical Gazette, Calcutta, 1st January, 1867, p. 14.

those that are most easily oxidized. These, it appears to me, are rather weak grounds on which to found the preference which is at present given to this mode of estimating the degree of organic impurity in water. Others speak of it as indicating the amount of putridity in the water, and this, in my opinion, comes nearer the truth. By this I understand that the amount of oxygen required is in proportion to the amount of certain products of the putrefactive fermentation of the organic matter in the water. This, however, as Dr. Frankland has stated,* furnishes no indication of the amount of organic matter actually present in the water. The offensive smell and other properties of these products make it more than probable that they are injurious to health; but even then it is not certain that there may not be other constituents, equally or even more injurious, but more difficult of oxidation. Nor is it even certain that these products of putrefaction are the only substances which are readily oxidized by the permanganate.

Moreover, a portion of these products are evidently of a very unstable character and quickly disappear, or at least lose their power of deoxidizing the permanganate. This was first brought particularly to my attention by the objections raised to my determinations of organic matter in the original paper, and has been noticed in the supplementary observations. Since then, I have made numerous observations on this point, and give a few selected ones by way of illustration. The details of the mode of observation are given in the original paper.

* Chemical News, March 23, 1866.

TABLE III.

	Time of trial.	Oxygen req. for 100,000 grs.
		grains.
River water of 5th October, 1866, Ebb tide, cleared by a little hydrochloric acid and filtered, ...	5th October,	.1430
	7th ,,	.0440
R. W. of 10th October, Flood, filtered,	10th October,	.1210
	12th ,,	.0860
R. W. of 10th Nov. Flood, filtered, ...	10th November,	.1210
	12th ,,	.0860
R. W. of 19th Nov. Ebb, Surface, ...	19th, ½ hour old,	.1390
	20th ,,	.0357
	23rd ,,	.0332
Deep, ...	19th, ½ hour old,	.0640
	20th ,,	.0320
	23rd ,,	.0345
R. W. 15th Feb. 1867, Flood, ...	15th, 2 hours old,	.1125
	16th, 28 hours old,	.0410
Dalhousie Sq. Tank W. of 9th Oct. 1866,	9th, 3 hours old,	.1425
	10th, 16 hours old	.0860
	2nd November,	.0430
General's Tank, of 6th Feb. 1867, ...	7th, 3 hours old,	.2830
	7th, 26 hours old,	.1155
Baranagar Tank, of 1st Oct. 1866, ...	1st October,	.3150
	2nd ,,	.2740
Ditto, of 15th Feb. 1867, ...	15th, 1 hour old,	.4755
	16th, 25 hours old,	.3625

This table exhibits very plainly the rapid diminution of the amount of oxygen required, by keeping even for one day, and the more gradual diminution afterwards. I have not observed that any notice has been taken of this circumstance by the English chemists. Dr. Macnamara first directed my attention to it, and since then I have not only made many observations of the fact, but have also made experiments as to the cause. The analyses of the London waters published monthly are of the waters supplied by the water companies, therefore, all probably two or three days old. It is evident that in the recent water, there must be substances possessing active deoxidizing properties, which speedily undergo certain changes by which they lose these properties. I have paid some attention to the subject, but am not at present prepared to discuss it. It will be matter for further examination.

At present, however, it has been brought forward to justify so far the comparatively unfavourable opinion I have expressed, of the value of the permanganate process as a guide to enable us to judge of the quality of a water as respects its salubrity. I could bring forward other reasons and adduce experiments, but as I do not intend to apply the method to the matters under investigation in this paper, only one other instance as an additional reason for rejecting it will be adduced.

I shall extract two or three numbers from the preceding table and place beside them a few others of waters from other sources, namely, from the Circular canal which connects the river at the northern extremity of the town with the Salt Water Lake. This Circular canal receives much the greater part of the sewerage of Calcutta. Reference will again be made to it and to the Salt Water Lake. Dalhousie Square Tank is filled from the river and the water is considered good; General's Tank is filled by the rains and is generally said to be the best drinking water in Calcutta.

Table IV.

		Oxygen reqd. for 100,000 grains.
Dalhousie Square Tank Water of 9th October, 1866, ...	16 hours old,	.0860
General's Tank Water of 6th February,	3 hours old,	.2830
1867, ...	26 hours old,	.1155
Circular Canal Water of 23rd November, 1866, ...	20 hours old,	.0832
Ditto of 20th February, 1867, ...	16 hours old,	.0680
Salt Water Lake water, flowing from Canal, 14th February, 1867, ...	20 hours old,	.1780
Salt Water Lake of 18th February, from Canal at Dhappa, ...	19 hours old,	.1475
From the Marsh, ...	19 hours old,	.1690

In his report on the London waters to the Chemical Society on March 13th, 1866,* Dr. Frankland is stated to have expressed surprise that the soft water supply from Loch Katrine required more of the permanganate than any of the waters of the Metropolitan districts, but here is something more surprising still. The water of the Canal

* Chemical News of 23rd March, 1866.

which receives the greater part of the sewerage of Calcutta requires less oxygen to destroy the products of putrefaction than the best tank waters of Calcutta; and the water of the salt marsh to the east of the town, called the Salt Water Lake, requires only about as much as that of General's Tank of the same age; for taking the rate of improvement between 3 hours and 26 hours, General's Tank water at 19 hours old would require .1626 grain oxygen. Results like these have led me to set but a small value on this favourite process, and induced me to turn to others promising more trustworthy indications.

The fundamental point with respect to the organic matter is the same as that connected with any other constituent, namely, its proportion by weight, ascertained as accurately as practicable. The method of doing this has already been detailed in the first paper, and I have only to repeat that, with a fine balance, patience, and care, it gives fairly satisfactory results. Attention to details is advisable to procure uniform results. Of the ordinary river or tank waters, I usually evaporate from 10,000 to 40,000 grains, according to the kind of water, contriving so as to have 4 to 6 grains of dry residue, beside 3 grains of dry Carbonate of Soda* added to the water, when put to evaporate. At one time I did not use the soda for some kinds of water, as unnecessary, but now I use it always. It makes the results more accurately comparable. These quantities are sufficiently large for the crucible, which holds conveniently about 200 grains of carbonic acid water, but requires to be twice or thrice filled up. A larger crucible would be more convenient, in which case once might do.

The river water of the cold season of 1865-66 had been kept over from two to four months, and the results as to organic matter therefore were doubtful. These will now be replaced by new determinations, all made without delay. There has been no opportunity yet for making new determinations of the hot season and rainy season waters; but I have already, in the "Supplementary Observations," given reason for believing that the delay of from 9 to 16 days in making these determinations, in the case of the hot season waters, cannot have been productive af any serious error. Additional reasons will be given for this opinion presently. There is greater doubt respecting the July and

* Dr. Parkes in his "Practical Hygiene" recommends 30 grains Carb. of Soda! This is surely a misprint. He also recommends to restore the carbonic acid lost by ignition by adding solution of carbonic acid or carbonate of ammonia, This is a mistake: the results by carbonate of ammonia are totally wrong.

August waters, which stood in most cases about five weeks, to allow the fine clay to settle. This is a special case and will require further remark; but at present, as I wish to present a view of the whole, they will be taken as they are in the construction of the following table. Many more determinations of organic matter were made, particularly of the waters of the rainy season, but these were made for special purposes and with various modifications of the process, so that they were not comparable. Only those are given in the table which were made by the plan already specified, and so far as this is concerned, they are therefore comparable. These variations in plan were chiefly tried in September and October, and so unfortunately no results for these months can be introduced into the table. But as an illustration of these variations, I may instance the case of the water of 6th October, which, cleared by Hydrochloric acid, gave 1.05 grains, and cleared by sol. potash, gave 3.22 grains organic in 100,000 grains of water. The addition of a little of either of these causes the mud to settle, and admits of filtering the water clear in course of a few hours. But as there is much organic matter adhering to or combined with the clay or other earthy matter of the mud, the acid or alkali acts upon this and brings it into solution.

TABLE V.

Shewing the amount of Organic matter by weight in 100,000 grains of the Hooghly water.				Ebb. Grains.	Flood. Grains.
6th July,	1866,	Neap,	Surface, ...	.80	
8th August,		Neap,	Surface & Deep, ...	.84	
21st August,		Neap,	Deep, ...	.86	
10th November,	1866,	Spring,	....		1.28
19th Ditto		Neap,	.... Deep, ...	.94	
,,		,,	.... Surface, ...	1.28	
9th January,	1867,	Spring,	....	.88	1.50
30th Ditto,		Neap,	.... Deep, ...	.58	
,,		,,	...............Surface, ...	1.28	
			Average, ...	.99	1.39
2d May,	1866,	Spring,	....		2.70
30th Ditto,		Spring,	....	.90	2.60
14th June,		Spring,	....	.90	2.20
		Average,	....	.90	2.50

With reference to this table, a few remarks may be made. The rainy season waters were taken during Neap tides at ebb. Probably they would not have differed much, though they had been taken at spring tide during flood. Special remarks will be made on these afterwards.

The numbers attached to the waters of November and January, shew that the surface water contains more organic impurity than the deep, and that there is a very decided excess of this during flood tide as compared with ebb.

The May and June waters are the old ones,—open to future emendation as to quantity of organic matter. But even these indicate a still larger excess of organic matter during flood tide. And comparatively small though the amount of organic matter be, compared with those hitherto generally received, they shew the influence of the tides in bringing up organic matter, as has not been shewn before.

I have already observed that the opposition, with which my statements as to the small amounts of organic matter originally met with, has been now in a great measure withdrawn; yet it may be desirable to make a few observations on the subject. Having regard to the delay in examining the waters of the cold and hot seasons, I abandoned those in which the water had stood from two to four months, (the cold season samples); but did not think that the delay of from nine to sixteen days would materially affect the correctness of the results from the hot season waters. Reasons have already been given in the Supplementary Observations for this, to some probably not sufficiently conclusive, so I shall in the first place give the results of the examination of another class of waters, which may have some bearing on the subject. These are the waters of the Salt Water Lake and of the Circular Canal.

The Salt Water Lake is a large salt marsh of about one-third of the degree of saltness of sea water, about two miles to the eastward of the boundary of the town. From Entally, near the Circular Road, a canal proceeds eastwards towards it, called the Baliaghatta Canal. At this extremity it forms a *cul de sac*, but is joined about half way in its course by another branch which proceeds from the river at the northern extremity of the town, and in its course, enclosing all the northern part of the town, at length joins the Entally branch. These

Canals, I am informed by the town surveyor, Mr. Rowe, receive by far the largest proportion of the sewerage of Calcutta, the course of drainage, except for a narrow space along the river, being towards the east, or from the river towards the lake; so to these sources of supply I went for specimens of impure water. The Canal water flows eastward or westward according to the relative height of tide in the Hooghly or Bidyadurrea with which it communicates. The following table gives the results of the examinations.

Table VI.

For 100,000 fl. grs. filtered water.

Salt Water Lake and Circular canal.	Total solid matter.	Organic matter.
	grains.	grains.
Water flowing from the Circular Canal at Chitpore bridge into the river on 14th February, 1867, Neap tide, ebbing commenced.	471.70	15.30
Water from Baliaghatta canal at Dhappa Toll House, 18th February, 1867, ...	489.50	6.00
Water from the Marsh taken at same time, ...	525.00	6.50
From Circular canal at junction with the Entally canal, water flowing from the river 24th November, 1866. Filtered,	40.40	*1.75
" " Ditto,		2.48
Cleared by per-chloride of iron and filtered, ...	42.60	2.51
" " Ditto,		2.58
From Circular canal at bridge on Dum-Dum road, full tide, 20th February, 1867, ...	32.95	1.78
From the mouth of the canal at same time, ...	34.90	1.53

The most remarkable thing exhibited by the table is the small quantity of organic matter in these waters. The excess in the case of the 14th February water, was, there can be little doubt, owing to the water having traversed the whole length of the circular canal, passing over its putrid mud and carrying with it the sewerage from the numerous drains which enter it. The small quantity of organic matter in the filthy looking water of the marsh, full of gelatinous

* Probably some unobserved error in this case.

looking rank vegetation, is very striking. I got in June last year 20 grains organic in 100,000; but besides that I doubted the correctness of the result, considering it perhaps over-estimated, the difference of season must be taken into account.* Besides this is a strongly saline marsh. The comparatively small quantity in the canal water is also remarkable, and shews how difficult it is to increase greatly the amount in the comparatively pure water of the downward flowing stream.†

And here it may be well to consider the amount of organic matter which the river can receive from the sewerage of Calcutta. First, we have to consider the amount of water carried by the Hooghly, for the data for which I have to acknowledge my obligations to Mr. Leonard. He estimates that at the lowest season, the river, through its tributary affluents, receives only about 2,000 cubic feet per second, but 8 or 10,000 cubic feet more by percolation from its banks, or say from all sources 10,000 cubic feet of water per second, equal to 864,000,000 cubic feet per day. Mr. Clark, in his report on the water supply, proposes to distribute 6,000,000 gallons per day or even ultimately 12,000,000 gallons. Now let us take the highest of these quantities; at a rough estimate this is about 2,000,000 cubic feet, and its proportion to the volume of the river water is as 2 to 864 or $\frac{1}{432}$ part. The greatest amount of organic matter I found in the filthiest ditch in Calcutta at its worst in June was about 24 grains per gallon. Now supposing all this large quantity of water was daily poured into the Hooghly in the state of sewerage of this degree of concentration, it would be only $\frac{1}{432}$ part of 24 grains of organic matter to each gallon of river water or about .05 to .06 grain per gallon. Even supposing that the amount of water carried by the river has been over-estimated, and that it amounts to only one-half or one-fourth of the quantity stated above, the proportion of organic matter added by the sewerage would not exceed one-fourth of a grain per gallon at most, during the hot season.

* Dr. Parkes states that 12 to 40 or 50 grains per gallon is not uncommon. It would be necessary to know how such results were obtained, before admitting them.

† Probably if the water of the canal, instead of having been collected at full tide, had been taken when the river water was beginning to flow into the canal, it would have contained more organic matter. An attempt indeed was made to get such water two days before (18th February), but the proper time was not hit.

It is unnecessary at present to say more respecting the quantity of organic matter in the Hooghly water near Calcutta. It does not appear to exceed two grains per gallon even in the most unfavourable circumstances of season and tide, and during ebb tide is only about half that or less. Dr. Parkes says that it should not exceed one and a half grain per gallon in drinking waters, and the London authorities seem to be endeavouring to reduce it almost to nothing. In view of the difficulty of judging of its nature, it is desirable to have as little of it as possible.

In the original paper I have discussed the nature of the organic matter, and have not now much to add. The season of the year since that communication is the least favourable to the examination of the impurities in the water, as during these months—October to February—all the waters are at their purest. I formerly expressed an opinion on the amount of ammonia being probably a good indication of the impurity of a water, and gave reasons for it. The following are the results of some examinations of the river water, during these months, for ammonia.

Table VII.

Showing proportion of Ammonia in 100,000 fl. grs. of water.

		grains.
18th September, 1866, River Water,		.0620
10th November, 1866, Flood tide,		.0065
9th January, 1867, Ebb,		.0160
Flood,		.0145
22nd January, 1867, Shore,		.0260
30th January, 1867, Ebb,	Deep,	.0090
	Surface,	.0160
20th February, 1867, Circular canal at mouth,		.0170
	at 3rd bridge,	.0190
18th February, 1867, Salt Water Lake Marsh,		.0250

The quantities are small, yet consistent enough with the previous observations. Reference may be made to them in remarks that follow.

But the Ammonia is not the only thing to look to in connection with organic matter. As formerly observed, there are the products of oxidation of nitrogenised matter, including that of ammonia itself, namely, nitric and nitrous acids, and there are nitrogenised substances in progress of decomposition, as well as non-nitrogenous substances, usually called vegetable, carbohydrates, and hydrocarbons more or less oxidised. Reasons have been given in the first paper for not attaching very much importance to the estimation of nitric acid, yet the enquiry is interesting, to account for the destruction of the nitrogenised matter. If the nitrogen is oxidised, it ought to be found as nitric or nitrous acid, unless it be supposed that it escapes in some gaseous form. Time has not permitted me to investigate this subject, but the few trials I have made for the detection of nitric acid have not been at all successful,—possibly it may be for want of sufficient care. On the other hand, the test recommended for nitrous acid,—Price's test by starch, acid, and Iodide of Potassium, at once gives indications of that acid. But unfortunately it equally has given me free indications in the distilled water used, though means have been taken carefully to free the water and all the re-agents employed from it. At present I can give no explanation of these difficulties: the point is reserved for enquiry.

The most difficult part of the subject is the estimation of the nature of that more fixed portion of the organic matter which has undergone comparatively little change. The determination of the amount of nitrogen in this is one mode of examining it: I have not at present attempted this, as the waters have during the last four months been in the least favourable condition for such examination, and my time has been occupied with other parts of the enquiry. But I can only confirm what was before stated, that the organic matter evidently varies considerably in its nature: that of the rainy season resembles more that contained in tank waters; that of the dry season is more like that contained in sea water. The former evidently contains more matter of vegetable origin, but so far as I have been able to form a judgment, this only partially accounts for the difference.

But before proceeding to discuss these points, it may be better to have the whole of the data before us, by including the composition of the tank waters as well as of the river water. In the first paper one table exhibited some of the principal characteristics: now, additional information can be given. It will be exhibited by the following tables.

TABLE VIII.

Tank and well waters. For 100,000 fluid grains.

	Date of collecting.	Solid matter.	Organic matter.	Oxygen eq. to oxidise.	Ammonia.
		grains.	grains.	grains	grains.
General's Tank, ...	7th Oct.	9.83	2.11		
	24th Jan.	9.05	1.59		.017
Monohur Doss' Tank, ...	9th Oct.	12.80	1.95		
	25th Jan.	12.33	1.24		.026
Dalhousie Sq. Tank, ...	9th Oct.	20.30	1.90		
	21st Jan.	25.38	2.33		.044
Ramdhone Ghose's Tank,	18th Feb.	66.25	4.62		
Baranagur Tank,.........	15th Feb.	46.00	4.05		.045
Well, ...	22d Feb.	105.25	4.56		
Nyan Chund Dutt's Lane Tank, ...	22d Dec.	72.50	6.25	.316	
Well, ...	22d Dec.	97.00	5.20	.060	
Blaquiere's Tank, ...	16th Dec.	107.20	8.00	.172	
Manictollah Well, ...	16th Dec.	187.20	12.90	.200	
Puttureaghat St. Well.,...	8th Dec.	158.01	9.23	.281	.660
Nimtollah Street Well,...	8th Dec.	278.60	21.23	.882	.700
River water from street aqueduct, ...	16th Dec.	20.80	1.80	.102	

The first three are well known tanks referred to in my first paper; Ramdhone Ghose's Tank, Jaun Bazar, is that also noticed there,* near Mr. Dall's school, the water of which has since become much cleaner, and the Baranagar Tank is also that referred to there, the well being an old one on my own premises.

As to the remainder, some explanation is necessary. I was requested by the Municipal authorities in December last to examine some waters in the northern part of the town, with reference to a proposed public tank to be excavated there, and the results are included in the table. Of these Nyan Chund Dutt's Lane Tank and Well and Blaquiere's Tank are old sources of supply; the three latter "wells" were simply holes dug in the ground 8 or 9 feet deep to collect water for examination: the water from the aqueduct was supplied at my request for comparison.

Another table will exhibit a few more points for comparison.

* Called Dhurrumtollah Tank by mistake.

TABLE IX.

Tank and well waters. For 100,000 gr. water.

	Hardness. Equal to that from Carbonate of Lime, in grains. Total.	Perma-nent.	Chlorine calc. as Chloride of Sodium.
General's Tank of 18th Feb. 1867,......	6.4	2.1	
Ramdhone Ghose's Tank of 18th Feb.,	29.9	15.1	28.66
Baranagar Well of 22nd Feb.	70.4	12.3	45.40
Nyan Chund Dutt's Lane Tank, ...	33.7	2.9	40.10
Well, ...	69.7	17.1	44.30
Blaquiere's Tank, ...	51.1	14.5	31.60
Manictollah Well, ...	68.1	6.1	58.50
Puttureaghat Street Well, ...	53.3	11.0	53.10
Nimtollah Street Well, ...	127.5	24.0	111.20
River water of street aqueduct,.........	19.7	2.1	1.73

And to get a full insight into the nature of such waters, a complete analysis was made of two of them, of which this is the result for 100,000 fluid grains of water.

TABLE X.

	Puttureaghat Street Well.	Nimtollah Well.
	grains.	grains.
Potash, ...	30 49	34.77
Soda, ...	31.35	35.33
Lime, ...	14.00	31.20
Magnesia, ...	8.76	22.80
Chlorine, ...	32.30	67.81
Sulphuric acid, ...	1.84	13.20
Phosphoric acid, ...		
Silica, ...	7.00	4.80
Carbonic acid by difference, (including errors of analysis,)	23.03	47.46
	148.77	257.37
Organic matter, ...	9.23	21.23
	158	278.6
Nitric Acid, ...	none detected.	small quantity.

Phosphoric acid: very distinct indications of in both.

This was also found in smaller quantity in the other four of these waters, and in still smaller quantity in the water of the aqueduct.

The relative proportions of these constituents, so different from those of ordinary spring or even river waters, point clearly to their origin. The large quantity of alkaline salts, compared with those of Lime and Magnesia, and the large proportion of Potash and of organic matter, indicate that they are derived from the decomposition of vegetable and animal substances: the phosphoric acid and perhaps the chlorine being more particularly characteristic of their animal origin. In fact, it is the composition of sewage water, and differs from some other analyses of English town sewage* most remarkably in the large proportion of potash present, no doubt the product of the vegetable food of the mass of the population. It is indeed simply sewage water, deprived in great part of its bad smell by filtering through the earth. And the partial analyses of the other tanks and wells (except the three first tanks of the table) indicate that the waters all partake more or less of the same character, and contrast strikingly with the superior purity and different characteristics of the river water during the cold season.

The large quantity of Ammonia as exhibited by Table VIII. in the two waters fully analysed is also very striking.

Now to return to the consideration of the organic matter which has undergone comparatively little change, and for the proper examination of which we have no very ready or suitable chemical processes: the best means of judging of its nature and properties have already been discussed in my first paper. These are, chiefly, the general appearance and smell of the residue obtained by evaporating the water, the smell on burning, and the estimation of the amount of nitrogen by the Soda lime process. This last, for reasons already stated, I have not applied. But I may observe again, that these bad tank waters more resemble the river water of the rains than of the hot season, in the appearance and properties of their organic contents. No doubt this proceeds in part from the larger proportion of matter of vegetable

* Lawes and Gilbert, Journal of Chem. Soc. Ser. 2, Vol. IV. p. 118 for 1866. Way's Report on Sewage of Towns quoted in Parkes's, Manual of Practical Hygiene, 2nd edition, 1866, p. 325.

nature; non-nitrogenised matter. It appears to me, however, that there is a tendency generally to make too much of this distinction between matter of vegetable and of animal origin, it being often spoken of as if the organic matter were of little importance, if it could be shown to be vegetable matter. Now it may be admitted that most probably water tinged by peaty matter consisting of the ordinary humous class of acids and salts, may be not at all even injurious to health, and that water flowing over or percolating through the soil of mountainous districts or others bare of vegetation, where there is little herbage and much earth or rock, may be very pleasant and wholesome. But citing such cases is only evading the question. It does not follow that water draining off cultivated fields or dense jungle, or flowing between banks covered with luxuriant and rank vegetation, will be equally harmless. Putrefying animal matter is very offensive, but putrefying green vegetable matter, though not so disgusting in idea, is scarcely less offensive. Nor, be it remembered, are the poisonous properties very much dependent or connected with a disgusting taste or smell, and the most powerful poisons come from the vegetable kingdom.

In my first communication, the oxidising action of the atmospheric air dissolved in river water was brought forward as a powerful agency for purifying the water. And though Dr. Frankland's results were quoted as strikingly illustrating it in respect to the Thames waters, yet such observations are by no means new. And it must again be observed that the high temperature of the climate will materially assist this action. No doubt it assists putrefaction, fermentation also, and in some cases this may take place in a river, when its course from any cause is rendered very slow. But in the case of the Hooghly the tides cannot fail to act beneficially; twice every day damming back the water and again retreating, enabling the river to flow with increased velocity, increasing the motion amongst its waters and constantly changing the surfaces exposed to the air. This is just one of those agencies that escape general observation: it does not exhibit itself to the senses, yet it must be remembered that it is by the oxygen dissolved by water, small though that be in amount, that animal life is preserved in the waters no less than in the ordinary atmosphere.

The organic matter remaining in the mother liquors, after having as well as practicable crystallised out or otherwise removed the mineral saline constituents, is, in the case of the hot season river water, of a pale brownish yellow colour, with a comparatively faint, somewhat urinous smell; that from the tanks and river water of the rains is of a darker brown colour and a more excrementitious smell: a smell, in fact, similar to that of Guana. So far as sensible properties go, the latter is the more disagreeable, and according to the results of experiment mentioned in the first paper, probably at least equally nitrogenised. At present it would be difficult to speak more positively on the subject.

In my first paper, and more particularly in the abstract of it furnished for the proceedings of the Society, I made some remarks in connection with some of the tanks which my own observations will not bear out. This was the result of haste and inadvertence, which will now be corrected. Some of the best tanks, General's Tank more particularly, are probably equal to the river water in purity at some seasons, and superior to it at others. Tank water deteriorates during the hot season from putrefactive fermentation; the river water proper improves from oxidation, but near Calcutta deteriorates from sewerage and tidal water. Tank water improves during the rains by dilution with rain water, and the animal and vegetable life in it preserves the proper balance, removes decaying matters, and prevents putrefaction to any great extent: at least, this is the case in good tanks. General's Tank seems a well kept aquarium; it abounds in animal life: though its water has often a slightly putrid flavour, this is easily removed by exposure. But even the water of that tank is not, in my opinion, equal in freedom from organic impurity to the river water proper, taken during the dry season at ebb tide.

General Conclusions.

Before closing this communication, it may be well to make a few general remarks as to the conclusions to be drawn from the data obtained. It must have been observed that there is some uncertainty connected with the subject of the organic matter. Persevering enquiry may in time enable us to remove much of this uncertainty, but at present we can only draw conclusions from the most certain grounds we possess. Probably all will agree that it is advisable to get drinking water containing as small a quantity of organic matter as possible, and more particularly as small a proportion as possible of that which is of recent origin. If, this being kept in mind, we take up the question which seems to have been considered of greatest practical importance by the Calcutta community, namely, can the supply be safely taken from the river at Cossipore? we can scarcely answer it in the affirmative. My results, as has been pointed out, show that there is a very distinct increase in the quantity of organic matter in flood over ebb tide, even during the cold, but still more during the hot season. How far this may be due to the proximity of Calcutta, could only be ascertained from extended observations; but as the town must supply a considerable quantity of putrefying and putrefiable matter and that of recent origin, in the absence of evidence indicating the contrary, it would be desirable to avoid taking it from that locality. What is the smallest distance up the river at which this source of contamination is not appreciable, is a point that could be determined only by observations during the hot season in various circumstances and places. But it is evident enough that the further up we go, the more certain are we to avoid this source of contamination.

But though this is an important question, it is not the only one: it seems to have occupied almost exclusively the attention of that portion of the community who have taken an interest in the subject, while another, and in my opinion an equally important one, has scarcely if at all been noticed; and that is, what is to be done with the muddy water of the rainy season? If we look to the amount of putrefying matter as indicated by the permanganate test, or even as observed by the senses, the water, for the first two months at least of the rains, is worse than the flood tide water of the hot season; if we look to the two as we have them, each with its suspended mud, the rainy season water is greatly the worst. If we consider the quantity of organic matter actually dissolved in the water, probably the hot season water contains most, though this at present is not quite certain, and it is also somewhat doubtful if it be so bad in quality as in the rainy season water. Of all points in the enquiry, this is the one involving the greatest doubt and difficulty, and I should feel it quite impossible to give a decided opinion on it, without again examining the water during that season. And what makes this point of chief importance is this, that though the town contamination may be avoided by going up the river, this cannot.

That flood waters (that is, floods produced by rain fall) are most impure, as regards organic matter, is now a recognised fact in England. It is by no means a new observation. In the Report on the Metropolitan Water Supply by Messrs. Graham, Miller and Hofmann, presented to the Secretary for the Home Department in June 1851, this point is repeatedly noticed and the remedy for it discussed, though from the nature of their remarks it is evident that the amount of finely suspended mud, and the degree of its putridity, have probably been much smaller than those of the Hooghly water in the rains. It must be remembered that while in England there are numerous small floods, here we have but one large flood in the year, washing down the accumulated refuse of seven or eight months. It is true that the large quantity of rain dilutes the muddy mixture, and, so far as matter in actual solution is concerned, improves the water. Still we have it loaded with mud, part of that in a very fine state of suspension, very slow in settling, and which cannot be separated by any ordinary filtration. And as the finely suspended clay contains organic matter, putrid or putrefiable, the water must be deprived of it to be rendered fit for use.

The subject has engaged the attention of the Engineer to the Justices, and in his Report on the works for the supply of water to Calcutta, he details the plan for meeting the difficulty alluded to. He admits the difficulty, for the says, para. 28, "The muddy character of the water to be dealt with is an unusual feature in works of this description and necessitates peculiar aud special arrangements being provided." Let us see what these are.

It is to be settled in large tanks 6 or 7 feet deep for 36 hours; then the upper portion, to the depth of 4 feet, is to be drawn carefully off to the filter, after passing through which it is conveyed to covered reservoirs for storage, whence it is to be distributed as required. The filter is composed of sand and gravel, and also, according to Mr. Clark's original proposal, a layer of "Spencer's magnetic carbide." The object of this is to purify the water from organic matter, and it is also said that it removes the suspended matter.

But so far as I can gather from the Report, Mr. Clark seems to consider that the settling of the muddy water of the rains for 36 hours will put the water on an equality with that of the rest of the year as to the rapidity with which it will pass through the filter, and, I suppose, with or without the magnetic carbide, will supply it in an unobjectionable state. At least I cannot find in the Report any provision made in addition to this for the special case of the muddy waters of the rains, or a single arrangement made to provide against any difficulty in this case.

My own observations on the waters of the rainy season are not at all in favour of the success of this scheme. On the contrary, I have experienced the greatest difficulty in getting the water freed from the finely suspended matter by either subsidence or filtration. After standing to settle for several weeks, it still contained much of this finely suspended clay, from which it could not be freed by filtration in the ordinary way. It seems therefore to be impossible to avoid the conclusion that through the ordinary sand filter the water will pass little changed; or if by any modification it be made effectual, it will pass with such extreme slowness as altogether to interrupt the ordinary supply of the water. And if it pass in its muddy state into deep covered reservoirs provided for it, daily it will deposit a portion of its mud, which will be daily more or less stirred up by the new flow of water into the reservoir, a state of matters which appears to be very well adapted to maintain the water in the state in which it entered, or even to tend to make it worse. Whether the water of this season then will be in a fit state for storage, after thirty-six hours settling and the short time longer necessary for its passing though the filter and being conveyed to the reservoirs, is a question deserving of serious consideration. My own observations lead me greatly to doubt it. It would be rather a serious error, if these fears should turn out to be well founded; for not only would the water be offensive during the rainy season, but, unless the reservoirs were cleaned out, would continue to be so. And in the plan there appears no arrangement for cleaning them, and no facilities for doing so.

There are other and effectual plans for speedily separating the suspended mud from the water, and rendering it easy to be filtered perfectly transparent. These are by chemical precipitants, to some of which I have previously alluded; one well known is alum, in daily common use. These have been observed sometimes to increase the quantity of organic matter in solution, but this is probably from imperfect knowledge of the proper way to apply them, rather than essential to their operation.

This enquiry into the water of the Hooghly was commenced, as formerly stated, without any reference to the water supply of Calcutta, but simply as an investigation interesting in a scientific point of view. For even in the single point of the organic matter there is room for the expenditure of much labour and research. It is difficult and not very promising, but persevering enquiry often brings much of interest out of unpromising subjects. The high temperature of the country increases the energy of chemical action, and the comparative regularity of the seasons favours the simplicity of its operation; and thus a country like India affords a field well adapted for the study of the influence of chemical changes on the phenomena of nature. Many of these changes may not be very obvious to those unaccustomed to study them, but they are not the less real on that account, and not the less powerful in their operation on the world around us.

16*th September* 1867.

Since writing the above, the enquiry has been continued, with the view of settling one or two points left in some degree of uncertainty. These were the amount of organic matter in the river water during the hot season and during the rains. The first of these was the point on which the greatest doubt was felt by many as to the correctness of the results given in my first paper, though little shared in by myself: the second was the point on which my own opinion was most undecided. The experimental results will be given in the tables, and comments and explanations will follow.

TABLE XI.

		For 100,000 grains. Total solid contents.	Organic matter.
Hot season.			
River water of 2[illegible]th May, 1867,			
Spring tide, ...	Flood,	55.60	.90
	Ebb,	16.45	.75
Ditto of 6th June, spring,	Flood,	50.75	1.70
General's Tank of 10th June,		10.74	2.40
Dalhousie Sq. Tank of 10th June,		41.35	2.58
Rainy Season.			
River Water of 13th July, purified by perchloride of iron,			1.22
Ditto by ditto in smaller proportion,			.63
Ditto settled 3 days and syphoned off, again settled 8 days,		12.07	.71
Ditto settled and sand filtered continuously with new water daily till 26th, then settled till 18th August,			1.06
River Water of 16th August,	Flood,	10.71	.74
Ditto of 24th August,	Ebb,	10 26	1.10

The experiments on the hot season waters were made to decide the question involved in the objection raised to my first results, namely, that the organic matter had been decomposed and lost by the delay (of from ten to fourteen days) in proceeding to the evaporation. In the present cases the water was evaporated on the next day after collection. The result shews only from .90 to 1.70 grains organic matter in 100,000 grains of water taken at flood tide of the highest spring tides of the season; less indeed than I had obtained in 1866. Many other experiments have shown me that there is very little change in the weight of organic matter sustained by keeping it even for several weeks, and least of all in the case of water containing so much saline matter as the river does at this season. The only thing that undergoes rapid change is the deoxidising power of the water as shewn by the permanganate test, but this does not appreciably affect the weight of the organic matter.

One thing is to be noticed in connection with these, namely, that the amount of saline contents is very decidedly smaller than it was in the corresponding season of 1866. This may possibly have arisen from the correct time of full flood not having been caught, but if so, this must have happened on both occasions: and moreover the quantity of saline matter at Ebb tide is also much smaller than in 1866. It appears to me more probable that the river water has contained less saline matter this year. It would be difficult to give an opinion as to the cause of this: besides, the observations were not sufficiently numerous to draw conclusions from with certainty.

The results of the examination of the river water of the rainy season confirm those I have already given in Table III. of the first paper and in Table V. of this. The absolute amount of organic matter is somewhat less than in the waters of the hot season, but, in proportion to the mineral constituents, very much greater. It is to be observed that the waters which were simply settled, or even sand-filtered, still contained clay: the water, clarified by a little sesqui-chloride of iron, does not give the correct amount of saline matter, therefore in the table this is omitted in these cases, but it was only by such means that the water could be got clear and free from clay, at the beginning of the rains, without delay. The two samples thus clarified were evaporated next day after collection, the others after greater delay.

The waters were also examined for ammonia by the process given in the first paper: the results are exhibited in the following table.

TABLE XII.

Shewing quantity of ammonia in 100,000 fl. grains water.

Hot Season.

		Grains.
River water of 13th May, Neap tide	Ebb,	.0350
	Flood,	.0240
20th May, Spring tide	Ebb,	.0090
	Flood,	.0155
6th June, Spring tide	Flood,	.0190
Average,..........................		.0205

General's Tank water,	.0385
Dalhousie Sq. Tank water,	.0265

Racny Season.

River water of 10th July,	.0240
,, ,, ,, 13th July,	.0810
,, ,, ,, 16th August,	.0380
,, ,, ,, 24th August,	.0140
Average,	.0392

These results exhibit great variations in the proportion of ammonia, and recent investigations throw some doubt on the trustworthiness of the method employed; besides, it is confessedly an imperfect indication of the amount of nitrogenous matter: nevertheless, so far as they go, they are confirmatory of those already given in table IV. of Part I. The waters of the rainy season yield more ammonia than do those of the hot season, and the tank waters, even the best of them, yield more than the river water. And the previous table also shews that General's Tank,—probably the best of the tanks, or at least one of the best, contains more organic matter than the river water; and the results given connected with Dalhousie Square Tank confirm the opinion expressed before, that the river water rather deteriorates by storage in tanks.

I do not mean to say that these results, as to the quantity of organic matter and the proportion of nitrogenous matter, prove with certainty that the river water is at least equal, if not superior, to even the best of the tank waters; but they are the best means of judging which chemical analysis affords of the quality of water for drinking purposes, and, in the absence of equally good evidence to the contrary, the results lead to such conclusions.

Only in one point have I to say something in modification of the results of previous examination, and that is connected with the water of the rainy season. In the previous pages I have spoken strongly of the putrid flavour of the river water of the rains, particularly of the early part of the season. This respected the year 1866. In the present year, however, I have not found this putrid flavour, or at least only to a comparatively very slight degree. At first I was inclined to attribute this difference to some local or accidental cause which had led me into a mistake as to the general character, but after further observation and consideration, I do not think that this is the explanation, but that the water is really different in this respect, this season, from what it was last. For not only has the putrid smell been absent, but the mud has been easier to separate from the water; the particles are not so fine, or at least not so glutinous, and it has not been so difficult to filter clear as it was last year at the corresponding periods; and the quantity of organic vegetable matter produced on standing in bottles has been decidedly less than it was last year. Indeed the river water of the rainy season of 1865 gave much more vegetable growth than that of either of the two succeeding years. Moreover the water of the river did not become muddy nearly so speedily after the setting in of the rains as it did last year: this was noticed particularly, as the muddy water was watched for. Neither after it had become muddy, did it exercise nearly so strong a deoxidating power on permanganate of potash as it did last year: only about one-third of the power; and this is a good indication of putridity. These facts, to which may be added the greater purity of the water of the hot season of this year, seem to indicate some general cause producing the variation. Both 1865 and 1866 were years of deficient rainfall, 62.40 and 60.32 inches; while the year preceding, 1865, was one of large rainfall, there having been 84.22 inches in 1864. This perhaps may have some connection with the points noticed. The peculiarity is worth attention in the future.

The subject of water analysis, in connection with hygiene, has lately occupied much attention in London. Dr. Frankland has expressed opinions respecting the small value of the oxidation test by permanganate, in accordance with my own and on additional grounds, and also proposed a fuller examination of the nitrogenous constituents as the most important guide. Miles Messrs. Wanklin, Chapman and Miles Smith have also proposed some new methods for determining the nitrogenous constituents. The details of these plans, however, have not yet been published, or at least have not yet come under my notice. The subject is also under experiment by myself, and will have further attention.

To sum up, it may be observed, that these extended enquiries, though leaving many points yet imperfect, still go to confirm the general conclusions arrived at in my first communication, favorable to the water of the Hooghly, compared either with the Calcutta Tank waters or the present London waters. I may repeat what I then said; "Such are the conclusions I have arrived at, some of them unexpected even to myself, and which may be disputed by others." And I may add, that they can only be properly controverted by evidence of the incorrectness of the experimental results from which these conclusions have been drawn.

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On the Reproductive Functional Relations of several Species and Varieties of Verbasca.

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In this paper, I purpose giving an account of a numerous and carefully performed series of experiments on the hybrid and cross-unions of several species and varieties of Verbasca, with the view of illustrating those functional relations, or differences existing between the results of unions of distinct species on the one hand, with those of different varieties of the same species on the other. I believe, the generally accepted view of naturalists on this point is, that a certain degree of sterility always results from the union of distinct species in their first hybrid produce, and that their progeny are absolutely infertile one with another; while in the cross-unions of varieties of a species, the fertility is in no respect affected in the first cross, and the progeny are, in every case, perfectly fertile, one with another. These relative differences, then, in the products of hybridism and mongrelism are strongly maintained to be decisively demarcative of the factors, included under the terms "species" and "varieties," affording, so to speak, an unequivocal analysis, whereby nature's original and immutable units—species—may at once be discriminated from those diverged forms—varieties—to which they have given rise, and with which, from the important structural differences they frequently assume, they might be hopelessly confounded. Such, at least, is the opinion of those naturalists who regard species as the result of distinct creative acts. On the other hand, those naturalists who believe in derivative hypotheses, and look upon all existing organisms as the genealogical connections of other and earlier kinds, entertain the directly opposite view, and maintain that no such essential differences as those above stated exist between the results of hybridism and mongrelism; though they readily admit a difference in degree. This point has been ably and philosophically discussed by Mr. Darwin, who, after a careful and impartial examination of all the evidence he could collate, considers himself justified in concluding, that "first crosses between forms known to be varieties, or sufficiently alike to be considered as varieties, and their mongrel offspring, are very generally, but not, as is so often falsely stated, universally fertile.........consequently that neither fertility nor sterility afford any clear distinction between species and varieties; but that the evidence from this source graduates away, and is doubtful in the same degree, as is the evidence derived from other constitutional and structural differences."*

Though Mr. Darwin thus clearly anticipates an essential accordance between the result of hybridism and mongrelism, it is to be observed that the extreme paucity of experimental observations on the latter phenomena prevents his illustrating the subject so fully and satisfactorily as its importance demands. The want of such observations, and the importance of their bearing on that theory of the "origin of species" proposed by Mr. Darwin, has been frequently and strongly insisted on by Professor Huxley. Thus in his "Essay on Man's Place in Nature," p. 106, we find the following remarks: "Our acceptance of the Darwinian hypothesis must be provisional so long as one link in the chain of evidence is wanting, and so long as all the animals and plants certainly produced by selective breeding from a common stock are fertile, and their progeny are fertile one with another, that link will be wanting." Again in his Lectures on our knowledge of the cause of the phenomena of organic nature, Lecture VI. p. 147, after

* Darwin's "Origin of Species," 3rd Edition, pp. 271 and 300.

discussing the obligations of a hypothesis, he remarks, that "Mr. Darwin, in order to place his views beyond the reach of all possible doubt, ought to be able to demonstrate the possibility of developing from a particular stock, by selective breeding, two forms which should either be unable to cross one with another, or whose cross-bred offspring should be infertile with one another," ...."Now it is admitted on all hands that at present so far as experiments have gone, it has not been found possible to produce their complete physiological divergence by selective breeding..........If it should be proved, not only that this has not been done, but that it could not be done, I hold that Mr. Darwin's hypothesis would be utterly shattered." Professor Huxley, however, though thus strongly insisting upon the absence of facts showing that any degree of sterility has resulted from the crossing of varieties known to have originated from a common stock, states that he does not know a single fact which would justify the assertion that such sterility could not be produced by proper experiment, expressing his belief that it may and will be produced.

Considering then the as yet positively equivocal nature of the relations between the phenomena of hybridism and mongrelism, together with its important bearings on the converse theories which now divide the scientific world, I trust the reader will bear with me, while giving a somewhat detailed statement of my own experiments on the above phenomena. I venture to premise that they show pretty clearly the relative claims of the two views now held by naturalists on our acceptance, and illustrate also one or two other points of high interest in theoretical natural science. First, for the union of *V. phœniceum* vars. *roseum* and *album* and *V. nigrum.*

Table 1.—Results of Pure and Mixed Unions of *Verbascum phœniceum*, var. *roseum* and *album*; and *V. nigrum.*	No. of flowers fertilished.	Capsules produced.	Seeds produced.	Average of seeds per capsule.	By calculation.	
					Capsules.	Seeds.
No.						
1. *Verbascum phœniceum* by pollen of *V. phœniceum roseum*, ...	10	8	193	24	20	483
2. *V. phœniceum, roseum* by pollen of *V. phœniceum*, ...	12	9	306	34	20	680

Table 1, *(Contd.)*—Results of Pure and Mixed Unions of *Verbascum phœniceum*, var. *roseum* and *album*; and *V. nigrum*.	No. of flowers fertilised.	Capsules produced.	Seeds produced.	Average of seeds per capsule.	By calculation. Capsules.	By calculation. Seeds.
No.						
3. *V. phœniceum*, by pollen of *V. phœniceum, album*, ...	10	6	120	20	20	400
4. *V. phœniceum, album* by pollen of *V. phœniceum*, ...	16	11	287	26	20	522
5. *V. phœniceum, album* by pollen of *V. phœniceum, roseum*, ...	8	4	116	29	20	580
6. *V. phœniceum, roseum* by pollen of *V. phœniceum, album*, ...	8	0	.	...	...	...
7. *V. phœniceum*, by pollen of *V. nigrum*, ...	10	3	57	19	20	380
8. *V. phœniceum, album* by pollen of *V. nigrum*, ...	10	6	110	18	20	367
9. *V. phœniceum, roseum* by pollen of *V. nigrum*, ...	10	7	107	15	20	306
10. *V. phœniceum*, by own pollen, ...	18	0	.	...	...	...
11. *V. phœniceum, roseum* by own pollen, ...	18	0	...	...	...	...
12. *V. phœniceum, album* by own pollen, ..	18	0	...	...	...	...

The following descriptive notice of the plants in Tab. 1, will show their close morphological relations. First, *V. phœniceum ; stem* somewhat downy, simple, producing upwards a racemose panicle. *Leaves* crenate, oblong-ovate, nearly glabrous above, deep green. *Radical* subcordate, ovately-acuminate, petiolate. *Upper cauline* crenulated, semi-amplexicaul. *Bracteas* lanceolate. *Raceme* elongated. *Flowers* lax, solitary ; pedicels longer than the bracteas. *Corolla* purplish-violet, beset with violet hairs at its base. *Stamens ;* filaments of the three shorter stamens covered with long glandular purplish hairs, these of the two longer naked, except on the upper side, where there are a few similarly characterised hairs. *Anthers* of the three longer stamens nearly circular, and covered with purple and white glandulose hairs, these of the shorter stamens, reniform and nearly naked. *Pollen* copper-coloured. Second, *V. phœniceum, roseum* differs from the above only in the less elongated raceme and the rose-coloured flowers. Third, *V. phœniceum, album* is of a more robust habit than the other two.

Radical leaves ovate-lanceolate, light green. *Flowers* white and rather larger than the others, wfth a few whitish glandulose hairs near the base of petals. *Filaments* and form of *anthers* similar to these of *V. phœniceum*, but beset with white instead of purple, glandular hairs. *Pollen* similarly copper-coloured in each.

Thus, judging from the characters of these three forms alone, there can be no doubt as to their being other than conspecific. In addition to this I may add, on the authority of Mr. Stirling of Edinburgh, that they have been raised from pure seed of the *V. phœniceum*, the rose-coloured variety frequently appearing amongst the seedlings of *V. phœniceum*, the white presenting itself more rarely.

In the first part of Tab. 1, the number of flowers fertilised, and the simple results are shown, and in the right hand, for the sake of comparison, the calculated produce of the number of seeds from 20 capsules of each is given.* If we compare the results, we see that reciprocal unions may be effected beceween the *V. phœniceum* and varieties, with one exception, viz., *V. phœniceum*, *roseum*, by pollen of *V. phœniceum*, *album*, in which case 1 have found that though the pollen tubes are abundantly developed and freely penetrate the stigmatic tissues, the capsules nevertheless drop prematurely. The goodness, however, of both the male and female elements of the above varieties is nevertheless shown by their reciprocal unions with *V. phœniceum*. The individual potency of the respective sexual elements of these varieties, in their reciprocal relations, is clearly shown; whereas by those experiments given in the three last lines of the table, in which the stigmas of each variety were covered by their own good pollen, no unions were effected, each proving utterly self-sterile!

This absolute, or conditional, sterility of the three varieties of *V. phœniceum*, when treated by their own good pollen, led me to examine

* From Mr. Darwin's suggestion in "The Origin of species" that the decreased fertility of mixed unions, as compared with that of the pure unions, might possibly be increased by the fact, that for perfectly satisfactory results, castration is necessary in the cross-unions; whereas in the latter, in pure unions, this not being necessary, we may have indiscriminate comparisons, of the two results though clearly castration may have a direct sterilising influence. In view of this prudent suggestion, I took the precaution to castrate every flower both of the pure and mixed unions, from which I intended to draw results. The sole exception to this is that given in the first line of Table 2 of *V. phœniceum* as I was unable to get any of the plants under me to produce seed by their own pollen. Whatever be the effects of castration then on the fertility of the plants so treated, in the present cases, all having undergone it, the results will be mutual.

into the apparent cause, as in certain cases we find it arising from the non-emission or non-penetration of the pollen tubes ; the pollen through some mysterious cause being thus utterly impotent on its own stigma. The results of my present examination will, I trust, be found of sufficient interest to permit of my stating them here. They are as follows : first, I applied the pollen of each of the three varieties, reciprocally, to their stigmas ; on dissecting these, I found them abundantly permeated by pollen tubes, many of which I distinctly traced into the ovary. Secondly, I fertilised several flowers in each variety, with its own pollen ; on examining the stigmas of a few of these flowers, I found that many of the pollen grains had emitted tubes, but comparatively few had penetrated the stigmatic tissue, and of these still fewer permeated the conducting tissues of the styles. Several of the latter, however, I traced into the vascular bundles of the placenta, the pistillary cords, and in one or two instances, I believe that I detected them in the nucleus of the ovule. Nevertheless we have seen that, though these pollen tubes are developed, they most ineffectively perform their deputed function, inasmuch as not one of these matured even a single ovary ! I have here to observe, however, that these pollen tubes do not seem utterly void of the fecundative influence, as many of the ovaries did undergo a certain degree of development ; and on examination of these, as they dropped off, I found that the ovules also had undergone a partial and variable degree of development. In general, the fleshy albuminous envelope of the embryo was largely developed, whereas the embryo had undergone a very slight development, judging from a comparison of other good seeds of a similar stage, not at all proportionate to the size attained by the albuminous parts. In nearly all the embryos which came under my observation, the development had ceased ere they exhibited any distinct separation of parts ; a few only had reached that stage in which the axial and lateral projections were visible.

We thus see, that whatever be the real cause of the inveterate self-sterility of the three varieties of the *V. phœniceum*, it does not arise, as has been shown in other cases, from the non-emission of the pollen tubes. In these, as I have elsewhere noticed it, in certain individual plants of different species of Oncidia, Maxillaria, and Passifloræ, sterility apparently results from some slight differentiation of the male element with respect to its own female element. I have also to remark, that the ultimate conditional sterility of these plants is not, relatively considered, an absolute but a graduated quantum; this is shown by the different degrees of development the embryos had undergone, thus illustrating a most interesting, though as yet imperfectly known fact, namely, that the male element, even though reaching the female element, may nevertheless fail to communicate that amount of vital stimulus necessary to the complete development of the embryo. Furthermore, I may in passing briefly refer to the perfect parallelism between these phenomena, and those occasionally observed in hybridisation, at least in the zoological kingdom, for unfortunately we are as yet nearly void of information on this point in the vegetable kingdom, hybridists having, in most instances, satisfied themselves by attending to the ultimate results, without troubling themselves to examine into the nature or degree of embryonic sterilisation. From the published papers of the Hon'ble and Rev. W. Herbert, we find, as might indeed be expected, that this point did not escape observation: thus in one case he remarks, "It has, I believe, not been duly considered, that the fecundation of the ovules is not a simple, but a complicated process. There seems to me to be three or four several processes: viz., the quickening of the capsule of the fruit, of the outer coats of the seed itself, of the internal parts or kernel, and lastly, the quickening of the embryo."........."It is further to be observed," he continues, "that there is frequently an imperfect hybrid fertilisation, which can give life, but not sustain it well. I obtained much good seed from *Hibiscus palustris* by *H. speciosus*, and sowed a little each year till it was all gone, the plants always sprouted, but I saved only one to the third leaf, and it perished then."

To recur, however, to the above parallelism, of which we have here additional and important illustrations: it has been stated by Mr. Darwin* on the authority of Mr. Hewitt, that in the hybridisation of gallinaceous birds a frequent cause of sterility in *first crosses* is the early death of the embryo. Again Mr. Salter records similar results from his experiments on the fertility *inter se* of several *hybrid Galli*,† thus concluding, "the one striking point of these experiments (which I believe has never been noticed before) is that a large proportion of

* loc. cit. p. 286.
† Nat. Hist. Rev. 1863, p. 276.

these eggs from hybrid birds breeding *inter se* have failed to produce young, not from absolute sterility, but sterility in degree, from an amount of vitalization insufficient to carry out the whole result of reproduction, in which the young individual has been completed, leaving it with vital resistance insufficient to maintain life and cope with common and customary external influences." And thus in those curious cases of sterility of structurally hermaphrodite organisms, whose sexual elements have become differentiated with respect to their mutual fertile conjunctions, so in the phenomena of sterility from hybridism, we find, as Mr. Salter well remarks, with respect to the relations of hybridism and parthenogenesis, "that the sterility is not absolute but in degree, and that the stimulus, whatever it may be, which starts the embryonic changes is feeble and imperfect rather than wholly wanting."

I have now shown that a regular more or less early embryonic abortion results from the self-fertilisation of certain individual plants of *V. phœniceum* and *vars. roseum*, and *album ;* whereas by their reciprocal fertilisation, highly fertile unions may in general be effected. By again consulting Table 1, however, it will be seen that besides a reciprocal fertilisation, these three plants are also susceptible of fertilisation by pollen of other species. Thus in lines 7, 8, 9, of Table 1, the male element of *V. nigrum* is singularly enough effective in the fertilisation of each, while in a succeeding Table—4—the goodness of the male elements is also similarly shown by each effectively fertilising the female element of the *V. lychnitis*, *lutea*. Again, we have fuller illustrations of these curious sexual phenomena in Table 2, in which one of the above plants, *V. phœniceum*, yields a varying degree of fertility to four other distinct species ; namely the *V. ferrugineum*, *Blattaria lutea* and *alba ; Lychnitis lutea* and *ovalifolia.* These are indeed remarkable physiological revelations. How strange that an individual plant could be fertilised by the pollen of five distinct species, and yet not by its own good pollen : how singular also, as shown above, to see three hermaphrodite individuals incapable of self-fertilisation, yet having each sexual element reciprocally meeting and fertilising the opposite elements of other species. Thus, for example, the male element of *V. phœniceum* and *vars. roseum* and *album* fertilise the female element of *V. lychnitis*, while the female elements of the three former are also susceptible of fertilisation by the male element of *V. nigrum*. The full explanation of these curious and complicated sexual relations, I leave for more sagacious and ingenious investigators, and simply confine myself to remarking on the apparent support that these and more especially those other cases which I have communicated to the Linnean Society,* on the fertilisation of certain species of Passifloræ, —in which I showed that individual plants perfectly self-sterile readily effected reciprocal unions with other similarly characterised individuals of the same species—give to that view which Mr. Darwin has propounded regarding the existence of a law in nature necessitating "an occasional cross with another individual, or, that no hermaphrodite fertilises itself for a perpetuity of generations," but "that some unknown great good is derived from the union of individuals which have been kept distinct for many generations."†

In the following table, the results of the pure unions of *V. phœniceum* given on the first line are taken from capsules on a specimen in the Edinburgh University Herbarium, as I have not yet been successful in getting good capsules from any of the plants which I have had an opportunity to experiment upon by their own pollen. The other plants of *V. phœniceum* and varieties mentioned in the table are the same as those from which I had the results given in Table 1. Indeed, in one or two instances, the same experiments are re-stated, with a view to show more clearly the relative degrees of sterility resulting from the crossing of undoubted varieties of a species on the one hand, with those from the hybridisation of distinct species on the other.

Table 2.—Pure and Mixed Unions of *Verbascum phœniceum* and var. as ♀	No. of flowers fertilised.	No. of capsules produced.	No. of seeds.	Average of seeds per capsule.	By calculation. No. of capsules.	By calculation. No. of seeds.	The comparative fertility of the different unions.	
No. 1. *Verbascum phœniceum* L. (wild plant naturally fertilised), ...	..	4	142	36	20	710	1000	

* "Journal Linn. Soc." Vol. 8. p. 197. † Orchid Fertilisation, pp. 1—360.

TABLE 2. *Contd.*—Pure and Mixed Unions of *Verbascum phœniceum* and var. as ♀	No. of flowers fertilised.	No. of capsules produced.	No. of seeds.	Average of seeds per capsule.	By calculation. No. of capsules.	By calculation. No. of seeds.		The comparative fertility of the different unions.
No.								
2. *V. phœniceum, rosea,* by pollen of *V. phœniceum* L.,	12	9	306	34	20	680	..	957.7
3. *V. phœniceum, alba,* by pollen of *V. phœniceum, rosea,*	7	5	154	31	20	616	..	867.6
4. *V. phœniceum, alba* by pollen of *V. phœniceum,* ...	16	11	287	26	20	522	..	735.2
5 *V. phœniceum,* by pollen of *V. phœniceum, rosea,* ..	10	8	193	24	20	483	..	680.3
6. *V. phœniceum* by pollen of *V. phœniceum, alba,* ..	10	6	120	20	20	400	..	563.4
7. *V. phœniceum* by pollen of *V. ferrugineum,* Andr., ..	12	7	148	21	20	423	..	595.8
8. *V. phœniceum* by pollen of *V. blattaria, lutea* L., ..	12	7	112	16	20	320	..	450.7
9. *V. phœniceum* by pollen of *V. blattaria, alba,* ..	12	4	54	13	20	270	..	380.2
10. *V. phœniceum* by pollen of *V. lychnitis lutea,* L., ...	12	8	102	13	20	255	..	359.1
11. *V. phœniceum* by pollen of *V. ovalifolium,*	12	5	43	8	20	172	..	242.2

In addition to the simple and calculated results given on Table 1, I have, in the above, given at the right hand, for the sake of comparison, the calculated product from an assumed 1,000 seeds of the pure unions relatively to those yielded by the cross and hybrid unions. By a further comparative study of these results, we find that the fertility of the pure unions of *V. phœniceum*, relatively to that of its cross-unions with the white and rose-coloured varieties, is, in the least differentiated or most highly fertile unions, viz., *V. phœniceum, rosea* by pollen of *V. phœniceum*, as 100 : 95; whereas in the least fertile unions, *V. phœniceum* by pollen of *V. phœniceum, alba*, the proportions are as 100 : 56. The average fertility of the *five* cross-unions given in the table, relatively to the pure unions given in the first line, is as 100 : 75; so that the pure unions thus exceed in fertility the cross-unions, in nearly the proportions of 4 : 3. Again by a similar comparative study of the relative fertility of the pure unions of *V. phœniceum* and the different hybrid unions given in the Table, we find that the highest degree of fertility results from the union of *V. ferrugineum* (which perhaps is correctly regarded by De Candolle and others as a mere variety of *V. phœniceum*) with *V. phœniceum*, the proportions of the pure to the hybrid unions being as 100 : 59, in favour of the former. The lowest degree of fertility results from the unions of *V. ovalifolium*, with *V. phœniceum*, the proportion of the pure to the hybrid-unions in this case being as 100 : 24.) Lastly the average fertility of the *five* hybrid unions given in the latter lines of the Table, relatively to the pure unions of *V. phœniceum*, is nearly as 100 : 40, or as 2.5 seeds of the pure unions to one of the hybrid unions. Thus, the relative differences in the degree of sterilisation resulting from the hybridisation of distinct species, and that from the cross-impregnation of varieties of a species, relatively in either case to the pure unions, is in the former as 2.5 : 1, and in the latter as 4 : 3.

TABLE 3.—Pure and Mixed Unions of *V. lychnitis*, L. var. *alba* as ♀.	No. of flowers fertilised.	No. of capsules produced.	No. of seeds.	Average of seeds per capsule.	By calculation.		The comparative fertility of the different unions.	
					No. of capsules.	No. of seeds.		
No. 1. *Verbascum lychnitis*, var. *alba* of gardens, by own pollen, ...	6	6	250	42	20	833	1000	
2. *V. lychnitis*, *alba*, by pollen of *V. lychnitis*, *lutea*, L.,	8	8	274	34	20	685	..	822.3
3. *V. lychnitis*, *alba*, by pollen of *V. thapsus*, L. var. *alba*, of gardens, ...	10	5	98	20	20	392	..	470.5
4. *V. lychnitis*, *alba*, by pollen of *V. phœniceum*, L. var. *alba* of gardens, ..	5	4	113	28	20	565	..	678.2

No.	Table 4.—Pure and Mixed Unions of *V. lychnitis, lutea*, L. as ♀	No. of flowers fertilised.	No. of capsules produced.	No. of seeds.	Average of seeds per capsule.	By calculation. No. of capsules.	By calculation. No. of seeds.	The comparative fertility of the different unions.	
1.	*V. lychnitis, lutea*, L. by own pollen,	6	6	226	38	20	753	1000	
2.	*V. lychnitis lutea* by pollen of *V. lychnitis, alba*,	8	7	249	36	20	711	..	944.2
3.	*V. lychnitis, lutea* by pollen of *V. phœniceum*, L.,	5	3	75	25	20	500	..	664.0
4.	*V. lychnitis, lutea* by pollen of *V. phœniceum*, L. var. *alba* of gardens, ..	5	3	63	21	20	420	..	557.7
5.	*V. lychnitis, lutea* by pollen of *V. phœniceum*, L. var. *alba* of gardens, ..	5	2	37	18	20	370	..	491.3
6.	*V. lychnitis, lutea* by pollen of *V. blattaria*, L. var. *alba* of gardens, ...	8	4	85	21	20	425	..	564.4
7.	*V. lychnitis, lutea* by pollen of *V. blattaria, lutea*, L., ..	8	5	97	19	20	388	..	515.2
8.	*V. lychnitis, lutea* by pollen of *V. thapsus, lutea*, L., ..	10	7	123	18	20	351	..	466.1
9.	*V. lychnitis, lutea* by pollen of *V. thapsus*, L. var. *alba* of gardens, ...	10	5	75	15	20	300	..	398.4
10.	*V. lychnitis, lutea* by pollen of *V. nigrum*, L., ..	10	6	182	30	20	607	..	806.1
11.	*V. lychnitis, lutea* by pollen of *V. virgatum*, With., ..	10	5	111	22	20	444	..	589.6
12.	*V. lychnitis, lutea* by pollen of *V. thapsiforme*, Schrad, .	8	3	52	17	20	347	..	460.8

In Table 3 we have first the results of the pure unions of *V. lychnitis, alba*, and by comparing them with those resulting from fertilisation with the pollen of *V. lychnitis, lutea*, we find that the latter cross-unions undergo the proportionately decreased fertility of 100 : 82. By the hybrid-unions of *V. lychnitis, alba*, with the pollen of *V. phœniceum, alba*, a slightly higher degree of sterilisation results; the proportion in this case being as 82 : 67, relatively to 100 produced by the pure unions of *V. lychnitis, alba*. The highest degree of sterilisation in this Table results from the union of *V. lychnitis, alba*, by pollen of *V. thapsus, alba*, the proportion of the pure to the hybrid unions being here as 100 : 47.

The results of my experiments on the yellow variety of *V. lychnitis* are given in Table 4. By a comparative examination of this Table, we have the following general results: first, the fertility of the pure unions of *V. lychnitis, lutea* exceeds that resulting from the cross-unions of the latter with pollen of *V. lychnitis, alba*, in the proportion of 100 : 94. The degree of sterilisation induced by these unions, though less than that resulting from the converse unions given in Table 3, is nevertheless sufficient to show a sterilising influence in the conjunctions of varieties of a species, characterised only by those, systematically considered, trifling differences in colour—the one being white, the other yellow. Secondly we have the results of unions of similarly and dissimilarly coloured forms of distinct species, with *V. lychnitis, lutea.* Thus the pollen of *V. phœniceum*, with purplish coloured flowers, applied to the stigmas of *V. lychnitis, lutea*, gives an average fertility of 66; the pollen of the white variety *V. phœniceum, alba*, gives an average of 55; while that of the rose-coloured variety is productive of the highest degree of sterilisation, giving only 49—relatively to 100, the produce of *V. lychnitis, lutea* by its own pollen. Mr. Darwin, on the authority of Gartner, states in his "Origin of Species," that similarly coloured varieties of distinct species are more fertile when crossed than are the dissimilarly coloured varieties of the same species. The particular illustration of this point will be found in a subsequent part of this paper; I will here merely state that, in the above unions, the degrees of fertility are by no means regulated by the colour affinities. Thus, we have first yellow and violet, then yellow and white, and lastly yellow and rose yielding a successively decreased fertility; whereas, judging by the colour affinities, the arrangement ought to have been, beginning with the most fertile, yellow first with white, then with rose, and lastly with violet. Secondly, with pollen of the *V. blattaria, vars. alba* and *lutea*, we see, that the *V. lychnitis, lutea* yields the higher degree of fertility with the former: *V. lychnitis, lutea*, yielding with pollen of *V. blattaria, alba*, 56, and with that of *V. blattaria, lutea*, 51, relatively to 100, the product of fertilisation with its own pollen. Thirdly, in the unions of *V. lychnitis, lutea*, by pollen of the yellow and white varieties of *V. thapsus*, we find that unions of the similarly coloured flowers are the more fertile. *V. lychnitis, lutea*, yielding with pollen of *V. thapsus, lutea*, 46, and with the pollen of *V. thapsus, alba*, 39, relatively to 100, the results of fertilisation with its own pollen. Fourthly, in accordance with recognised systematic affinities, we find the following descending scale of sterilisation resulting from the unions of *V. nigrum*, *V. virgatum* and *V. thapsiforme* with the *V. lychnitis*. Thus with the pollen of *V. nigrum*, the average fertility of *V. lychnitis*, *lutea*, is 80, with that of *V. virgatum* 58, and with that of *V. thapsiforme* 46, relatively, in each instance, to 100, the product of fertilisation by its own pollen. A similar accordance is observable between the functional and systematical relations of *V. blattaria* and *V. thapsus* with the *V. lychnitis*. In the unions, however, of *V. phœniceum* and varieties with the *V. lychnitis*, no such accordance is observable. The different unions vary greatly in the degree of fertility *inter se*, and judging indeed by the relative functional potency of the pollen of the three varieties on the stigmas of *V. lychnitis*, the different results are comparable with those from distinct species, and would cause their interpolation into systematically considered false positions, showing us that the functional and systematic affinities of the species of a genus are by no means strictly co-ordinated.

Table 5.—Pure and Mixed Unions of *Verbascum blattaria*, L. var. *alba* of gardens.	No. of flowers fertilised.	No. of capsules produced.	No. of seeds.	Average of seeds per capsule.	By calculation. No. of capsules.	By calculation. No. of seeds.	The comparative fertility of the different unions.	
No. 1. *Verbascum blattaria*, L. var. *alba* of gardens by own pollen, ..	8	8	438	55	20	1095	1000	
2. *V. blattaria*, *alba* by pollen of *V. blattaria*, *lutea*, L., ..	6	5	217	43	20	868	...	792.6
3. *V. blattaria*, *alba* by pollen of *V. thapsus*, *lutea*, L.,	6	2	36	18	20	360	...	328.7
4. *V. blattaria*, *alba* by pollen of *V. thapsus*, L. var. *alba* of gardens, ..	6	4	95	24	20	475	...	433.7
5. *V. blattaria*, *alba* by pollen of *V. lychnitis*, *lutea* L., ..	8	5	65	13	20	260	...	237.4
6. *V. blattaria*, *alba* by pollen of *V. lychnitis*, L. var. *alba* of gardens, ...	6	4	79	20	20	395	...	360.7

Table 6.—Pure and Mixed Unions of *V. blattaria, lutea*, L. as ♀	No. of flowers fertilised.	No. of capsules produced.	No. of seeds.	Average of seeds per capsule.	By calculation. No. of capsules.	By calculation. No. of seeds.	The comparative fertility of the different unions.	
No.								
1. *Verbascum blattaria, lutea*, L. by own pollen, ..	8	7	354	50	20	1011	1000	
2. *V. blattaria, lutea* by pollen of *V. blattaria, alba* of gardens, ..	6	3	147	49	20	980	...	969.3
3. *V. blattaria, lutea* by pollen of *V. thapsus, lutea*, L.,	6	4	103	26	20	515	...	509.4
4. *V. blattaria, lutea* by pollen of *V. thapsus, alba* of gardens, ...	6	2	62	31	20	620	...	613.2
5. *V. blattaria, lutea* by pollen of *V. lychnitis, lutea*, L.,	8	4	81	20	20	405	...	410.4
6. *V blattaria, lutea* by pollen of *V. lychnitis, alba* of gardens, ...	8	1	23	23	20	460	...	454.8

The results of experiments on the *V. blattaria*, varieties *lutea* and *alba*. are given in the above Tables : they comprise 12 unions between the white and yellow varieties of three species. Let us briefly compare the results of their reciprocal unions. First, the fertility of *V. blattaria, alba*, when fertilised by its own pollen. undergoes the highly proportionate sterilisation of 98 : 78 when fertilised with the pollen of the yellow variety—*V. blattaria, lutea.* In the converse case, the sterilising influence of the cross relatively to the pure unions of these forms is much decreased, the pure union of *V. blattaria, lutea*, yielding more seed in the proportions of 90 : 88 than from its cross-union with the white variety—*V. blattaria, alba.* Secondly, as to the hybrid unions with the pollens of the yellow and white varieties of *V. thapsus.* In these the pollen of the white variety is the more potent. Thus *V. blattaria, alba*, fertilised by pollen of *V. thapsus, alba*, affords an average fertility of 43, whereas by that of *V. thapsus, lutea*, the produce is reduced to 32, relatively in both cases to 100, the average fertility of *V. blattaria, alba*, when fertilised by its own pollen. By the union of the yellow and white varieties of *V. thapsus* with the yellow variety of *V. blattaria*, we see that the relative differences in the potency of the two pollens on the stigmas of *V. blattaria, lutea,* are much less than those we have above noticed when *V. blattaria alba* is used as female; and also that the potency of the two pollens is greater on the stigmas of the yellow than those of the white variety of *V. blattaria lutea;* and again that the white variety of *V. thapsus* is more fertile than the yellow, in their respective unions with the *V. blattaria, alba.* Thus *V. blattaria, lutea,* by pollen of *V. thapsus, alba,* gives an average fertility of 61; by pollen of *V. thapsus, lutea,* 50, relatively to 90, the product of fertilisation by its own pollen. Lastly, we have the different unions of the two pollens of the white and yellow *V. lychnitis* on the stigmas of the yellow and white varieties of *V. blattaria.* In these unions we see first that with *V. blattaria, alba* as female, the pollen of the white variety exceeds that of the yellow in the proportion of 36 : 23; secondly, with the *V. blattaria, lutea,* as female, the pollen of the white variety is again singularly enough the more fertile, exceeding that of the yellow variety, in the proportion of 45 : 41. Thirdly, we find that here also the yellow variety of *V. blattaria* yields a higher degree of fertility,—taking the conjoint products of the two unions with the pollen respectively of *V. thapsus, lutea* and *alba,*—than the white variety of *V. blattaria* when similarly treated, the proportions being as 70 of the *V. blattaria* to 47 of the *V. blattaria, alba,* or nearly as 3 : 2.

This leads me to notice a curious fact prominently brought before us in the above Table, whatever may be its real signification, namely, that the yellow varieties of *V. lychnitis* and *blattaria,* though yielding a higher grade of fertility to the pollen of the white and yellow varieties of distinct species than do the respective white varieties of the above species when similarly fertilised, are nevertheless less productive of seed than the white, when both are fertilised with their own pollen. This will be seen by consulting the following tabular arrangement, in which I have given a reduced approximate of the relative fertility of the different unions, selecting from the hybrid unions in each instance only the most fertile.

1. *V. lychnitis, alba,* by own pollen is as 83 : 75 of *V. lychnitis, lutea,* by its own pollen.

2. *V. lychnitis, alba,* by pollen of *V. lychnitis, lutea,* is as 68 : 71 of *V. lychnitis, lutea,* by pollen of *V. lychnitis, alba.*

3. *V. lychnitis, alba*, by pollen *V. thapsus, alba*, is as 39 : 30 of *V. lychnitis, lutea*, by pollen of *V. thapsus, alba.*

4. *V. lychnitis, alba*, by pollen of *V. phœniceum, alba* as 56 : 42 of *V. lychnitis, lutea*, by pollen of *V. phœniceum, alba.*

5. *V. blattaria, alba*, by its own pollen, is as 98 : 90 of *V. blattaria, lutea* by its own pollen.

6. *V. blattaria, lutea*, by pollen of *V. blattaria, alba* is as 96 : 79 of *V. blattaria, alba*, by pollen of *V. blattaria, lutea.*

7. *V. blattaria, lutea*, by pollen of *V. thapsus, alba*, as 61 : 43 of *V. blattaria, alba*, by pollen of *V. thapsus, alba.*

8. *V. blattaria, lutea* by pollen of *V. lychnitis, alba*, as 45 : 36 of *V. blattaria, alba*, by pollen of *V. lychnitis, alba.*

We thus see, from the eight pure, cross, and hybrid unions of *V. blattaria alba* and *lutea* given in the above comparative table, that though the white variety exceeds in fertility the yellow variety, when both are fertilised by their own pollen, the yellow variety, in the mixed unions, is in every case more highly fertile than the white. In the different unions of *V. lychnitis, alba* and *lutea*, there is some little discordance, this, however, is confined to the hybrid unions which are as yet very insufficiently illustrated, as may be seen by consulting Tables 3 and 4. In the case of the pure and cross unions, we see, as in those of *V. blattaria*, that in the *pure unions* the *white* variety, and in the *cross unions* the *yellow* variety is the more fertile.

I know not whether this concordance is casual or otherwise, but I was so forcibly struck with it in the comparative study of my Tables, that I have thus ventured a special statement. I have been more especially induced to notice it also from its evidently bearing and illustrating, as I am inclined to think, that view of Mr. Darwin, (*loc. cit.*) respecting the good derived from cross fertilisation; inasmuch as we see that the yellow and original, or normally coloured, form of the species is less fertile than the white or derivative form in the pure unions, whereas in general, in the mixed unions, the yellow variety relatively exceeds the white in the degree of fertility. Any how, the mere fact of such variations occurring, whether or not they have any bearing on other points of theoretical natural science, seems to me worth noticing, as affording an additional link to that broken chain of evidence which is said to disjoin the serial continuity of the phenomena of mongrelism and hybridism.

TABLE 7.—Pure and Mixed Unions of *Verbascum thapsus, lutea,* L. as ♀.	No. of flowers fertilised.	No. of capsules produced.	No. of seeds.	Average of seeds per capsule.	By calculation. No. of capsules.	By calculation. No. of seeds.	The comparative fertility of the different unions.	
No. 1. *Verbascum thapsus, lutea,* L. by own pollen,	8	8	920	115	20	2300	1000	
2. *V. thapsus, lutea* by pollen of *V. thapsus* var. *alba* of gardens,	4	2	218	109	20	2180	...	947.8
3. *V. thapsus, lutea* by pollen of *V. lychnitis, lutea,* L.,	6	1	54	54	20	1080	...	465.2
4. *V. thapsus, lutea* by pollen of *V. lychnitis,* var. *alba* of gardens,	6	3	187	62	20	1246	...	541.7
5. *V. thapsus, lutea* by pollen of *V. nigrum,* L.,	10	4	275	69	20	1375	...	597.8
6. *V. thapsus, lutea* by pollen of *V. pyramidatum,* Beib.,	10	6	374	62	20	1246	...	541.7
7. *V. thapsus, lutea* by pollen of *V. thapsiforme,* Schrad,	10	8	408	51	20	1020	...	443.2
8. *V. thapsus, lutea* by pollen of *V. virgatum,* With.,	10	5	222	44	20	888	...	386.0
9. *V. thapsus, lutea* by pollen of *V. blattaria, lutea* L.,	8	3	98	33	20	653	...	283.9

In Table 7 we have several unions of the yellow variety of *V. thapsus.* If we compare these results, we see that the fertility of the *V. thapsus, lutea,* by its cross-unions with the *V. thapsus, alba,* is decreased in the proportions of 94 relatively to 100, the product of fertilisation by its own pollen. We also see a great difference in the degrees of potency of the two pollens of the white and yellow variety of *V. lychnitis* on the stigmas of the yellow variety of *V. thapsus;* the pollen of *V. lychnitis, alba,* exceeding in its fertilising influence that of *V. lychnitis, lutea,* in the proportion of 54 : 46. Judging from the results of the seven hybrid unions given in this Table, we also see how little the recognised systematic affinities of species guide us in pronouncing *a priori* as to the degree of fertility of their several unions. For example *V. thapsiforme, V. virgatum* and *V. blattaria,* though much more closely allied to the *V. thapsus* than the others given in Table, are nevertheless least effective in their conjunctive fertility with the latter species. Furthermore, we see by those unions of *V. thapsus, lutea,* as female, with the yellow and white varieties of *V. lychnitis,* and of *V. pyramidatum ;* that though the pollen of *V. pyramidatum* is equally potent on the stigma of *V. thapsus lutea,* as is that of *V. lychnitis, alba,* there is nevertheless a considerable decrease in the proportionate fertility of the unions with *V. lychnitis, lutea.* Hence, as we have before shown it to be with the varieties of *V. phœniceum,* and judging by the physiological test, the *V. pyramidatum* would interpolate itself between these slightly different and undoubted varieties of a species.

In the foregoing Tables, then, I have given nearly all the results of my experiments in the unions of Verbasca. Before considering the nature of the evidence they afford us as to the relationship of mongrelism and hybridism, I will briefly attempt to show how far these results accord with those of Gartner, who has also largely experimented on these plants. I may premise, however, that as my experiments are much less numerous than Gartner's, comprising some 57 distinct unions, in which 527 flowers were artificially fertilised,—whereas, as will be seen beneath, Gartner subjected no less than 1085 flowers to experiment,—they would induce very different conclusions, in certain points, to those arrived at by that careful experimentalist. I readily acknowledge therefore the higher claim of the latter to a provisional acceptance, until further experiments show more conclusively their relative correctness. I have also to notice a cause of some little discordance in such a comparative examination as that which I am about to institute; namely, that I have given in every case the *average* number of seeds produced *both* by *pure* and *mixed unions,* whereas Gartner gives the *average number* of seeds in the *pure unions* only, taking in each case the *maximum* or highest number produced by a single capsule in the *mixed unions.* I was not aware of this peculiarity in Gartner's deductions when I counted the seeds in my own experiments, otherwise, I should have drawn them up for the sake of comparison on a similar basis; even though I consider it a less fair method than that which I have adopted, in all such cases as the present, in which the ovaries contain an *indefinite* number of ovules. And this the more especially if, as in my own experiments, *castration* and *artificial impregnation* be performed in both *pure* and *mixed* unions. In drawing comparisons between *uncastrated* pure unions, and *castrated* mixed unions, the *average* of the former, with the *maximum* of the latter would certainly be the fairer method, as affording a complement for the sterilising influence of castration.

For the following digest of Gartner's experiments I have to thank Mr. Darwin, who kindly sent it to me from his yet unpublished MS. illustrations of these phenomena: "To show the scale on which Gartner worked, I may state that, in the genus Verbascum, he crossed no less than 1085 flowers and counted their seed, and recorded the results. Now in two of his works he distinctly asserts that similarly coloured varieties of *V. lychnitis* and *V. blattaria* are more fertile together than when differently coloured varieties of the same species are crossed. But Gartner chiefly relied on the crosses which he made between the yellow and white varieties of these two species and nine other distinct species, and he asserts that the white-flowering species yielded more seed than did the yellow-flowered varieties when crossed with the same white varieties of these two-flowered species, and so conversely with the yellow flowering varieties with the yellow species. The general results may be seen in his Table. In one case he gives the following details; the white *Verbascum lychnitis* naturally fertilised with its own pollen had on an *average* in 12 capsules 96 good seeds : 20 flowers artificially fertilised with the pollen of its yellow variety gave as the *maximum* 89 good seeds. I should have thought that this slight difference might have been wholly due to the evil effects of castration; but Gartner shows that the white variety of *V. lychnitis*, fertilised by the pollen of the white and yellow varieties of *V. blattaria*, in both of which cases there must have been previous castration, bore seeds to the white variety in the proportion of 62, to 43 when pollen of the yellow variety was used."

First then, in regard to the greater fertility of the unions of similarily coloured varieties, relatively to that of the unions of dissimilarly coloured varieties of the *same* species. To these phenomena I will apply in the subsequent parts of this paper the following terms: "*Homochromatic*" to the unions of similarly coloured varieties, and "*hetero-*

chromatic" to those in which dissimilarly coloured varieties are united In the following table we will at once see the comparative fertility of these different unions given in the previous ones.

RELATIVE FERTILITY OF THE HOMOCHROMATIC AND HETEROCHROMATIC UNIONS.

1. *V. phœniceum* by its own pollen, . . .	1000	
2. *V. phœniceum, rosea,* by pollen of *V. phœniceum,* ...		958
3. *V. phœniceum, alba,* by pollen of *V. phœniceum, rosea,*		867
4. *V. phœniceum, alba,* by pollen of *V. phœniceum,*		735
5. *V. phœniceum,* by pollen of *V. phœniceum, rosea,*		680
6. *V. phœniceum,* by pollen of *V. phœniceum, alba,* ...		563
7. *V. lychnitis, alba,* by pollen of *V. lychnitis, lutea,* ...		822
8. *V. lychniits, lutea,* by pollen of *V. lychnitis, alba,*		944
9. *V. blattaria, alba,* by pollen of *V. blattaria, lutea,* ...		792
10. *V. blattaria, lutea,* by pollen of *V. blattaria, alba,* ...		969
11. *V. thapsus, lutea,* by pollen of *V. thapsus, alba,*		947

Here the comparative fertility is shown by calculation from the number of seeds produced by 20 assumed capsules of both unions. The various cross-unions of *V. phœniceum* and its varieties are in each case to be considered relatively to the assumed results of the pure unions of *V. phœniceum* given in Table 2, these plants experimented upon being individually self-sterile as shown in Table 1. The unions, on the other hand, of *V. lychnitis, blattaria,* and *thapsus,* with their respective varieties, are each to be considered relatively to the 1000 seeds produced by the pure union of that variety given as female. Now in all the above heterochromatic unions, as compared with the homochromatic, we have the clearest evidence of reduced fertility. Thus, taking the 10 heterochromatic unions given, and comparing them with a similiar number of homochromatic unions, we find that the average proportion in which the former exceeds the latter, is as ·05 to ·23. On again confining ourselves to those species alone which have the yellow and white varieties, and keeping the unions of white as ♀ with yellow ♂, distinct from those of yellow as ♀ with white as ♂, we find that the cross-unions with white as female are to the pure unions of the latter as ·04 to ·28; and in those cross-unions with yellow as female, the proportions are as ·23 to ·29, relatively to the pure unions of the latter. Thus, in whatever way we proceed, the general results are the same, testifying to the highly remarkable fact announced by Gärtner, that varieties of a species, characterised by no other differences than that of colour, are occasionally so differentiated functionally, that the cross-unions, as compared with the fertility of the pure unions, invariably indicate a certain degree of sterilisation !

In connection with this higher relative fertility of homochromatic to that of heterochromatic unions, as limited to the crossing of varieties of a single species, I will venture to add that this law not only holds, but, as I believe, extends to and regulates the functional relations in accordance with the relative colour affinities of the varieties crossed. Thus for the sake of illustration, we may take the three primary colours of the cyanic series, namely, blue, violet, and red. Now beginning with red, we know that greater physiological changes must take place in the minute anatomy of the petals of an originally red-coloured flower to give the impression of blue than that of violet. Hence we might suspect that a species presenting varieties characterised by such differences in colour, would likewise afford different degrees of fertility in their conjunctive functional relations, the blue and red yielding less fertile unions, than the violet and red; while the violet holding an intermediate colour position between these, might be equally as fertile in its unions with the blue as the red variety. In practical illustration of these relations, we may take the results of the various unions of *V. phœniceum* and varieties given in Table 1. Thus the *V. phœniceum* with purplish-violet flowers yields more seeds when fertilised by the pollen of the rose-coloured variety, than by that of the white variety, in the proportion of 5 to 4. Again the white variety of *V. phœniceum* fertilised by the pollen of the rose variety yields an average of 29 seeds per capsule, and by that of the purplish violet variety the average per capsule is 26, that is as 9 to 8, in favour of the unions of the rose and white varieties. We see here evident co-relations between the degrees of fertility and the colour affinities of these plants in their respective sexual unions, and I venture to look for more marked differences in these respects, had we as subjects of experiment, varieties of a species presenting three, or at least two, of the primary colours with intermediate shades irrespective of the white. The latter being rather unsatisfactory from its similar relations to the primary colours, though in such instances as the above of the purplish-violet, rose and white, in which we have secondary colours forming intermediate steps between the primary and white, by a gradual dilution of the colouring principle, we find that the white, agreeably to the above views, form less fertile conjunctions with the violet than the rose-coloured flowers. Before passing from this point of my subject, I will now only add that I have thought these indications of a tangible law, co-relating and regulating the sexual functions of varieties when crossed—dim though they as yet undoubtedly are— worth noticing, as we are as yet in utter ignorance of anything like definite or specific laws in these phenomena, the results being considered as most capricious and uncertain.

Gärtner's second proposition is, that in the hybridism of differently coloured varieties of distinct species of Verbasca, the conjunctions of the similarly coloured flowers are more fertile than these of dissimilarly coloured flowers. For example Gärtner shows* that on the calculation of *V. lychnitis, fl. alba*, yielding with its own pollen 1.000 seeds, it yields when fertilised with the pollen of *V. blattaria fl. alba*, 0.622 seeds, and with that of *V. blattaria, fl. lutea*, only 0.438, so that the similarly coloured unions of these species are more fertile than the dissimilarly coloured unions in the proportion of 3 to 2. Let us now see then in how far this law of the differences in the fertility of the homochromatic relatively to the heterochromatic unions, is borne out in the case of my own experiments as given in the preceding Tables. And here again, for the sake of clearness, and facility of reference, I will restate them in a tabular form, and show as clearly as possible the differences in the relative fertility of the homochromatic and the heterochromatic unions, in each case, by making calculations from an assumed 100 seeds produced by the more fertile of the two unions compared. The results may be conveniently arranged under three heads; thus, first, the heterochromatic unions, or those in which the unions of differently coloured flowers are the more fertile: second, the homochromatic unions, or those in which similarly colour-

* Versuche über die Bastarderzeugunj, 1849, section 216.

ed flowers are the more fertile: and lastly, the irregular unions in which no relations are observed between the degree of fertility and affinity of colours.

A. 1.—Heterochromatic union, *the* more *fertile.*

1.	*V. lychnitis, lutea,* by pollen of *V. blattaria, alba,* .	100	
2	*V. lychnitis, lutea,* by pollen of *V. blattaria, lutea,* .	,,	to 91
3.	*V. blattaria, lutea,* by pollen of *V. thapsus, alba,* .	100	
4.	*V. blattaria, lutea,* by pollen of *V. thapsus, lutea,* .	,,	to 83
5.	*V. blattaria, lutea,* by pollen of *V. lychnitis, alba,* .	100	
6.	*V. blattaria, lutea,* by pollen of *V. lychnitis, lutea,* .	,,	to 88
7.	*V. thapsus, lutea,* by pollen of *V. lychnitis, alba,* .	100	
8.	*V. thapsus, lutea,* by pollen of *V. lychnitis, lutea,* .	,,	to 87

B. 2.—Homochromatic unions, *the* more *fertile.*

1.	*V. lychnitis, lutea,* by pollen of *V. thapsus, lutea,* .	100	
2.	*V. lychnitis, lutea,* by pollen of *V. thapsus, alba,* .	,,	to 85
3.	*V. blattaria, alba,* by pollen of *V. thapsus, alba,* .	100	
4.	*V. blattaria, alba,* by pollen of *V. thapsus, lutea,* .	,,	to 76
5.	*V. blattaria, alba,* by pollen of *V. lychnitis, alba,* .	100	
6.	*V. blattaria, alba,* by pollen of *V. lychnitis, lutea,* .	,,	to 66

C. 3.—Degree of Fertility and affinity of Colour Irregular.

1.	*V. lychnitis, lutea,* by pollen of *V. phœniceum,* .	100	
2.	*V. lychnitis, lutea,* by pollen of *V. phœniceum,* .	,,	to 80
3.	*V. lychnitis, lutea,* by pollen of *V. phœniceum,* .	,,	to 74

In A. and B. of the above comparative tables, I have arranged those unions in which a certain regularity is observed between the colour relationship and the degree of fertility. Now, by comparing the 14 unions therein given, we find that the heterochromatic unions are, in the greater number of cases, more fertile, viz., as 8 to 6, than the homochromatic unions, and that this higher fertility, in every case, results from those unions in which the yellow variety of the species is treated as female. Again that the average proportion of the four heterochromatic to the four converse homochromatic unions in the first of the above tables is nearly as 7 to 6 in favour of the former. In B. 2 of the tabulated results, we see in one instance the homochromatic unions with yellow as female exceed in fertility the converse heterochromatic union; but in the other cases given in lines 3 and 5, this higher fertility of the homochromatic unions is yielded by the white variety; the relative proportions of these being much more marked than in the above cases of the heterochromatic union with the yellow variety as female, viz., as 4 to 3, whereas, as we have seen, in the heterochromatic, A. 1, the proportions are as 7 to 6. In further illustrations of this point we see in B. 2 that the yellow homochromatic union of *V. lychnitis*, *lutea*, by pollen of *V. thapsus*, *lutea*, relatively to the heterochromatic unions of the former with pollen of *V. thapsus*, *alba*, is nearly as 5 to 4, so that we here again see (as in the heterochromatic and homochromatic unions in A 1) a more intimate approximation between the products of these two unions, than occurs in the other cognate unions of B. 2, in which the white variety is the more fertile.

These curious relations, however, as I have already shown, are partly explained by the fact,—though we can only dimly see why it should be so,—that in the pure unions of the white and yellow varieties of the above mentioned species, the white, in every case, yields more seed than the yellow; whereas in the cross-unions the yellow variety in general is the more productive. But, it may be asked, how is the greater potency of the pollen of the white variety relatively to that of the yellow variety, as shown in the above tables to be accounted for? Does it really imply that the female element of the yellow variety yet retains its normal or original potency, the male element alone having become absolutely less potent, as compared with the male element of the white variety. This hypothesis, analogically considered, does not seem to me at all improbable. I think we have clearly seen by the comparative results of the pure and mixed unions of the yellow variety with those of the white, that the pure unions of the yellow do not yield a degree of fertility at all proportionate to that of the like unions of the white variety, as judged by the relative fertility of their cross-unions; and that accordingly this would seem to be due to an acquired weakness in the generative powers of the yellow variety. In noticing this point in a former part of my paper, I treated it as if both sexual elements had undergone a similar decrease in their generative powers;

but we here see that it is more particularly, if not altogether confined to the male element. Now, as the results of hybridisation show that the pollen is more susceptible to the concomitant sterilising action of hybridism than the female element, may we not suppose that the debilitating effect of continued self-impregnation will also manifest itself more quickly in the male than in the female element, and thus afford an explanation of the decreased sexual powers of the male, as compared with the female element, in the yellow varieties of the above species of Verbasca furthermore, showing us that as it has been a slowly acquired quality, so will it be in its elimination and regainment of its pristine vigour.

The relations of the several reciprocal unions in the above tables is another point which we must briefly consider, as having most important bearings on the subject of our present enquiry. A hasty examination suffices to show that these are much complicated. Thus *V. lychinitis*, *lutea*, in its two unions with the white and yellow varieties of *V. blattaria*, the heterochromatic unions are the more fertile; whereas in its two unions with the white and yellow varieties of *V. thapsus*, we find it yields the more fertile by a homochromatic union. Again *V. blattaria*, *lutea*, in its four distinct unions with the white and yellow varieties of *V. thapsus* and *V. lychnitis*, yields the higher degree of fertility in the heterochromatic unions, while the *V. blattaria* in its similar unions with the white and yellow varieties of *V. thapsus* and *lychnitis* is, singularly enough, more highly fertile in the homochromatic than the heterochromatic unions. Lastly the *V. thapsus*, *lutea*, yields more seed by its heterochromatic unions with *pollen* of the *V. lychnitis*, *alba*, than by its homochromatic unions with the *V. lychnitis*, *lutea*; whereas in the converse unions we have seen that the *V. lychnitis*, *lutea*, is more fertile in the homochromatic unions with *V. thapsus*, *lutea*, than in the heterochromatic unions with *V. thapsus*, *alba*!

The tabulated experiments given in C. 3, afford another source of complexity to the question under examination, inasmuch as they are quite irregular in the relative degree of fertility produced by the affinity of colour. Thus by the three unions of *V. lychnitis*, *lutea*, with pollen of the three varieties of *V. phœniceum*, the most highly fertile is that in which *V. lychnitis*, *lutea*, is treated with pollen of the purplish violet, or normal form, the average in this being 25 seeds per capsule; then follows the unions with pollen of the white variety, the average of seeds being in these 21 seeds per capsule; and lastly in the unions with the variety with rose-coloured flowers, the fertility of *V. lychnitis*, *lutea*, is reduced to the low average of 18 seeds per capsule. Thus judging by the degrees of fertility, we clearly see that the natural functional co-relations of these plants in place of being regulated by their respective colour affinities, arrange themselves in an entirely independent and opposite scale; the extremes in the scale of colour given, viz., the purplish-violet with yellow, manifesting the nearest functional co-relation. Again as a further complication we find that the white and yellow unions, —the most closely allied of the colours mentioned,—hold a medial position between the purplish violet and rose. How obviously futile then, we may well remark, would our *á priori* conclusions have been, as to the degrees of fertility of the above unions, on a presumed coordination between colour and function in the phenomena of hybridism!

It would thus appear from the results given in the foregoing tables that in the hybridisation of varieties of distinct species characterised by differences of colour alone, no definite relations whatever can be observed between the affinities of colour, and the degrees of fertility, but that in these cases as in the reciprocal hybridisation of pure species, the relative fecundity is a most variable and unpredicable quantum. This view seems to me to be further supported by the results of my experiments on the reciprocal hybridisation of the dimorphic species of Primulæ* in which I showed that the laws of dimorphism were limited in their action to the unions of the two forms of a species; the heteromorphic and homomorphic unions of distinct species proving irregularly the more fertile. From considering the important functional co-relations of the two forms of dimorphic species, and their trifling morphological characteristics, together with the specifically limited extent of their operations, we have less reason to be surprised, if a similarly limited relationship should ultimately prove to regulate the degree of fertility of those unions of differently coloured varieties of a species as in Verbascum and analogous cases. Indeed, judging

* Linn. Soc. Jour. Vol. 8, p. 78.

from my previous remarks on the co-relations between the degree of fertility and affinity of colour in the crossing of varieties of a species, together with the results of the hybridising differently coloured varieties of distinct species, this law seems clearly indicated, that the relative degree of fertility of the cross unions between the differently coloured varieties of *certain* species is inversely proportionate to the less or more mediate colour affinities of these unions. Further that this law does not extend to, or regulate the hybrid unions of differently coloured varieties of distinct species, but is strictly limited in its operations to those unions of varieties of a single species. Such at least is the conclusion which my own experiments would induce me to hold, but seeing that they are so directly opposed to the results of Gärtner's large experience, I would rather avoid at present anything like definite or positive conclusions, until subsequent experiment affords us a crucial array of data.

In conclusion, I will now by a cursory retrospect of the above details, re-state a few of the more important points, which elucidate the mooted relations between the phenomena of the hybridisation of a species and the mongrelism of the varieties of a species. First then in *hybridism* we see on the calculation of *V. lychnitis* yielding with its own pollen 100 seeds, it yields upon fertilisation with pollen of *V. nigrum* 80 seeds, by the pollen of *V. virgatum* 58 seeds, by that of *V. phœniceum* 66 seeds and by that of *V. thapsiforme* 46 seeds. In the unions of varieties of a species, with these of other species we find differences in the sexual powers, so that the pollen of the one variety of a species is less potent than that of the other on the stigmas of the same variety of another species. Thus *V. lychnitis* fertilised by the pollen of *V. blattaria, lutea,* yields 51 seeds, by that of *V. blattaria, alba,* 56 seeds, and again by pollen of *V. thapsus, lutea, V. lychnitis* yields 46 seeds, by that of *V. thapsus, alba,* 39 seeds, relatively in each case to the 100 seeds produced by its own pollen. Again we have evidence also of reciprocal differentiation in the relative sexual powers of varieties of a species, and those of other species. Thus in the case mentioned above of *V. blattaria*, the pollen of variety *alba* is more potent on the stigma of *V. lychnitis* than that of variety *lutea*, whereas in the converse unions of these forms, we find that the pollen of *V.*

lychnitis is more potent on the stigmas of *V. blattaria*, *lutea*, than that on those of the variety *alba*, in the proportion of 40 to 26.

Secondly, in mongrelism, we also find variabilities in the relative sexual powers of varieties of a species, by differences in the degrees of fertility resulting from their simple and reciprocal unions. Thus on the calculation of *V. phœniceum*, yielding 100 seeds by fertilisation by its own pollen, it yields with that of the variety *rosea* 68 seeds, and by that of the variety *alba*, 56 seeds, or nearly as 5 to 3. In the reciprocal unions of these varieties, we also find variabilities in their converse sexual powers. For example, in the reciprocal unions of *V. phœniceum* and varieties, the potency of the pollen of *rosea* relatively to that of *alba* on the stigmas of the normal form is nearly as 5 to 4; whereas the pollen of the latter on the stigmas of *rosea* and *alba* is as 4 to 3. This difference in the reciprocal sexual powers of varieties when crossed is so regulated however by colour affinities, that unlike the irregular and indefinite results of the reciprocal unions of varieties of distinct species, judging by my own experience, we see that the pollen of *rosea* is more potent on the stigmas of the normal form than these of *alba* and so conversely, the pollen of the normal form is more potent on the stigmas of *rosea* than on those of *alba*. In those cases, however, in which colour differences do not come into play the pollen of one variety, relatively to that of another variety of the same species is so differentiated with respect to their reciprocal stigmatic relations that the grade of fertility of the pure unions of these varieties does not at all correspond with that of the cross unions. For example, in the pure unions of varieties *lutea* and *alba* of *V. blattaria*, the fertility of the latter exceeds that of the former in about the proportions of 12 to 11; whereas in their converse unions, *lutea* exceeds *alba* in the higher proportions of 6 to 5! Thus in the inter-crossing of varieties of a species, as in the inter-crossing of varieties of distinct species, there are converse variabilities in the reciprocal sexual powers of their respective elements.

As the facts stand then, it appears to me that in the first crosses of the varieties of certain species, as in the first hybrid crosses of distinct species, a variable degree of sterilisation results, and again, that the relative sterilising influence is as highly intensified in the crossing of undoubted varieties of certain species, as it is in the hybridising of several undoubtedly distinct species. There is also a parallelism between the results of reciprocal hybridisation of varieties of distinct species, on the one hand with those of the reciprocal inter-crossing of varieties of a single species on the other. The sole difference in the two lines at least is merely as to the degree of extension; species relative to species occupying a higher point in the divergingly extended line, than do the varieties of a species relatively to each other, and accordingly yielding in general more intensified results, harmoniously testifying to the truth of Mr. Darwin's remark that sterility is simply a superinduced quality due to incidental differences in the reproductive system....As in the varieties of a species, however, we find that the relative amount of physiological divergence,—as judged by the fertility of their reciprocal conjunctions,—is by no means regularly or definitely co-ordinated with their morphological; so in the hybridisation of the different species of a genus, the most distinct morphologically are often found to be most nearly allied in their physiological characteristics, and thus there being no necessary co-ordination of these characteristics we can readily understand how the sterility of the first crosses of varieties of a species may, and occasionally does, exceed that of well-marked and undoubtedly distinct species.

Contributions towards a history of Panolia Eldi ; *McLelland.*

By Captain R. C. Beavan, C. M. Z. S. &c.

The published accounts of this comparatively rare species of deer are scattered through back numbers of various scientific periodicals and proceedings of Societies, some of which are out of print, and not easily procured. I have therefore brought together nearly all that has been previously written on the subject, and added much information on the manners and habits of the species procured during a recent visit to its haunts in Burmah.

Panolia Eldi. The Sungnái.

Nondescript Deer, McLelland, Calcutta Journ. N. H. Vol. I. p. 501, Pl XII.

Cervus Eldi, Guthrie, (Calcutta Journ. N. H. Vol. II. p. 405, Pl. XII.

C. lyratus, Schinz. Syn. Mam. II 395.

C. dimorphe, Hodgson, Journ. As. Soc. Bengal, Vol. XII. p. 897.

C. smithi, Gray, Proc. Zool. Soc. 1837, p. 45.

Panolia acuticornis, Gray, List Mamm. B. M. 180.

Panolia platycercos, Gray. List Mamm. B. M. 181, adult; Cat. Osteol. B. M. 66.

Cervus (Rusa) frontalis, McLelland, Calcutta Journ. N. H. III. p. 401, Pl. XIII. Sundevall, Pecora, 132.

Panolia Eldi, (The Sungnái), Gray. Cat. Hodgson Coll. B. M. 34; Osteol. B. M. 66 : Knowsley Menag. Cat. Mam. in Museum As. Soc. Bengal, Blyth, 1863, p. 149.

Native names, Sungnái, apud Guthrie and Blyth : Sungraëë apud Eld : Thamyn of Burmah.

Hab. Pegu, northward to the valley of Munipore : Siam : and proximate portion of the Malayan Peninsula, (Kedda) Mergui, (*Blyth.*)

The first notice we have of this deer, was published in 1841,* and entitled—'Indication of a nondescript species of Deer by John McLelland."

"Captain Guthrie of the Bengal Engineers, employed in the construction of a road from the valley of Cachar to Monypore, procured the horns of a deer whose lower, or basal antler descends in the axis of the

* Calcutta Journ. Nat. Hist. Vol. I. p. 501, Pl. XII.

beam, rather as an extension of the horn itself than as a mere shoot. The horn may be compared to the segment of a circle, the burr, or root from which both limbs extend, being placed on the outer circumference. The beam is round, and terminates by a fork, as in the Rusa deer. The lower prolongation of the horn beneath the burr may also be said to terminate in a fork, for on the left horn, about two inches below the root, there is a small snag directed forward. In illustration of this notice, a figure of the horns is given at pl. 12."

Captain Eld, one of the principal assistants to the Commissioner of Assam, who had been previously attached to the British Residency in Muneypore, having had his attention called to the notice and the figure alluded to, soon after wrote an interesting letter on the subject, which affords the first general information hitherto received relative to the habits and character of this interesting species. His description is as follows:* "I observe mention made of a new description of Deer, said to exist between Munipore and Cachar; some specimens of the horns of which were procured in the latter place by Captain Guthrie. From the drawing, it is evident to me that the Deer alluded to is of the kind originally discovered by myself in the valley of Munipore in the beginning of 1838, and several pairs of the antlers of which were given by me to Captain Guthrie in the same year. I had intended at the time to send a description of the animal to one of the Journals, but was told that a similar Deer was to be found in the north-western jungles. As this, however, does not appear to be the case, I now forward you a correct drawing of a pair of the horns in my possession, together with a short account of the animal &c. taken from notes made at the time in my sporting diary; and which you are welcome to make use of in any way you please.

"The *Sungraëë*, as it is called by the natives, or large Deer of Munipore, is only to be found in the valley of that state, but neither in Cachar, nor the Kubo valley, nor in any of the Naga hills surrounding Munipore. Its favourite haunts are the low grass and swamps round the edge of the Logta, (lake) at the western end of the valley, and the marshy ground at the foot of the hills. It is gregarious in its habits, and after the annual grass burning, I have frequently seen herds of two and three hundred. The colour of the males from the month of November, till about the end of May, is of a dark brown,

* Calcutta Journal Natural History, Vol. II. p. 415.

nearly approaching to black, and their bodies are covered down to the knee-joints with thick shaggy coats, resembling split whalebone, of four to eight inches in length.

"The hair about the neck is very thick, and just like a horse's mane, and the appearance the stag presents when roused, with his shaggy mane standing on end, coupled with the strong smell which at this season proceeds from their bodies, perceptible at 40 and 50 yards distance, is so formidable, that I have known the boldest elephant refuse to approach them. In June the stags commence shedding their horns, and the new ones have nearly attained their full size by the end of November, but are in perfection in February and March; about this time also (June) they change their coats, which lose their whalebone texture, and become of a beautiful glossy chesnut colour, and about half an inch in length. The contour of their peculiarly small heads, and the perfect symmetry of their forms, divested of their long bristly coats, are now fully developed, and at this season they are, in my opinion, the most beautiful and graceful of the Deer species. The height of the full grown stags averages about eleven and a half hands, and that of the does three or four inches less. The colour of the latter is always the same—a bright bay, but more glossy during the rains than at any other time. The principal distinction between the *Sungraëë* and others of the Deer species consists in the peculiar shape of the lower antlers, which, instead of breaking off at an angle where they are set on the head, preserve the continuity of curve downwards, and project over the eyes of the animal, which they nearly hide, their semicircular shape giving the Deer, when at gaze or in motion, the appearance of having too distinct pairs, the one inclining forwards and the other backwards. The generality of the stags have from six to ten branches or snags, but I have killed very old ones, with no less than sixteen clearly defined branches.

"It would be a great object gained, could any live specimens be procured for transmission to Europe, but it would I fear be attended with much difficulty. I have known several instances of the fawns being caught and thriving well for months, but at about a year old, they invariably pined away and died; nor have I known or heard of a single instance of one having arrived at maturity, this too in their native climate; and I therefore think the chances of one surviving a voyage home but small. I have written to a friend in the valley to send me a complete skeleton of one with the skin &c., and he has kindly promised to do so if he can succeed in procuring one; but says he can hold me out but slender hopes, as the Deer now seem to bear a charmed life, and roam about unpersecuted by anybody."

The next detailed description of this deer was given by Dr. McLelland in 1842,* and I quote his remarks nearly in full.

"Although differing considerably in the form of the horns from any of the Rusa deer, still the general form, the colour, the mane, and the Asiatic habitation of the species, seem to refer it to the Rusa group, of which it forms one of the most unique and striking examples.

"The form of the skull agrees more with that of *Cervus hippelaphus* than with that of any other species that I can refer it to, but the nasal and intermaxillary bones, as well as the muzzle generally, seem to be somewhat mere prolonged and compressed, and though the face is broad and flat between the eyes, the forehead is compressed, and the head as well as the muzzle narrow, and the profile nearly straight, but with a short prominent ridge commencing on the forehead, and extending between the horns. There are two canine teeth, not much developed, in the upper jaw of both sexes, and the suborbital sinuses are large.

"*The horns* are large and directed backwards, and obliquely outwards without ascending from the burr: they are then curved gradually upwards and outwards, and terminate in a point directed forward. A single small antler extends obliquely inward from the upper third of the horn; this antler in young individuals appears to form a fork with the summit, but in the adult it is placed about six or seven inches from the top point of the horn, and is more or less developed according to age; in the adult, and particularly in aged individuals, an imperfect nodular spine extends from the base of this antler towards the point of the horn, with several irregular blunt snags arising from it, forming an incomplete kind of crown. *The brow* antler advances directly forward from the burr, and bending upwards and onwards, terminates in a point which, if prolonged, would meet the summit of the horn, and thus complete an almost perfect circle.

* Calcutta Journ. Nat. Hist., Vol. III. p. 401, Pl. XIII. XIV.

„A single little snag sometimes shoots out promiscuously from the base of one or other horn, more frequently from that of the brow antler.

" The length of the horn following the curve is three feet, and that of the brow antler twenty inches. The circumference of the horn is five and a half inches, that of the brow antler five inches, and both together form one extended and uniform curve of four feet and seven inches; the horns spreading laterally from each other to a distance of three feet, and then approaching at their bases to an inch or an inch and a half.

" *The body* in its general symmetry is light, the limbs slender but strong, the hoofs long, black, and pointed; the head is carried erect; the tail short and conspicuous in the summer dress, but only appearing as a short tuft in the thick winter coat.

" *The coat* is thick and dense in winter, longer and coarser on the neck than on other parts, forming a thick but undefined mane of straight, harsh, and coarse hair, five or six inches long in the winter, but in summer the mane is more defined. From the withers the hair becomes shorter, diminishing towards the tail, which in summer is thinly clad, though in winter it is covered with a dense clothing of hair, in common with all the upper parts of the body. On the face, the muzzle, the limbs, and the external ears, the hair is short, close, and compact; on the lower surface of the chest it is coarse and short; it is thin, lengthy, and fine on the under-parts of the belly. The inner parts of the thighs and upper and inner parts of the forelegs are also thinly clad.

" *The colour* changes from yellowish brown in summer to a brownish grey in winter: during summer, brownish grey prevails on the face and neck, becoming yellowish brown on the upper parts of the body, the backs of the ears, and the upper and outer part of the limbs and the muzzle. The belly, the inner parts of the thighs and the forelegs, the under parts of the lower jaw, the hips, the tail, and adjoining parts of the rump, are white in summer, but the rump and upper parts of the tail partake of the colours of the upper parts of the body in winter. The lower parts of the limbs are light grey, the same also prevails irregularly round the eyes, and corners of the mouth and nose, and lengthy tufts of light grey hair cover the inner surface of the ears.'

Mr. Blyth, as noticed above, considers the *Cervus dimorphe* of Hodgson to be identical with the species under notice; but that the horns of the individuals figured by the latter are abnormal, on account of their being developed in captivity. Had not Mr. Hodgson mentioned, (as quoted hereafter,) that his animal was three years old and the horns perfect, I should have been inclined to have considered it as bearing its first year's horns.

The following information was obtained during a recent visit to Burmah.

Lieut.-Colonel Blake kindly furnished me with the following account: " As regards the exact localities of the *Thamyn* I can only say where I have found them and where not. As far as I know, they do not occur to the south of Moulmein, but from within a short distance of Thabyoo point, the south-western headland of the Martaban district, to Sittang, bounded to the eastward by the forest line, they are found in large herds.

" Again, on the opposite side of the Sittang river, to the south and west of Pegu, they are also found in large numbers. How far they extend in a westerly and northerly direction, from the mouth of the Rangoon river, and in the Bassein district, I do not know, but I have heard that they are common even as high up as Munipore.

" From Pegu to the north they are found in very small parties, the ground not suiting them, until you cross the " Koon" creek or river, the separating boundary between the Martaban and Thoungoo districts, and from this to within a few miles of Thoungoo they occur in large herds.

" Sometimes the plains or open spaces between the Eng* forests will be covered with them, and three or four hundred may be seen at one time. Under these circumstances they are shy and very difficult of approach. Strange to say, that although the ground appears quite as favourable for them, I have never seen a single one to the eastward of the Sittang river north of Sittang. From the above, you will see that they are gregarious in their habits. During the night, and early morning and evening, they frequent the plains, and where the forest jungle is not distant, they retire into it during the heat of the day.

* *Dipterocarpus grandifolia*, Wallich; Wood oil Tree, Mason's Burmah, edit. 1860, p. 493.

"Their food, I imagine, consists of grass. I cannot call to mind having seen more than *one* fawn with its mother.

"The colour of the young, as well as that of the females, is what is termed light fawn colour (light rufous?) The males are sometimes of the same, and sometimes as dark as the male of the Sambur, *Rusa hippelaphus*. I know not if any change takes place in their coats with the change of seasons."

Colonel D. Brown, Officiating Commissioner at Moulmein, has noticed them to range along both banks of the Irrawaddy, on the proper right bank up to Meanoung, and on the left bank as far as Meaday, on the British frontier, N. Lat 19° 40′ E. Long. 95° 20′ (approximately). He has also observed them as plentiful at Theegwen, near Bassein, a few at Padoung opposite Prome, and to be more sparsely scattered through the Therrawaddy district.

For most of the following information I am indebted to the courtesy of J. Davis, Esq., Superintendent of Police in the Martaban District, an Officer well known for his intimate acquaintance with the Burmese language; hence his services as interpreter were invaluble when Burmese and Karen Shikarees had to be questioned.

Pioneered by him, early in October last, I visited the haunts of the *Thamyn* near Thatore (a town about 40 miles N. W. of Moulmein), and although, owing to the dense nature of the vegetation covering the plains at that time of year, I was only able to see a few scattered females and young of the second year, yet the insight thus afforded into their habits and economy more than repaid me for the severe attack of illness I subsequently incurred by exposure to the heat and wet.

This plain of Yengyaing was then, owing to the recent and heavy falls of rain, one large swamp. Nearly the whole of its unbroken extent, which embraces an area of 14 miles in length with an average breadth of 10, could be traversed in a small canoe, except here and there, where mud and vegetation combined obliged one to resort to a very unpleasant system of half wading in water, and half sticking in deep slime. A continuation of this plain, broken up by belts of jungle, extends for several hundreds of miles up the Burmese coast, and has evidently been formed by the gradual retirement of the sea, which at one time doubtless dashed its waves against the Martaban and other continuous ranges of laterite hills. It is now, at Yengyaing, some eight to ten miles distant from the hills, and seems to be still retiring, since the water along the coast of this gulf of Martaban is very shallow and studded with sandbanks. For the primary cause of this we may doubtless look to the immense amount of silt deposit brought down by the waters of the Salween, Beeling, Sittang and Rangoon rivers, all of which discharge themselves into the gulf of Martaban. As the sea retires, a belt of mangrove jungle about a mile in width appears to travel with it, thus enclosing the plain with a barrier of vegetation on one side and the mountains on the other. This strip of mangrove jungle gives cover to numberless hog-deer, tiger, leopard and pig, but is never entered by the *Thamyn*, except where somewhat open; nor on the other side do they ever attempt to penetrate into the mountains. The plain is intersected by numerous tidal creeks which in the hot weather, when deprived of water from the hills, appear to dry up to a great extent, and those still open at that time of year contain no admixture of fresh water, so that it is evident, that for two, if not three, months in the year, the *Thamyn* must be entirely deprived of fresh water, whilst during the rainy season, for six months at least, they may be said to live in water. It appears wonderful how they can manage to exist in such extremes of heat and wet. With the exception of a few stunted trees, and a fringe of hibiscus bushes along the creeks, the plain is covered with nothing but grasses and paddy, of which latter both the wild and cultivated varieties are abundant: owing, however, to the paucity of the population and the consequent demand for labour in this immediate neighbourhood, perhaps only one fourth of the whole area is under cultivation for paddy: this crop succeeds here admirably, and the grain forms one of the staple articles of export from Moulmein and other Burmese ports. The remaining three fourths are covered with the indigenous uncultivated plants which, in seasons of scarcity, are reaped and used for food. This tract of country forms a vast grazing ground both for the *Thamyn*, and for large herds of tame buffaloes which are during the rains pastured here by the Karens, but withdrawn into the heavy jungles near the hills, when, in April and May, the whole of the vegetation on the plain becomes parched up, or is devoured by jungle fires. At the time of my visit vast flocks of waders and other water-birds were arriving from the north, and the creeks were filled with pelicans of several species; whilst the mud flats absolutely swarmed with stints, sandpipers, egrets, and especially the rosy tantalus. Here and there, stalking gravely amongst the flowering paddy, might be seen pairs of the Sarus crane, *(Grus antigone)*, or a troop of adjutants, both of which breed in the neighbourhood. Occasionally the rarer Javanese adjutant was met with, and the Jabiru stork, *Mycteria australis.*

The rutting season commences in the middle of March and lasts throughout April, to the middle of May.

The female gestates nearly seven months, and brings forth her young in October and November, amongst the jungle paddy which is then flowering or in seed, and at its greatest height. The sexes begin to breed at about 18 months old and the female has only a single young one at a time, which frequently stays with its mother until the second year.* Females have only four teats. In colour they are much like the female Sambur, but perhaps a little lighter. The young are at first spotted or menilled, but this disappears with age. The females are hornless. In the second year the young males first begin to acquire horns which are perfectly developed in March, and shed in the middle of the rainy season, that is about September.† After two years they get two tines, and when about seven years old are in their prime with twelve tines (including the brow antler). The natives have a vague idea that two distinct species, the lesser and the greater *Thamyn*, are to be found in the same herds, distinguishable only by difference of size in horns, and colour; but this of course is to be accounted for by the individual distinctions common to all races of animals.

The average weight of the male is from fifty to sixty vis,‡ that of a female forty vis.

Four men can carry a male with ease, when disembowelled and quartered.§

* The mother will breed a second time in 18 months after bringing forth, so that the young of two seasons are not unfrequently seen with their parents.

† As noticed above by Blyth in Major Tickell's specimen at Moulmein.

The colour of a full grown buck is dark brown, especially about the back and neck, with underparts lighter. As far as I can ascertain there is no trace of a mane, and the texture of the coat varies considerably with the seasons; more exact information on these points is however needed.

‡ A vis is equal to 140 tolahs.

§ As noticed by Blyth, the Burmese always quarter deer with the skin on. The Karens, however, will not eat the meat, because they think it will breed cholera.

The male averages $3\frac{3}{4}$ feet in height at the shoulder. The female is a little less : the very largest males do not exceed $4\frac{1}{2}$ feet. The flesh is much liked by the Burmese, and always finds a ready sale in the neighbouring villages. It is rarely brought into Moulmein. In the country the wholesale price of a doe is Rupees 3, and that of a buck Rs. 4,* which is of course less than the usual retail bazar rate.

The flesh is said to smell a little about the end of March when the weather is very hot, but about November and December it is in good condition for the table.

Their habitat and range, according to Mr. Davis, are as follows : In the Martaban District they inhabit exclusively the open grassy plains between the sea and the mountains. In the Pegu plains they are perhaps more abundant than in any other part of Burmah ; next to them the Yengyaing plain in Martaban produces most ; near Rangoon they are found in the Dallah plain. About Pegu and Yengyaing they are found in herds from fifty to an hundred in the month of March, but when hunted, they congregrate much more, and as many as two hundred may then be seen together. In habits they are essentially gregarious, and associate with no other species, although hog deer abound in the grass and jungle along the edges of the plain ; nor will they allow the tame buffaloes to come nearer to them than about 100 yards. In habits they are very wary and difficult of approach, especially the males ; they are also very timid, and easily startled. The males, however, when wounded and brought to bay with dogs, get very savage, and charge vigorously. On being disturbed, they invariably make for the open, instead of resorting to the heavy jungles like hog deer and Sambur. In fact, the *Thamyn* is essentially a plain loving species, and although it will frequent tolerably open tree jungle, for the sake of its shade, will never venture into any composed of dense or matted underwood *i. e.*, bush jungle in contradistinction to " tree jungle." Indeed I was credibly informed of a large stag which, being driven into a corner of the plain last year, by herd boys, with pariah dogs, and finding no means of escape, took refuge in heavy jungle where its horns got entangled in a hibiscus bush, and so was actually captured alive. Its captors, however, soon put an end to its existence with a sharp dhar.

* The prices quoted are what a shikarry expects usually to realize.

When first startled, their pace is great. They commence by giving three or four large bounds like the *axis* or spotted deer, and afterwards settle down into a long trot, which they will keep up for six or seven miles on end where frequently disturbed. This is when the vegetation on the plain is comparatively short. In the rains they do not go far before they find a hiding place in the long paddy. Their powers of leaping are highly developed. On the Yengyaing plain alone there are at the present time about a thousand head, on the Thatong plain, a little further to the north west, perhaps a hundred head only, which go about in small herds of seven and eight. At Yengyaing the annual number killed amounts to about forty-five, including those bagged by Europeans, and about five natives gain their livelihood in that place, almost entirely by the sale of the flesh. They are least gregarious in the rainy weather, the females have mostly then retired in twos and threes into quiet spots, and the herds are altogether more scattered, owing to the increased density of the vegetation. They feed during both day and night, chiefly however in the early morning and evening, their food consisting principally of the jungle paddy. During the night they do a great deal of damage to the cultivated variety, treading down more than they eat. They also feed on grass, and on the leaves of two jungle trees called in Burmese the "Keay" and the "Thamey," the scientific appellations of which I am unable to resolve.* In a tamed state they will eat plantain leaves.

The call of the female, uttered when disturbed, is a short barking grunt, that of the males is louder and more prolonged. It is most frequently heard in the rutting season, during which period the males have frequent and severe battles; a pair have been known to have been captured whilst so engaged, with their antlers interlocked.

* I lately had a stag *Panolia* in confinement for many months. It was put out every day among capital pasture, but invariably abstained from eating it. I tried it with a number of trees and found that it eat quickly the leaves of *Ficus venosa, religiosa* and *indica*, and that the tender shoots and leaves of bamboos were its special favourite. It was kept close to a tank in which *convolvulus reptans* was growing luxuriantly, and it was accustomed daily betimes to stand in the water up to its middle, and feed on the leaves of this plant also. It did not appear, however, to be so fond of the water as the nearly affined *bara singha, Rucervus Duvaucellii.* A male of the latter species in my possession, in the hot season, used to spend the greater part of the day lying in the water. Its food also apparently differs from that of the *thamyn*, for it browsed on common pasture, and while in the water fed on the long straggling grass *Seersia hexandra* (*Editor.*)

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for the Zoological Society of London.* Major Tickell had one alive for some time in Moulmein, but it was eventually killed by pariah dogs which got into its enclosures at night. My informant, the shikarree, tells me that he had one also tame some years since; he caught it when about three months old, fed it on milk at first, and afterwards on grass and plantain leaves, and, after a short time, it became so tame that it would follow its owner about, and never attempt to leave the dwellings of man; after an interval of two years, it got a small pair of horns shaped like those of the adult, but much smaller. Finally, like most pets, it met with an untimely end, being stolen and killed for food by rapacious Burmese officials. From this the species appear to be capable of easy domestication, although it is said by some invariably to pine away and die after capture. The horns of the species are of large size, and are kept by the natives for making handles for sickles. The small ones are of no value, and are either thrown away or cut up and used as pegs.

As to medicinal qualities, when a buffaloe is bitten by a snake, the horn of the *thamyn* ground to powder is mixed with a solution of the leaves of the "Yekazoon" (*Ipomœa. sp.* or convolvulus,) and given internally, as it is said to cure the bitten animal immediately. No other part of the beast appears to be used medicinally, and the above mentioned nostrum is of no avail for the human race.

In conclusion, there is one point to which I wish to draw especial attention, as one on which our information at present is very limited. It is not known for certain whether the *thamyn*, in its first year, has horns without the brow antler, or whether they are the same as those of adult individuals, but smaller and with fewer tynes. The *pros* and *cons* on either side of the question are I find about equal. It remains for those who have the opportunity of rearing the young animal in captivity, or of shooting a young one, to prove which is the right view of the case.

* I have since heard that Col. Phayre has one at the present time alive at Rangoon, and Mr. Grote one at Alipore, supposed to be the young of this species.

A fine full grown stag which I received for Col. Phayre is now in the Zoological Soc. Gardens, London.—*Editor.*

Zoological Notes.

By William T. Blanford, F. G. S.

Cor. Mem. Z. S. Lon.

[Received 10th June, 1867.]

The following notes refer chiefly to the distribution of various animals in India and Burma, and to the habits of a few species. There is much in them which is probably not new, more especially with regard to the habits of animals. Still the subject is so interesting, and so little studied by naturalists for want of opportunity, that I trust these few remarks may have some interest. All the facts noted are from personal observation, except where the contrary is stated.

1. *The Lion in India.* Mr. Blyth, about 2 years since, called attention to the circumstance that lions had been recently met with in parts of India in which the animal had been supposed to be extinct. Since that time, one or two other localities have been added to the list of those in which lions have been met with. A paragraph went the round of the newspapers rather more than a year ago, in 1866, to the effect that a lion had been killed near Rewah. An account of the death of this animal was given in the new Oriental Sporting Magazine; and again in "Land and Water," for December 8th, 1866, Captain Le Mesurier described the locality and gave the dimensions of the skin. The animal was killed by Messrs. Lovell and Kelsey, of the Jubbulpoor railway staff: it was a fine male *with a full mane.* The dimensions of the stretched skin were the following:

	ft.	in.
From tip of nose to end of tail,...........	9	8
Ditto to insertion of tail, ...	6	10
Ditto to hinder end of mane, ...	3	6
Across skin from fore toe to fore toe, ...	6	11

So that the animal, when alive, probably measured rather less than 9 feet from the tip of the nose to the end of the tail, measured as tigers usually are, that is, by carrying a tape from the nose over the head and along the middle of the back.

The mane is specially mentioned as very full, the longest hairs being about eleven inches in length, the colour yellow sandy, except on the crown of the head, along the crest, and across the shoulders, where a blackish shade prevailed, the hairs being white, black and yellow, in about equal proportions. The ears were black on the outside, and the tip of the tail was also black; the lower tip white. From the dark colour of a portion of the hair, there can be little doubt that this was not an aged animal, although, from the fully developed mane, it must have been mature, and not a young lion. The spot where it was killed was near the 80th milestone, on the railway from Allahabad to Jubbulpoor.

I am indebted to Mr. Grote for a note from Captain Le Mesurier confirming the above particulars, and adding the following, also mentioned in the letter published in "Land and Water."

"Some few years ago Mr. Court, who is now Commissioner of Allahabad, and a very good sportsman, disturbed two lions on the rocky plain near Sheorajpúr, twenty-five miles west of Allahabad, when he was stalking antelope."

"Two years ago (1864) Mr. Arratoon of the Police shot at and wounded a lion very near Sheorajpúr, and eventually, with native help, *stoned* him to death, as he had no spare ammunition. Some of the members of my staff saw the skin, and got the story, nearly as I relate it, from Mr. Arratoon, who still holds a police appointment somewhere in the N. W. Provinces."

The last authenticated appearances of an animal now verging on extinction in Central India are, I think, sufficiently worth preserving to demand a record. The Sheorajpúr lion is, I believe, the furthest to the eastward yet known as having been killed in the present century.

Col. Torrens also has written to Mr. Grote to say that lions still occur about Lalatpúr, between Jhansi and Saugor.

A few lions appear to be killed every year about Gwalior and Goona, but the animal is scarce, and, being eagerly sought after by some of the keenest sportsmen in India, it is rapidly becoming scarcer. In the hot weather of 1866 no less than 9 lions were shot by one party in the neighbourhood of Kota in Rajpootana. My information is derived directly from one of the sportsmen, Major Baigire. Of one of these Rajpootana lions I have seen a coloured drawing, taken immediately after death by an excellent artist. The mane was very fine and well developed, although the beast was killed in the hot weather, when the mane, like the rest of the fur, is doubtless thinner than in the winter.

From a native I learn that in a recent beat in Rajpootana (somewhere on the neighbourhood of Kota), no less than 10 lions were turned out. If this story be true, and I think I have heard of similar large gatherings amongst African lions, this animal occasionally collects in much larger numbers than tigers do. At the same time I do not place much faith in the story. The largest number of tigers of which I ever heard as being found together was six. These were full grown animals. Five I have several times heard of. In such cases all are one family, the old tiger and tigress and their full grown progeny. A tigress not unfrequently has 3 or 4 cubs (I have known the latter number of fœti to be taken from the body of a slain animal) but they rarely, I suspect, all attain to muturity.

The lion seems still to exist in 3 isolated parts of Central and Western India, omitting its occasional occurrence in Bundelkund. These are (1) from near Gwalior to Kotah. (2) Around Deesa and mount Aboo, and thence southwards nearly to Ahmedabad and (3) in part of Kattiawar, in the jungles known as the Gheer. It is possible that isolated examples may yet remain in others of its original haunts.

I may add that the opinion expressed by Mr. Blyth (Cat. Mam. in Mus. As. Soc.) of the inferiority in size of the lion to the tiger is quite borne out by all I have heard on the subject. Major Baigire, one of the best known tiger hunters of Western India, who has also killed more than one lion, told me that the muscular development of the latter animal, as displayed in the skinned carcase, is decidedly less than that of the former.

2. The hunting leopard, *Felis* (*cynalurus*) *jubatus*. Blyth, in his catalogue, gives the range of this animal in India as confined to the west and south. It is found throughout the greater portion if not the whole of the Central Provinces, though everywhere scarce, and I have seen the skin of a specimen killed near Deogurh in the Sonthal pergunnahs, and brought to that station by a shikaree. I think it will be found to exist, here and there, almost throughout the Peninsula. In Cutch it is said to be the only large feline existing, but I cannot speak positively on this subject.

3. The wild dog. *Cuon rutilans*, Pallas.

The ordinary prey of these animals, who, as is well known, hunt in packs, is the sámbar (*Rusa Aristotelis*, Cuv.), the chital or spotted deer (*axis maculatus* Gray), and the wild pig. But they attack higher game. I have heard a perfectly authenticated account of their destroying a young gaur (*Bos gaurus*), and I myself found the fresh carcase of a full grown (tame) buffalo which had been killed by them. This was in the jungles east of Baroda. Now a buffalo is not an easy beast to kill; very few tigers will attack an adult. It struck me that the teeth of a wild dog would scarcely suffice to tear the enormously thick skin of the throat of their prey : and on examining the carcase I found scarcely the mark of a tooth on the neck and throat, although there were many about the muzzle. The animal had evidently been killed by tearing out its intestines, a portion of the pack meantime holding the animal by hanging on, in bull dog style, to his muzzle and forequarters. I suspect that they kill all large animals in the same way; a young sambur, which I saw on the Nilgiris, had apparently been killed in this manner. I have heard from natives, too, that this is their mode of attacking tigers. That they do attack and kill tigers is so universally stated in India, in every place where the wild dog is found, from the Himalayas to the extreme south, that I do not think its truth can be doubted, startling as the assertion appears. Yet, singularly enough, they never attack men : at least I never heard of their doing so. The wolf, which, although larger, is proportionately their inferior in strength and speed, and which rarely, and in India, I think, never, collects into packs as large as those of *Cuon rutilans*, not unfrequently attacks men, though I believe he rarely attacks an animal of the size of a full grown sambur.

Ruminantia.

4. The gaur and gayal. *Bos gaurus*, Smith, and *Bos pontalis*, Lambert. I had the unusual advantage last year, and at an interval of 2 months, of seeing five adult examples of both these magnificent bovine species alive. The gaur were wild in the jungles of Nimar, the gayals were the magnificent tame specimens procured by Dr. J. Anderson for the Zoological Society, and living for some time in the Botanical gardens at Calcutta. There could be little question of the purity of breed of the latter; although far more tame and gentle than most domestic cattle, their symmetry and the regularity of their colouring were those of wild animals.

There is, at the first sight, a remarkable resemblance between these two races. The massive proportions, thick horns, short legs, immense depth of body, the dorsal ridge terminating abruptly about half way down the back, the general colouring, are all characters common to both. But one or two differences are immediately perceived, and others become conspicuous on closer examination. The most remarkable of course are the comparatively straight and wide-spreading horns and the enormously developed dewlap of the gayal, as contrasted with the sharply curved horns and absence of any dewlap in the gaur, and the shorter tail of the former. But if Dr. Anderson's specimens are fair examples of the gayal, they shew that there are several minor distinctions between the two. In the gayals the head is shorter and, I think, altogether smaller than in the gaur, and the dorsal ridge is not quite so high. In the adult bull gayal in Calcutta, the skin of the back and sides is almost naked, as in the buffaloes of the plains of India; this I have never seen in the gaur. The legs below the knees too, which in the gaur are dirty white, are, in these gayals, dirty yellow. The female gayal is darker in colour than the cow gaurs which I have seen, but as the latter vary considerably in tint, the former may possibly do the same.

I have seen a good deal of the gaur in the Satpoora hills during the last few years. It there inhabits the peculiar thin jungles which cover the trap rocks of Central and Western India. These jungles, as is well known, consist of tolerably open spaces of thick grass 3 to 5 feet in height, with small scattered trees. This grass is burnt at the end of the cold weather over the greater portion of the country. In ravines and along the banks of streams the jungle is thicker, but elsewhere there are few places where the trees are an impediment to riding. The gaur feeds in these plains in the morning and evening, drinking in the evening, or at night, and retreating during the day either to a shady ravine, or, during the hot weather, at least, to the top of a high hill, the most breezy spot being apparently chosen, irrespective of shade. So far as I have observed, the gaur, like the sámbur, never remains in the vicinity of water, or drinks, during the heat of the day.*

The ferocity of the gaur has been, I think, greatly overstated. I have never heard of but one well authenticated instance of an unwounded animal attacking man, though the bulls, like those of all

* The spotted deer, on the other hand, almost invariably does so. The sámburs, I believe, only drink at night.

large bovines, are undoubtedly dangerous in the rutting season. In general, the gaur is a timid and rather stupid animal, not very sharp of sight, though, like all ruminants and, indeed, all wild mammals, gifted with strong powers of scent.

I have never seen a herd of more than 16, and ten to twelve is a more common number, the herd comprising one or two adult bulls only, the remainder being cows and calves. The bulls remain apart; either solitary, or in parties of two or three. But I have heard both from Europeans and natives of much larger gatherings having been seen. These are doubtless formed by the union of many herds, and this habit of collecting, at particular seasons, in very large numbers, appears common to most ruminants which habitually live in herds. Thus I have seen, in April, at least 150 spotted deer (*Axis maculatus*) together, and I have heard of far larger numbers collecting in the hot season, and I have recently heard of similar assemblages of the bárasingha (*Rucervus Duvaucellii*).

The cows of the gaur, as I have already mentioned, vary considerably in colour, being usually some shade of brown, approaching dun. Some, in Nimar and the Satpoora hills at all events, are of a very red tinge, in some cases approaching closely to the deep red so common in European cattle,—the colour also, I believe, of the cow Banting, *Bos sondaicus*. I am inclined to think that the colour is redder in the cold season than in the hot weather. The usual tinge in the hot season at least is a much duller brown, nearly the colour of the Nilgiri buffaloes. From what I have heard, the tint of these Nimar animals may be lighter than that of the cows in the Western Ghats and southern India, a circumstance probably connected with the much greater exposure to the sun which they must undergo in the thin trap jungles, and also partly, perhaps, accounted for by that tendency which appears to exist in most wild animals to approximate, in their colour, the general hue of their habitat. This is, of course, much lighter in a tract mainly covered by grass, which is dried and of the colour of straw for 7 months of the year, than in the depth of the evergreen forests of Malabar and the Western Ghats.

The size of the gaur, great as it is, is often, I suspect, exaggerated by unfair measurement. Instead of measuring the true height, as is done with horses, the length from the forefoot to the end of the spinal ridge is substituted. A great addition to the height is also easily made by pulling out the foreleg as the animal lies, and by measuring from the toe instead of from the heel, especially if the cord be curved a little over the side. Another plan I have lately heard of is to stretch a tape from one forefoot to the other over the back, and to take half the resulting length as the height. When it is remembered that the measurements are made by sportsmen, not by naturalists, it will easily be understood that all should be taken *cum grano* and that many may be rejected altogether. My own impression is that it is as rare to find a gaur exceeding about 17½ hands (5 ft. 10 in.) as it is to meet with a tiger above 10 feet in length. Larger animals do undoubtedly exist, but they are rare, and it is, I think, doubtful if 20 hands (6 ft. 8 in.) is ever reached. To judge from all the horns I have seen, the gaur of no part of India proper attains a larger size than in the Satpoora hills.

The gaur is called *ran pado* in Goozerat and *ran híla* by the Bheels of Kandesh, both words, like the name commonly used throughout Central and Southern India, *ran* or *jungli byns*, meaning wild buffalo, which is just as absurd, as the term *bison* applied by Anglo-Indians. I have even heard the name *arna*, which of course means the wild buffalo, applied to the gaur; and the correct name is rarely used, in Central India at least, except in the neighbourhood of districts where wild buffaloes occur.

5. The wild buffalo, *Bos* (*Bubalus*) *buffelus.*

I think Blyth is in error in restricting the range of the aboriginally wild buffalo to the Ganges valley and Assam. (Cat. Mam. As. Soc. p. 163). Wild buffaloes are completely unknown throughout Western and Southern India, but they are common on the east coast, to some distance south of Cuttack at least, and throughout the jungles of Mandla, Raipur and Sumbalpúr, extending west as far as the Wein a Gunga and Pranhita, and south to the Godavery; a few herds may occur beyond these limits, but they are very rare. My information is derived partly from my own observation, partly from various sportsmen who have seen and killed the animal in these districts; and I have myself seen the spoils. All that I have seen belong to the *B. speiroceros* race of Hodgson, with horns curving from the base. My reasons for thinking all these animals aboriginally wild, and and not feral, are—1st, the perfect symmetry and immense size of their horns. 2nd, the fact that the tract inhabited by them is contiguous to the area, Lower Bengal and Assam, inhabited by the undoubtedly wild race. 3rd, the circumstance that precisely the area mentioned comprises the range of other animals also restricted, in India proper, to Bengal and the neighbourhood; e. g. *Rucervus duvaucellii* and *Gallus ferrugineus*, concerning the distribution of which I shall have something further to say presently.

6. The four-horned antelope (*Tetracerus quadricornis.*)

This species is especially abundant in the trappean districts of Western India, it is one of the commonest wild animals in Nimar, Malwa, Khandeish, the western part of the Nerbudda valley, and throughout the Taptee valley. It is also common along the Western Ghats and in the Konkan about Bombay. It lives in jungle, and is generally to be found near water. It is comparatively a solitary animal, and I have never seen more than four together, the two parents and their young. For a long time I was inclined to look upon the animals with only the posterior pair of horns developed as a distinct race, with lighter coloured fur, and I am by no means satisfied that there is not a distinction to be drawn. The two horned specimens, in the country I have mentioned above, are quite as numerous as the four horned, and although they are fully adult, I have failed to find a trace of the cores belonging to the anterior pair of horns on the skull; a specimen with all four horns fully developed and pointed is rare, generally the anterior horns are mere knobs.

Mr. Blyth is, I think, in error in his catalogue of the Mammalia in Mus. As. Soc. p. 166, in applying the name Chikara to this animal. The Chikara or Chinkara (the latter being the correct name, but the *n* is nasal and very little sounded) is the name which I have heard universally applied to the Indian gazelle, *Antelope bennettii*, Sykes. The 4-horned antelope is called *Chousingha* in Hindee, as stated by Mr. Blyth; it is known by the Mahrattas as "*Benkara*" and by the Bheels of Guzerat as *Bokra* or *Phokra*.

7. The Indian antelope and gazelle. (*Antilope bezoartica*, Aldr and *A. Bennettii*, Sykes). Both of these animals can exist without water. The antelope abounds on the strip of sand separating the Chilka lake, which is quite salt, from the sea; and on this strip the only fresh water is obtained from one or two deep wells. The strip is about 30 miles long. I have been assured by so many people that

antelopes do drink in places, that I cannot absolutely assert that they do not, although I suspect their visits to the edges of streams and tanks are rather for the purpose of feeding on the green grass growing there than for drinking. As regards the Chinkara or Indian gazelle, I quite believe that it never drinks. I have seen it in the deserts of Sindh* in places where the only water for 20 miles around was procured from wells; and in places in Western and Central India where, in the hot weather, the only water is obtained from small pools remaining in the beds of streams, and around which the tracks of almost every animal in the forest may be seen, I never yet saw the very peculiarly formed tracks of the gazelle, although it frequently abounded in the neighbourhood. The four horned antelope, on the other hand, drinks habitually. I have seen it doing so, and its tracks are constantly to be found at water holes. The Nylgai drinks, but not, I think, habitually, except in the hot weather.

8. The Bára Singha, *Rucervus Duvaucellii.* For some remarks on the geographical distribution of this species see further on, under the jungle fowl. The localities given by Mr. Blyth† are Upper Bengal; valley of Nepal; Assam; *Nerbudda territory*; Eastern Sunderbuns. This list requires slight modification. The animal occurs, though scarce, in Beerbhoom, and I believe, here and there throughout the Chota-Nagpoor country, Sirgooja and Chutteesgurh, and it abounds in Bustar, as I have lately learned from Captain Glasfurd, the Deputy Commissioner of Sironcha. It is to be found about Umarkantak, the source of the Nerbudda, and in Mundla, but with one exception, to be presently noticed, not further to the west, and it is unknown throughout the greater portion of the Nerbudda valley. Generally the limits of its range are very nearly those which I have indicated for the wild buffalo.

PACHYDERMATA.

9. The Indian wild pigs. *Sus scropha?*

Mr. Blyth has pointed out (J. A. S. B. XXIX, 105) distinctions in the form of the skulls of wild pigs in India, but he has not referred to

* The Sindh species may be distinct.

† Catalogue of the Mammalia in the Museum of the Asiatic Society. The localities given by Mr. Blyth are in general thoroughly trustworthy, so far as my experience goes. I am therefore the more anxious to correct them where any improvement is possible, a task only practicable to those who like myself have had opportunities for extensive travelling in India.

differences in colour. Now I have seen whole herds (or sounders) of wild pigs which were brown in colour, irrespective of size or sex, and other herds in the same region, all the members of which were black. Large hogs are usually black, becoming grizzled with age, but I have seen a large solitary hog of the brown species, which had been just killed by a friend, and it was the same colour as the smaller animals. The brown race, so far as my observations extend, is never found except in bush or forest jungle, the black pigs are the common wild hog of the plains, but are also frequently met with in forest. These may be accidental varieties, but it is equally probable that the dfference in colour is connected with other distinctions. I can, however, only point out the question as one for enquiry.

Rodentia.

10. The Burmese bamboo rat, *Rhizomys castaneus*, Blyth.—In the Catalogue of mammalia in Mus. As. Soc. the locality of a specimen received from me is erroneously entered as South Arakan. The specimen was killed by me at Prome in Pegu. The distinction is important, as the fauna of S. Arakan, and of Arakan generally, is very different from that of Upper Pegu, though many species, like the present, are common to both.

Cetacea.

11. The freshwater dolphins of India and Burma (*Platanista*). It is well known that species of *Platanista*—whether the same or distinct,is less clearly ascertained, occur in the Ganges and Brahmapútra and in the Indus. It is less generally known that a species abounds in the Irrawadi. I have seen them in various parts of that river from near the mouth to nearly 100 miles above Ava, and I was told by natives that they are to be met with as far to the north as Bamo, the Burmese frontier. I was, however, never able to obtain a specimen. The species is very likely to differ from that of the Ganges.

I cannot say if these animals are found in any other Burmese rivers. They may very likely exist in the great rivers of Siam and Cambodia, and they should be looked for in the great Chinese rivers. I am pretty certain that in India they are only found in the Ganges, Brahmapútra, and Indus, and their tributaries. I can speak pretty certainly of their non-existence in the Brahmini, Mahanadi (of Cuttack), Godavery, Taptee and Nerbudda, and I never heard of their occurrence in the Krishna or Cauvery.

Aves.

12. Geographical distribution of the red and Sonnerat jungle fowls. *Gallus ferrugineus*, Gm., and *G. sonneratii*, Tem.

I regret very much having been the means of misleading Dr. Jerdon as to the distribution of the red jungle fowl. I had been told by two different observers that they had seen and shot jungle fowl exactly like the common barn door fowl in and near the Rajpihla hills, and a third had assured me that he had seen specimens of two different kinds of jungle fowl from the same neighbourhood.

I have now been through the Rajpihla hills and the western Satpooras pretty thoroughly, and I am convinced that the only jungle fowl inhabiting those ranges is *Gallus sonneratii*. This species is also found north of the Nerbudda, in the jungles east of Baroda, and around Chota Oodipoor, but how far it extends to the north and north-west I cannot say. It is not improbably to be found in the Aruvelli range and perhaps about Mount Aboo. It occurs throughout the Satpoora hills, north of Kandesh, and indeed throughout the Taptee valley. Further south I have recently shot it in the jungles just east of Chanda.

Jerdon mentions its occurrence at Pachmurri, where, however, I learn from Lieut. J. Forsyth that *G. ferrugineus* also occurs. I am indebted to Lieut. Forsyth for the following most singular fact with reference to the limits of the latter species. He tells me that it is precisely conterminous in the hills south of the Nerbudda with the Bára Singha, *Rucervus Duvaucellii*, and the Sál tree, *Shorea robusta*. The western limits of the great belt of Sál forest which covers so large a portion of Eastern India is in the Mundla district, and there bára singha and red jungle fowl also occur. The sál is not found in Western India; but there is one spot in the Deinwa valley, just under Pachmurri, where a patch of sal forest occurs, and there, and there only, the red jungle fowl and the bára singha are met with, although the nearest spot to the eastward where the three again recur is 150 miles off. Lieut. Forsyth adds that the two kinds of jungle fowl meet on the plateau at Pachmurri and he has shot both there. When in charge of the forests, he has traversed the whole of the jungle tracts south of the Nerbudda, and can speak positively as to the above very curious circumstance. It would be very interesting to ascertain whether any other animals or plants have a similar distribution. The only hypothesis which appears to account for the existence of an isolated colony of eastern forms like this is to suppose that, like a geological outlier they were formerly connected with the present main range, and that they existed throughout the intervening area in which they are now no larger found.

To the south, the range of the bára singha and red jungle fowl appears again to coincide with that of the sál tree. I have mentioned above the occurrence of the bára singha in Bustar, where Jerdon found both kinds of jungle fowl together, and where the sál tree is also met with. *Gallus ferrugineus* does appear to reach the Godavery further east, as I heard one crowing not long since in the gorge through which the river runs about 50 miles above Rajahmundry.

13. Distribution of the black and painted partridges, *Francolinus vulgaris*, Stephens, and *F. pictus* Jerd. and Selby.

Jerdon, Birds of India, pp. 559, 562, leaves the relative distribution of these two species to the west somewhat undefined. I haye only seen or heard of *F. vulgaris* in Sind. *F. pictus* abounds throughout eastern Guzerat near Baroda and Surat, and I believe, extends throughout Kattiawar. It also occurs, though less commonly, in Cutch, where I have seen it.

Reptilia.

The garial (*Gavialis gangeticus*.)

This crocodile is generally supposed be confined to the Ganges and Brahmapútra with their tributaries. It is found also in one other river running into the Bay of Bengal, the Mahanadi of Cuttack. It does not, however, appear to range further south and is unknown in the Godavery. It is wanting in the Nerbudda and other rivers which fall into the sea on the west coast.* It is also unknown in Burma.

* I have been recently informed on good authority that it exists in the Indus. Editor.

Kashmir, the Western Himalaya and the Afghan Mountains, a Geological paper, by

Albert M. Verchere, Esq. M. D.
Bengal Medical Service, with a note on the fossils by
M. Edouard de Verneuil,
Membre de l'Académie des Sciences, Paris.

(Continued from page 115, of No. II. 1867.)

In April 1864, I sent a box of fossils, mostly from Kashmir, to Professor Faire, of Geneva. M. Faire kindly forwarded these to M. E. J. de Vernueil, who was good enough to examine them carefully, and to write a most interesting note, of which a translation is now given.

Some of the fossils represented in the Plates were not sent to Professor Faire, and some which were sent, are not figured here; the numbers at the head of some of the paragraphs of M. de Vernueil's note refer to the fossils represented in the Plates.

Note on the fossils forwarded by Mr. Verchere, *by* M. Edouard de Vernueil, *Member of the Academie des Sciences, &c. &c.*

The largest of the two specimens sent, of which the matrix is a dark brown limestone, belongs to the *Productus Semireticulatus*, (Martin), one of the most characteristic species of the carboniferous limestone, in Europe, in Russia and in America. This species has been brought from the south of the Oural, and Mr. Tchihatcheff has found it in Siberia in the Altai mountains.

A specimen of *Productus costatus* (Sowerby). This is a species scarcer than the preceding. The specimen from India shows well the characters of the species such as they are figured by Sowerby, whilst those from Missouri, figured by M. de Konnick, do not possess the large and thick ribs which characterise the original species. The *Productus costatus*, first found in England, does not exist in Continental Europe, except in Russia where I found it in the government of Toula. Some Russian authors mention it from the government of Tiver and of Kalonga.

Productus Humboldti (D'Orbigny). This species is very like *P. Granulosus* (Phillips) and *P. Heberti* (Vernueil, Bull. Soc. Geolog. de

26

France, Vol. XII. p. 1180). It is distinguished from this by its well marked sinus, and its fine and numerous spines strewed without order on the surface and not forming concentric series. The *P. Humboldti* is mentioned by Keyserling as having been found by him in the carboniferous limestone of the Soiwa, an affluent of the river Petchora on the western slope of the north of the Oural. Mr. Davidson has thought proper to make a new species which he calls *P. Purdoni* (on some Carboniferous Brachiopoda collected in India by A. Fleming and W. Purdon in 1848 and 1852, Quarterly Journal of the Geol. Soc. of London, Pl. 2 fig. 5, 1862) based on specimens similar to those under examination, and which came from Chederoo and Moosakhel (Salt Range, A. M. V.). He gives a drawing, under the name of *P. Humboldti*, of a species on which the spines are fewer and confusedly arranged in quincunces, and of which the sinus is very slight and only visible near the front of the shell. I would regard this rather as the *P. pustulosus.*

Productus Cora, (D'Orbigny). Two good specimens possessing well the characters of the species.—Discovered first in the Bolivian plateau by D'Orbigny. This species is one of the most characteristic of the carboniferous limestone in England, in Belgium, in Spain and in Russia.

At the time I found it in the last named country D'Orbigny had but just described it; I did not know his work, and, as this shell varies much, I had made two species of it under the names of *P. Tenuistriatus* and *P. Neflediwi.* It is found on both slopes of the Oural, and also in the white carboniferous limestone of the plains of Russia at Sterbitamak on the river Oka, and in the carboniferous region of Douety. Finally it is also mentioned in North America. It has therefore a great geological range.

Four specimens of *Productus.* That in the black limestone and brought from Kashmir is the *P. Flemingii* or *Longispinus* or *Lobatus* (three names of the same animal). It is one of these *Producti* largely distributed on the globe. It has been found on the Mississipi in the state of Ohio and in Kentucky. It exists in England, in Spain, and in Belgium. Messrs. Keyserling and Murchison and I have found it in the governments of Tiver, Kalonga, on the Douetz as well as on the river Belaja near the glacial sea. The specimens from the white limestone of the Kafir-Kote are a distinct variety, remarkable for a pretty considerable number of tubular spines, and by the large size of its longitudinal striæ, which are often well marked.

Four specimens of a small species which differs from the *P. Longispinus* or *lobatus* by the want of lobes and of a sinus on the middle of the greater valve. It is perhaps the *P. Aculeatus*, (Martin), but the specimens are not good enough to be determined rigorously.

Very small specimens of *Productus* which are perhaps the young of the *P. longispinus* or of *P. Boliviensis*, (D'Orbigny), of which Keyserling found a valve in the carboniferous limestone of the basin of the Petchora (government of Archangel). It is characterised by well detached ears.

Two specimens of *Athyris*, without the test and too imperfect to allow of their being determined (*Terebratula Subtilita*, Halls?)

Four specimens of a species of *Athyris* which is perhaps new. It belongs to the class of *Terebratulae* with concentric striæ and internal spires, called by D'Orbigny *Spirigera* and by M'Coy *Athyris* (a name, let us remark, which means the reverse of what exists, since, instead of being imperforate, these species have a round hole on the beak). This species from Kashmir approaches the *A. Ambigua*, (Sowerby), and the *A. Globulosa*, (Phoill.), but it is more transverse and the beak is more detached and sharper. It may be called *A. Buddhista*, as proposed by Mr. Verchere. The *A. Ambigua* is found in Russia in the carboniferous limestone, but is rare there, whilst it is common in England.

Two specimens, of which one is perhaps a variety of the *T. Subtilita*, (Hall*) or the *T. Subtilita* itself. The other appears to me to be an *Athyris Royssii*, (Vernueil), discovered by myself in the carboniferous limestone of Belgium. When this species is well preserved, the shell is seen to be covered by a pilose investment or coating, consisting of very fine spines continuing the lines of growth. The specimen I possess presents traces of this structure in the shape of a pubescence of very fine hairs.

Three specimens in a bad state of preservation, which are probably merely varieties of the *A. Roysii*.

* The *Terebratula Subtilita* is a species of Hall, found in the carboniferous of the Great Salt Lake in America. Mr. Davidson mentions it from India.

One more specimen of the same species.

Two specimens of a *Terebratula* which is probably new, but the specimens are not good enough to be determined.

Six specimens of a *Spirifer* which appears to me to be new. At first sight one would take it for the *S. Trigonalis*, (Martin), but it differs from it by the narrowness of the sinus, and by the want of folds in that part which most commonly shows some of them, more or less well marked, in the Sp. *Trigonalis.* The narrowness of the sinus reminds one of the *S. Mosquensis*, of Russia.

Spiriferina nearly allied to the S. *Octoplicata*, (Sow.), and still more to the *Sp. Cristata* of the Zechstein, two species which Mr. Davidson unites into one. This author figures the *S. Octoplicata* among the fossils of India. The specimen, which is marked No. 16, has narrower ribs and broader furrows than the specimens figured by Davidson. On another are admirably well seen the granulations peculiar to the genus *Spiriferina* of the lias, and to the Permian and Carboniferous species under notice. Pl. I. fig. 2, a, b, c, d.

Great *Cardinia*, perhaps new. Pl. VI. fig. 2.

Two specimens of *Cardinia* bearing a distant likeness to the *C. Ovalis* (Martin,) *C. Uniformis* of the Carboniferous of England and also to the *C. Listeri Unio* (Sowerby,) of the Lias.

M. de Koninck has figured a shell very similar to this under the name of *Solenopsis imbricata*, (Descrip. of new fossils from India, discovered by A. Fleming, by de Koninck, Quart. Journal of the Geol. Soc. vol. 19 Pl. IV fig. 3.) obtained from the carboniferous limestone of Varcho, (Vurcha, Salt Range, Punjab. *A. M. V.*)

Aviculo-Pecten dissimilis (*Pecten id.*, Fleming), This specimen reminds one of the *Pectea Ellipticus*, (Phillips), which is found in the Carboniferous of Russia.

Axinus, sp. nova. This shells resembles much the *Axinus obscurus*, (Sow. *Schizodus*, King,) of the magnesian limestone or Permian of England. It has also some distant likeness to the *A. Carbonarius (vernus)* Sow. Geol. Transac. vol. V. pl. 38.

Fenestella Sykesi, Koninck, Quart. Journ. vol. 19, pl. 1. fig.,

Fenestella megastoma, Koninck, Quart. Journ vol. 19, pl. I.

Fenestella. Undetermined. Pl. V. fig. 1.

A very pretty species which I do not know. Perhaps the *Vincu-*

laria multangularis (Postlock). It is to be regretted that the surface is not seen and that the branches are split in two.

Lithostrotion floriforme, Flem. a common enough species in Russia in the carboniferous ; found also in England.

Michelinia or Beaumontia. Ill preserved specimen.

Phyllopora cribellum, Konnick, Quart. Journ. vol. 19. pl. I fig. 2.

List of species which have been identified from the specimens sent by Mr. Verchere.

1. *Productus Semireticulatus*, Martin.
2. „ *Costatus*, Sow.
3. „ *Humboldtii*, D'Orbig.
4. „ *Cora*, D'Orbig.
5, „ *Flemingii*, Sow. = *P. Longispinus* and *P. Lobatus*, Vernueil.
6. „ *Aculeatus*, Sow.
7. „ *Boliviensis*, D'Orbign.
8. *Athyris ambigua ?* Sow. (perhaps *Sp. hova*).
9. „ *Royssii*, Verneuil.
10. „ *Terebratula Subtilita*, Hall.
11. *Spirifer Vercheri*, Verneuil (new species, nearly allied to the *S. Trigonalis*, Martin, but distinct).
12. *Spiriferina Octoplicata*, Sow.
13. *Cardinia ovalis ?* Martin.
14. *Solenopsis imbricata*, Konn.
15. *Aviculo-pecten dissimilis*, Flem.
16. *Axinus, Sp. nova* (nearly allied to *A. Obscurus* of the Gechstein)
17. *Fenestella Sykesii*, Konn.
18. „ *Megastoma*, Konn.
19. *Vincularia multangularis ?* Postlock.
20. *Lithostrotion floriforme*, Flem.
21. *Phyllopora cribellum*, Konn.

Remarks.

Several notes on fossils collected in India have been published lately ; the fossils were forwarded by Messrs. Fleming and W. Purdon and more recently by Captain Godwin-Austen. These publications are 1st, Davidson's Memoir "On some *Carboniferous Brachiopoda* collected in

India by A. Fleming and W. Purdon, Quart. Journal, vol. XVIII. p. 25; 2 plates. 2nd, Description of some fossils from India discovered by J. Fleming, by Dr. L. de Koninck, Quart. Journ. vol. XIX. with 8 plates on which are figured among others some very curious goniatites. 3rd, Geological notes on part of the N. W. Himalayas, by Capt. Godwin-Austen, with notes of fossils by T. Davidson, R. Etheridge and P. Woodward. It is only an abstract of the memoir, without plates. Capt. Godwin-Austen followed the Carboniferous limestone along the foot of the mountains at the north of the valley of Kashmir as far as Ishmalabad.* The carboniferous series is, according to Capt. G. Austen, as follows, from the highest to the lowest. 1st Layers with goniatites more or less analogous to the ceratites of the Musckelhalk. These layers are the highest of the carboniferous formation. 2nd. Below is found a compact limestone poor in fossils; 3rd, argillaceous series; 4th, limestone rich in fossils, *Productus*, &c. 5th quartzite.

As early as 1850, Sir Roderick Murchison had shown me some of the fossils sent by Mr. Fleming, and I had identified the *P. Cora*, *costatus*, Flemingi, the *Athyris Roysii*, *Orthis crensistria*, &c. Quart. Journ. vol. 7, p. 39. At the same epoch Dr. Falconer and Major Vicary had announced the existence of palæozoic fossils in the mountains which separate British India from Kabul, as remarked by Sir R. Murchison, Quart. Journ. vol. VII. p. 38. In 1852, Mr. A. Fleming published his observations on the Salt Range in several letters addressed to Sir R. Murchison, Quart Journ. vol. IX. p. 189.

All the fossils collected by Mr. Fleming, Mr. Purdon, Captain G. Austen and Dr. Verchere belong to the carboniferous formation. Captain Strachey alone has proved the existence of more ancient rocks (in a palæontological point of view.)† He sent to London a series of fossils collected in the mountains, from 17 to 18000 feet above the sea, which separate Thibet from the British provinces of Kumaon and Garhwal. I have identified among these fossils some *Asaphus*,

* Capt. Gordon-Austen and myself visited the localities referred to in the geological notes, during a tour we made together in the autumn of 1863. We thought at one time of writing a memoir in collaboration, but having been sent to the extremes of India, we arranged our notes separately. A. M. V.

† In the present paper are figured a few Cystoids which are in all probability *Silurian*, see Pl. VIII. fig. 61 and 62.

Lychas, *Illœnus*, *Cheirurus*, *Orthoceras*, &c. all characteristic of the Lower Silurian. In the upper part of the beds Captain Strachey found goniatites, ceratites and even ammonites, which remind one much of the Trias. So far, therefore, two of the four great divisions of the Palæzoic formation have become well known in the Himalaya, viz. the Silurian and the Carboniferous. The Devonian will be found also, for we have received from a Missionary travelling in China three species of *Brachiopoda* characteristic of the Upper Devonian rocks, among others the *Terebratula Cuboides*. These fossils have been presented this year to the Académie de Sciences de Paris. Mr. Davidson has also figured and described, as received from China, *brachiopoda* which also are characteristic of the Devonian, among other the *Spirifer*, Verneuil. The discovery and determination of the Devonian in the Himalaya requires attention and research.

I have further to remark how great is the analogy between India and Russia; I have found in this last country most of the species which Mr. Verchere has found in the Himalaya. Russia, the Oural and the Altai, are connecting links between England and India.

In terminating this note, we wish to observe that if, according to Mr. Verchere, the coal measures, (which should be superior to the carboniferous limestone), are wanting in India, this want is one more resemblance with Russia, for in all the carboniferous zone which extends from Moscow to Archangel the carboniferous limestone is never covered in by coal measures. There has been a slow upheaving motion of the ground, which has raised the strata above the sea-level, without, however, otherwise disturbing them, at the epoch when in other countries, the coal was being deposited. It is in the south of Russia only (the Douetz), and in a few localities on the western slope of the Oural, that coal measure deposits are to be found.

(Signed) Ed. de Verneuil.

Paris, 21*st Nov.*, 1864.

APPENDIX.

FOSSILS.

Silurian.

Sphæronites sp. Pl. VIII. fig 5.

Perfectly globular ; covered with small rounded warts sharply defined. The whole shell, between the warts, is pierced with minute pores. No trace of plates ; no mouth nor stalk-scar visible.

Found in the rocky plains at the foot of the Masha Brum, Korakoram Chain.

Sphæronites sp. Pl. VIII. fig 6.

Proposed name of a new species : *S. Ryallii, Verch.*

Globular. Large warts well set apart and not very sharply defined. The whole shell is covered with pores. No mouth. A stalk-stem very conspicuous.

From the same locality as the preceding. Name proposed in honour of Mr. Ryall, Gt. Trig. Survey, who discovered the shell.

Sphæronites sp. Pl. IX. fig. 1.

Depressed. No warts or spines ; no plates or traces of plates, no stalk-scar. The whole surface pierced by minute pores.

Same locality.

Carboniferous.

Zeawan Beds.

Cephalopoda.

Nautilus Flemingianus, DeKon.

Journal, Geological Society, Vol. XIX. Part I, No. 73, p. 15. Pl. VIII. fig. 2. A fragment of this shell was found at Zeawan, Kashmir.

Nautilus Favranus, Verch., n. sp.

A very large globular Nautilus, eleven inches across the mouth. Perfectly smooth and inornate. Siphon large and central, formed by a series of dilatations, giving it a beaded appearance.

Rotta Roh in the Punjab.

Orthoceras sp.

Zowoor and Zeawan in Kashmir.

GASTEROPODA.

Macrocheilus Avellanoïdes, DeKon.

Journal, Geological Society, Vol. XIX. No. 73, p. 10. Pl. III fig. 4. Rotta Roh.

Dentalium Herculeum, DeKon.

Op. Cit. p. 8. Pl. IV. figs. 10, 11 & 12. Several specimens were found in the Rotta Roh, but none in Kashmir.

Trochus sp.

Some large specimens of Trochus, four inches across, were found at the Rotta Roh, Punjab.

LAMELLIBRANCHIATA.

Anomia Lawrenciana, DeKon.

Journal, Geological Society, Vol. XIX. p. 6. Pl. IV. figs. 7, 8 & 9. Found in the Rotta Roh, but not in Kashmir.

BRACHIOPODA.

Terebratula sacculus, Martin.

Journal, Geological Society, Vol. XXII. p. 40. Pl. II. fig. 1. Found at Zeawan Zowoor and Barus, Kashmir.

Remark. A few other species of true Terebratulæ were found in the Zeawan group of Carboniferous limestone, but I am unable to identify them at present.

Spirifer Vercheri, de Verneuil, new sp. Pl. I. figs. 1, 1*a*.

See M. de Vernueil's note.

Barus in Kashmir. It has been found in Spiti.

Spirifer striatus, Martin.

Journal, Geological Society, Vol. XVIII, No. 69, p. 28. Pl. I. figs. 9 and 10.

Several fragments were found at Zeawan and Zowoor, and complete specimens in the Rotta Roh.

Spirifer Moosakhelensis, David.

Op. Cit. p. 28. Pl. II. fig. 2.

This shell is extremely abundant at Zeawan, but was always found in fragments. It is also common at the Rotta Roh.

After comparing numerous specimens of the last two species, in various states of weathering, I must express my impression that the S. Moosakhelensis is only a variety of the S. striatus, in which the concentric laminæ (which do exist in the striatus) have become exaggerated. All stages of transition are to be observed in a moderately large series.

Spirifer Rajah, Strachey [*Syn. S. Keilhavii Buch ?*]

Paleont. of Niti, page 59.

Fragments found at Zeawan and Barus.

Spirifer, spec. nor. ? Pl. III. figs. 1 & 1*a*.

Hinge-line straight and much longer than the greatest width of the shell. Umbones prominent above the hinge-line ; hinge-area not seen. Six or seven irregular ribs radiate from the umbo to the margin in a wavy manner. Fine ornamental raised lines (coarser on the larger than on the smaller valve) radiate likewise in a wavy manner. Shell flat. It varies a great deal in shape and size, but is always very flat, so much so that it has somewhat the appearance of such shell as the *Strophomena grandis* of the Silurian. It may possibly be, like the precedent, a variety of the *S. Keilhavii.*

Found at Zeawan in Kashmir and at the Rotta Roh.

Spiriferina octoplicata (Sow.), var. Transversa (Verch.)

Pl. I. figs. 2, 2*a*, 2*b*, 2*c*, and 2*d*.

Specimens like *a*, are not common at all ; but fragments of the shell such as are represented at *b*, are innumerable in the brown shale of Zeawan. Found also in the limestone of Kafir Kote in the Rotta Roh, but it is there rare. This shell seems to vary wonderfully, from the narrow forms figured by Davidson, (Journal Geological Society, Vol. XVIII. Pl. I. figs. 11 and 14,) to the very transverse variety represented here.

Athyris sp. (Ath. subtilita. Hall), Pl. II. figs. 1 and 1*a*.

This species varies considerably, especially as to size, but is easily recognized by the overlapping of the upper edge of the lines of growth, so that the shell looks as if made up of several layers laid one over the other, like the many capes of a coachman's cloak.

Found at Zowoor in Kashmir, in lenticular beds where it appears to be gregarious. Also in the Rotta Roh and Salt Range.

Athyris Buddhista, Verch., n. sp. Pl. II. figs. 2, 2*a*, and 2*b*.

It has flat, expanded sides on each side of a well marked sinus of the larger valve and sharp fold of the lesser. The beak terminates in a point, occasionally pierced by a small foramen but generally imperforate. The spiral oral arms appear to fill nearly the whole of the shell, leaving only a small hour-glass-shaped space in the centre.

This shell varies a good deal, some specimens being much more transverse than others, some being very flat and others less so. It was a gregarious animal found now accumulated in lenticular beds.

Zeawan and Zowoor. The name proposed is derived from the first few specimens which were found having been discovered in blocks of stone of a Buddhist ruin.

Athyris sp. probably A. Royssii, (L'Eveillé) Pl. II. fig. 3-3.

Less transverse than the preceding and ornamented with fine and closely set concentric lines of growth strongly marked. Foramen generally obliterated. Imprints showing the fringe-like expansion round the margin are very common in the brown shale of Zeawan. The shell is abundant in all the localities where the Zeawan bed has been observed in Kashmir and the Punjab.

Remark. Several other species of Athyris were discovered at Zeawan, Zowoor and Barus, some having the general facies of our figs. 2 and 3 and being probably varieties of the *A. Royssii.* Others with the umbo-marginal diameter longer than the transverse and being probably narrow varieties of the *A. subtilita.* Others again have the general facies of the *T. Digona*, and others the carinated appearance of the *Ath. Navicula* (Sow).

Retzia radialis (Phill), var. grandicosta (Davids.)

Journal, Geological Society, Vol. XVIII. p. 28. Pl. I. fig. 5.

Very frequently met with at Zeawan and Zowoor, and also in the Rotta Roh.

Streptorynchus crenistria, Phill. var. robustus.

Op. cit. p. 30. Pl. I. fig. 16.

This shell attains a very large size in Kashmir and in the Punjab, specimens five inches in tranvserse diameter not being rare. Fragments of this shell, and young shells, swarm at Zeawan and in some beds in the Rotta Roh.

Orthis resupinata, Martin.

Op. cit. page 31. Pl. I. fig. 15.

Abundant in the brown shale of Zeawan, Kashmir.

Orthis sp. Pl. III. fig. 3.

A cast of an Orthis belonging to the type of the *Orthis plicatulla*

(Hall) of the Silurian. It has six ribs, not very conspicuous, and two well-marked lines of growth; and is ornamented with fine radiating striæ. Only one specimen was found at Zeawan.

Remark. An immense number of small, or perhaps young, Orthisidæ occur in the ferruginous dark shale of Zeawan, in some places so abundantly that they cause the shale to exfoliate like a disintegrating mica-schist. The shells are, however, so thin and brittle that imprints alone can be procured.

Strophomena analoga (Phill.) ? Pl. II. fig. 4.

There is, I think, little doubt of this shell being Phillip's species. The shell is raised in irregular concentric furrows and ridges, and is ornamented by fine radiating striæ. Both valves are nearly flat; the umbones are hardly marked; the hinge is linear and nearly as long as the greatest diameter of the shell. These Indian specimens are very large, above four inches across.

Seldom found entire in Kashmir; but even pieces of it are conspicuous and easily recognized. Good specimens were obtained from the Rotta Roh in the Punjab.

Strophomena ? sp. Pl. III. fig. 2.

An internal cast only. Found at Zeawan in Kashmir.

Productus costatus (*Sow.*)

Journal, Geological Society, Vol. XVIII. p. 31. Pl. I. figs. 20, 21.

Numerous specimens of this well known species were found at Zeawan and Zowoor in Kashmir, and in the Rotta Roh and Salt Range.

Productus semireticulatus (*Martin.*)

Op. Cit. p. 21.

It varies considerably, some specimens being very transverse. The Kashmir and Punjab specimens are usually very large and often deformed by pressure.

Zeawan, Zowoor, Barus. Rotta Roh, Salt Range.

Productus cora (*d'Orbigny.*)

Found abundantly every where in the Zeawan group.

Productus Humboldtii (*D'Orb.*)

Journal, Geological Society, Vol. XVIII. p. 32. Pl. II. fig. 6.

Large specimens found at Zeawan and smaller ones at Barus. Also in the Salt Range and Rotta Roh, Punjab.

Productus Purdoni (Davids).

Op. Cit. p. 31. Pl. II. fig. 5.

Zeawan in Kashmir and Rotta Roh in the Punjab. In a series of specimens of *P. Humboldtii* and *P. Purdoni*, it is quite impossible to decide where one species ends and the other begins.

Productus Flemingii (*d'Orb.*)

Syn. *P. longispinus* (*de Vern*) *and P, lobatus* (*de Vern.*)

Journal, Geological Society, Vol. XVIII. p. 31. Pl. I. fig. 19.

Davidson's figure does not show the enrolled and horn-like ears so well defined in our specimens.

M. de Vernueil regards the Rotta Roh specimens as a well defined variety ; see his note.

Found at Zeawan and Zowoor and in the Rotta Roh.

Productus Boliviensis (*d'Orb.*) *and P. aculeatus ?* (*Martin*).

See M. de Vernueil's Note.

Found at Zowoor and Zeawan in Kashmir.

Strophalosia ? Arachnoïdea,) *Verch.*) *n. sp.* Pl. IV. figs. 1, 1*a*, 1*b*.

The specimen of the larger valve is from the Rotta Roh and the other two from Zeawan in Kashmir ; they may be different shells. The larger valve resembles the *Productus Purdoni*, but the spines are fewer, better defined and less slanting towards the margin. The other two specimens are remarkable for the excessive length of the thread-like spines and for some complications in the hinge.

Crustacea.

Eurypterus ? Limulus ? sp. Pl. V. fig. 4.

Claw of a Crustacean, belonging apparently to one or the other of the two genera above. It was found on a slab which had been worn by running water, so that a horizontal section of the claw is produced. The same slab was full of *Athyris Buddhista* (Verch.), *Productus Flemingii* (D'Orb.). *P. Aculeatus*, *Fenestella Sykesii* (deKön.) and *Vincularia Multangularis* (Patlock).

The tegument is smooth and pierced by pores, which are seen vertically sected on the margins of the claw, and appear like dots where the tegument is not worn off. The tegument forms septa in the upper mandibule, but none in the lower. The ends of the mandibules are hooked. There are no traces of teeth on the internal margin of the claw. No other part of the animal could be found.

Kashmir.

Remark. Another crustacean has been found abundantly in the Carboniferous of the Himalaya. It is a *Trilobite*, with the rings sharp and rib-like. Though common, it has not been found good enough for identification and figure.

Zeawan, Banda and Barus in Kashmir. Also Rotta Roh and Salt Range in the Punjab.

ECHINODERMATA.

Cidaris Forbesiana, (*deKön*).

Journal, Geological Society, Vol. XIX. No. 73, p. 4. Pl. IV. figs. 1 and 2.

Rotta Roh, but not in Kashmir. There are several species or varieties.

These cidarides will have, I think, to be made into a new genus when better known. They appear to have been borne on long thin branching stalks. The body has not been found yet, but I have found *hexagonal* plates with an articulation cup in the centre, spines four inches long, and stalks of considerable length.

Crinoid stems were found in enormous quantity in all the layers of the Zeawan bed. Sometimes the rock is nothing but a mass of rings pressed together. In the Rotta Roh I found a great number of an Encrinus, cup-shaped and nearly a foot in height, belonging apparently to a new genus. I cannot describe it at present. It supports a multitude of minute arms and fingers, the debris of which form a glaring-white rock, very conspicuous as one of the layers of the Zeawan bed in the Punjab.

BRYOZOA.

Tenestella Sykesii, (*deKon.*) Pl. IV. bis. figs. 1, *a. b. c. d.*

Journal I. Geological Society, Vol. XIX. p. 5. Pl. 1 fig. 1.

The colony forms a wavy leaf. The openings of the cells cover the whole surface of the longitudinal bars without assuming a linear arrangement ; the transverse bars are barren of cells. The cells are arranged in bundles imbedded in sockets of the support, so that a vertical section along one of the longitudinal bars shows a succession of little cups or sockets, in each of which are collected from six to eight elongated cells, disposed fan-like. The calcareous support between the sockets is massive.

This Bryozoon is extraordinarily abundant in the Zeawan bed. The colonies are often packed one over the other like dead leaves, and I have counted seven and eight colonies in a piece of shale not an inch thick.

Fenestella Megastoma, (*deKon*). Pl. IV. bis. fig. 2, *a. b. c. d.*

Op. Cit. Vol. XIX. p. 5. Pl. II. fig. 3.

The shape of the colony was not seen. The openings of the cells cover the longitudinal bars, without assuming a linear arrangement. The bars are rounded on the cell-bearing side and are angular on the barren surface. They are hollow or tubular, and the cells are arranged over the roof of the tube, like bricks in an arch, and are not connected in bundles and contained in sockets as in the Fen. Sykesii.

Fenestella, *sp.* Pl. V. fig. 1.

Shape of colony not seen, but generally very flat and wavy. The oscules, which are small, are somewhat quadrangular. It is found mostly as an imprint. Disposition of the cells not seen.

Very abundant at Zeawan, Zowoor, Banda, in Kashmir and also in the Rotta Roh.

Vincularia Multangularis, (*Portlock*) ? Pl. IV. bis., figs. 3, *a. b. c. d.*

See M. de Vernueil's note.

The colony has a moss-like appearance. The cells are arranged all round a calcareous support, and inclined forwards.

This Bryozoon is extremely abundant in the Zeawan bed, the branches extending in all directions but never anastomosing ; their division is nearly always dichotomous. I have seen colonies cover more than a square foot of rock with their ramifications.

Disteichia ? ? (*Sharpe*). Pl. V. fig. 2.

I am unable to refer it to any genus which I know, unless to the genus *Disteichia* (Sharpe). It is found at Zeawan, but is there rare ; in the Rotta Roh it is very common. The layers of cells accumulate one over the other to a great extent, forming occasionally large masses of Coralline rock.

Acanthocladia, *sp.* Pl. V. fig. 3.

The colony has the aspect of a fern. The central stem throws out branches at regular intervals, and at a certain fixed angle, and these branches throughout younger branches. Both stem and branches support short spines like leaflets. The disposition of the cells was not seen, as only imprints of this animal were found.

Found near Banda in Kashmir.

Phyllopora ? Cribellum (deKon).

Journal, Geological Society, Vol. XIX. p. 6. Pl. I. fig. 2.

Fragments are not scarce in the Rotta Roh, but it was not found in the Kashmir beds.

Retepora Lepida, (deKon).

Op. Cit. p. 6. Pl. I. fig. 5.

Several fragments found at Zeawan and in the Rotta Roh.

Remark. A few other species, not yet satisfactorily determined, were found in this group.

ANTHOZOA.

Lithostrotion Floriforme, (Flem.).

Beautiful specimens are to be obtained near Bilote in the Rotta Roh. Not found in Kashmir.

Lithostrotion Irregulare, (Phill.) ?

A Lithostrotion which is this species, or a very near ally, is very common in the Rotta Roh. The calyces are long, rounded, irregular cylinders, more or less vermiform in appearance and varying considerably in size in various specimens, but always of nearly the same size in each individual colony.

Very small fragments only were seen in Kashmir, but in the Rotta Roh colonies of this coral attain to great size, forming masses of rock several feet across, and many tons in weight.

Alveolites Septosa, (Flem.) ?

Journal Geological Society, Vol. XIX. p. 4. Pl. II. fig. 1.

It often forms shapeless masses, the centre of which is converted into flint.

Zeawan in Kashmir and Bilote in the Rotta Roh.

Michelina, sp.

Rotta Roh. Never found in Kashmir.

Remark. The abundance of corals in the lowest beds of the Zeawan division of the Carboniferous at the Rotta Roh is sometimes astonishing. In Kashmir they are rather scarce. We have a few specimens not yet determined.

PISCES.

Saurichthys ?

Teeth of fishes, large for the genus to which they appear to belong, were found in Kashmir and in the Rotta Roh. They are conical, but compressed so that the section is an oval ; they are strongly striated or rather grooved the whole length. The largest i about three quarters of an inch long.

Wean Beds.

CEPHALOPODA.

Goniatites Gangeticus, (*deKon.*)

Journal Geological Society, Vol. XIX. p. 14. Pl. V. fig. 2.

I had thought at first that this Goniatites was more like *G. Henslowii*, Sow. ; but better specimens, which I have since procured, leave little doubt that the species found was DeKoninck's shell. Some of the species from the Rotta Roh are much larger than DeKoninck's figure, and some are elliptical.

Found near Banda in Kashmir and near Gung and Oomurkhel in the Rotta Roh.

Goniatites Curvicostatus, (*Verch.*), *nov. sp. ?*

The species is well characterized by curved ribs, rather coarse and irregular. The suture is like that of the *G. Gangeticus*. Only one specimen, from near Gung ; not good enough to be figured.

Remark. Several indeterminable Goniatites were found near Banda, and at Barus in Kashmir.

Nautilus Clitellarius, (*Sow.*) *?*

Fragments very like this species were found near Gung. Two or three other species, indeterminable, were found in the Goniatite-bed in Kashmir and at the Rotta Roh.

Orthoceras, sp.

A small species, about two inches long and a third of an inch thick, was found in the limestone with *Goniatites Gangeticus* near Gung.

LAMELLIBRANCHIATA.

Solenopsis Imbricata, (*deKon.*)

Journal Geological Society, Vol. XIX. p. 8, Pl. IV. fig. 3.

Found at Koonmoo and in the hills near Mutton and at the Manus Bal, in Kashmir. Also in the Rotta Roh. Good specimens were procured from blocks not in situ, near Bij-Behara in Kashmir.

Solenopsis, sp. vel var. nov. Pl. VI. fig. 1. Similar to the preceding but longer; the anterior end is narrower than the posterior extremity, whilst in the *S. Imbricata* both ends are nearly equal. The imbrication of the lines of growth is strongly defined.

Found with the preceding.

Cardinia, sp. (*C. Himalayana, Verch. nov. sp.*) Pl. VI. fig. 2.—(*Anthracosia, King.*) ? ?

The lines of growth are deeply impressed and imbricated, and the shell bulges a little between these lines. The hinge was not seen.

Animals gregarious; their shells occur heaped together in patches.

Manus Bal, Koonmoo, Mutton ?, Rotta Roh.

Cardinia, sp. (*Cardinia Ovalis, Martin,*) Pl. VI. fig. 3.—(*Anthracosia King.*) ?

A species more elongated than the preceding. Lines of growth similarly disposed. Found with the preceding.

Cucullæa, sp. Pl. VI. fig. 4.

A gregarious small shell, sometimes so abundant that it forms masses of rock by itself. Lines of growth well defined, especially near the margin. Hinge not seen. It is perhaps the young of some larger shell.

Found at Wean, Koonmoo and Ishmalabad in Kashmir and in the Rotta Roh in the Punjab.

Pecten, sp. Pl. IV. fig. 5.

Small shell, perfectly smooth with the exception of a few lines of growth. It is ornamented with *painted* dark lines, which radiate from the beak to the circumference, increasing in width as they approach the margin. The convexity is very small, and the ears small.

Only one-valve specimens were ever found, through the shell is tolerably common in the reddish limestone of Koonmoo in Kashmir.

Found also in the Rotta Roh ?

Aviculo-pecten Dissmilis, (*Flem.*)

See M. de Vernueil's note.

This and the following Aviculo-pectens are apparently identical with the group of animals represented in England by the *A.-Pecten Arenaceus.* They were gregarious and all lived together, and are now found in a sandy somewhat friable limestone, in lenticular beds which are evidently the remains of sandbanks near the shore.

Our specimens of *A.-Pecten Dissimilis* are oval in shape, the umbo-marginal diameter being the longest. The shell was at first very gibbose, but after the second line of growth it is much less so. Four sunken lines of growth are well marked. Ears small and transversely striated. Shell nearly equilateral, beak prominent.

The cast shows two deep pits, corresponding on the inside of the shell to two tubercles. These pits are more than half way down the valve. The cast is covered with shallow irregular fossæ which correspond to small bosses inside the shell, and are probably due to the presence of pearly matter. There are traces of an epithelium.

Found at Koonmooh, Rotta Roh.

Aviculo-pecten, sp. (*A-pecten Ovatus, Verch.*) Pl. VI. fig. 6a, and 6b.

A small specimen, quite smooth. Outline elliptical; convexity trifling; ears meeting above the beak into a straight line.

The inside of the valve shows (*b*) two strong lateral ridges proceeding from the beak, and terminating about two-thirds down the valve in well defined tubercles. The hinge presents two short rounded ridges or teeth proceeding from the beak for about a quarter of an inch, when they also terminate in minute tubercles.

Aviculo-pecten, sp. (*A. pecten Ranus, Verch.,*) Pl. VI. fig. 7 and 7a.

Outline sub-circular ; shell very flat ; ears irregular. The whole valve is covered with fine radiate striæ, and with thin lines of growth. Shell thin. Internal cast not found. It is perhaps the *P. Crenisteria* (*de Koninck.*)

Aviculo-pecten Circularis, Verch., Pl. VII. fig. 1a. and 1b.

Outline of shell sub-circular, rather transverse. Shell moderately convex ; concentric striæ faintly seen. Lines of growth irregular and unconspicuous. The cast (*b*) presents two deep pits which are continued by a groove towards the beak, corresponding on the inside of the shell to two muscular tubercles and ridges. The ridge is much more defined posteriorly than anteriorly. Lines of growth strongly marked on the cast ? No pearl fossæ. It may be a variety of *P. Ellipticus* (Phill.) ? ?

Aviculo-pecten, sp. Pl. VII. fig. 2a & 2b.

Outline pyriform, umbo-marginal diameter the longest. Moderatly gibbose ; beak much incurved and somewhat imbedded in the ears, which meet above it in a straight line.

The cast only was found. It shows two strongly marked lines of growth well set apart. No pearl-fossæ on cast.

The inside of the shell, (*b*) shows two ridges proceeding from the beak but not terminating in tubercles (at least not on one side; the other side was not seen). Two small teeth in the hinge terminate by minute tubercles. Beak grooved by a canal or foramen. Inside of ears concave.

Aviculo-pecten Testudo, Verch. Pl. VII. fig. 3 and 3a.

Shell pyriform, umbo-marginal diameter longest. Extremely gibbose. Beak pointed; ears meeting above in a straight line. A few concentric striæ. Lines of growth unconspicuous, excepting one near the margin.

Aviculo-pecten Gibbosus Verch. Pl. VII. fig. 4 and 4a.

Outline sub-circular, transverse. Shell enormously gibbose, especially as far as the second line of growth. Shell inornate. Lines of growth shallow and confused. Ears meeting in a line above the beak. Shell thick.

Remark. These Aviculo-Pectens were found in Kashmir in the Wean groups only; but in the Rotta Roh they have been found here and there mixed with shells of the Zeawan group, such as *P. Semireticulatus*, *A. Subtilita.*

Axinus, nov. spec. conf. A. Obscurus.

See M. de Vernueil's note.

Found with the Aviculo-Pectens.

BRACHIOPODA.

Spiriferina Stracheyii, (*Salter.*)

Paleontology of Niti, page 72, Pl. IX. fig. 13.

This shell is not rare in the Wean group near Koonmooo; in some beds it swarms in company with a small Terebratula. We have two varieties, one like Mr. Salter's figure and another higher and narrower Some specimens show plainly to the naked eye the punctate structure of the shell.

POST-SCRIPTUM. *Productus Lævis*, (David.) T. Geol. Soc. Vol. XXII. p. 44, Pl. XI. fig. 16, and *Spirifera Barusiensis*, (David), Op. Cit. p. 42, Pl. XI. fig. 7.

Both these shells are found in the Wean limestone near Koonmoo, and at the Rottah Roh in the flaggy limestone with *Goniatites Gangeticus.* I have not found them in the Zeawan group, except at the Rotta Roh in the mixed beds.

Trias (Middle and Upper.)

Kothair Beds.

In the text I considered provisionally the Kothair group as either the uppermost layer of the Carboniferous, or else Permian or Triasic. I had no fossils then to decide the point. During the time which has elapsed between my first sending in this paper and its publication I have found, in breaking up some rocks from the Kothair bed in Kashmir, a Globosus with Ceratite-like sutures; and I have discovered in the Rottah Roh, in beds corresponding to the Kashmir bed, a few shells which do not leave a doubt of this group being Triasic.

Cephalopoda.

Ammonites, sp. conf. A. Gaytani (Klip.)

Paleont. of Niti, p. 65, Pl. TII. fig. 4.

Our specimen is a little more than half an inch across, and very globose. It shows well two or three of the sutures which are identical with Mr. Salter's figure.

From the Upper Bed, near Banda in Kashmir.

Ceratites Semi-partitus (Gaillardot.)

A very good and nearly complete specimen was found in the Rotta Roh, in a pale limestone which forms a high cliff above the much disturbed Carboniferous. The shell is slightly elliptical. The suture is exactly like that represented in Pictet's Traite de Paléontologie. It has some resemblance to M. de Konninck's *Ceratites Lyellianus* or more still to his *C. Lawrencianus*, but the suture differs. Cliffs above Kotela and Oomurkhel, Rotta Roh.

Remark. I have but little doubt that several of the Ceratites described by Mr. de Koninck (from Dr. A. Fleming's collection), as obtained from Carboniferous beds with Spirifers and Producti, had their situs in those cliffs or similar ones, and had dropped and become mixed with the much broken up and fragmentary rocks of the Zeawan and Wean groups below.

Ceratites Nodosus (Sow.) ?

On a slab of reddish calcareous sandstone from the Alged Wan, Rotta Roh, a shell, which has all the characters of this species, is to be seen in company with the Posidonomya to be hereafter described, with fragments of bone and what appears to be a tooth of Lepidotus (?)

Gasteropoda.

Natica, sp.

Like *N. Subglobulosa* (Kl.) Pal. Niti, p. 68, Pl. VIII. fig. 12.

Only sections and outlines were seen on the weathered surface of rocks. Very abundant in the upper beds at Banda and at Kothair in Kashmir.

Macrocheilus, sp.

Sections and outlines of a shell of this genus are very abundant at Sono Murg and Kothair.

Nerinæa, sp.?

Small shells with a raised spot in the centre of each half-whorl.

Pyramidella or *Loxonema?*

Several specimens of this fine Pyramidella were seen on the weathered surface of the sandy limestone of the patch of Kothair rock near Koonmoo.

Lamellibranchiata.

Posidonia conf. P. Minuta.

Minute shells of this genus, with well-marked concentric striæ, were found in the sandstone containing the *C. Nodosus.* Algerd Wan, Rotta Roh.

Outlines of small bivalves are very abundant on the weathered surface of the rocks at Sono Murg and Kothair, but the shells cannot be extracted.

Echinodermata.

Pentacrinites, sp.? Pl. VIII. fig. 1.

Starry rings of Encrinite stems are very abundant in most of the arenaceous limestone of the Wean groups, and also in the rocks of the Kothair groups at Sono Murg and Kothair in Kashmir.

Anthozoa.

Cyathophyllum, sp.

Abundant on the weathered surface of Kothair-rocks.

Cyathophyllum, sp.

Same remark as above.

Cyathophyllun, sp.

Generally found as figured at (*a*). Found as represented at (*b*) near Martand, Kashmir.

Remark. Several small species of corals were seen in the Kothair limestone in Kashmir, but in a very bad state of preservation.

LIAS (LOWER.)

CEPHALOPODA.

Ammonites Tubar (*Strachey.*)

Pl. Niti, p. 32, Pl 20 fig. 2 a—c and Pl. 21 figs. 1 a—c.

Three good specimens of this shell showing well all the characters and the suture, as represented by Mr. Blanford.

From a muddy and sandy brown bed, very sparingly calcareous, in the Chichali pass near Kalabagh, Punjab.

Ammonites, sp.

Pal. Niti, Pl. 19 fig. 3 a, 6 and c.

The figure in the Palæontology of Niti is exactly like our shell; it is not described in the text and not named. It resembles a little the *A. Striatulus* (Sow.).—Found in the same bed as the preceding.

Belemnites, sp.

A coarse species when full-grown, with a well marked front sulcus, and often a back one also. The section is oval.

From the same bed as above in Chichali and from some brown sandstones under the Oolite at the foot of Sheikh Bodeen near Tora Obo.

POST-SCRIPTUM. I find this species described and figured by Mr. Stoliczka, (Sections across Himal., Mem. Geol. Surv. of India, Vol. V. Part 1, fig. 78, Pl. VIII. fig. 1-4,) under the name of *B. Bisulcatus* (Stol.) from the lower Lias of Spiti.

LAMELLIBRANCHIATA.

Gryphæa Arcuata (Lam.)

Some specimens, from the Chichali pass and the same bed as the Ammonites, belong certainly to this well-known species.

Astarte, sp.

A very circular Astarte from the same bed, Chichali.

OOLITE (OXFORDIAN).

CEPHALOPODA.

Ammonites Biplex, Sow.

Journal Asiat. Soc. No. 2, 1863, p. 129, Pl. II., fig. 5 and Pl. III. figs. 4 and 5.

Ammonites Strigilis, Blanford.

Op. Cit. p. 126, Pl. III figs. 1 and 1*a*.

Five fragments showing well the single ribs bending forwards.

Ammonites Triplicatus, Sow.

Pal. of Niti, p. 80, Pl. 13 fig. 1.

Ammonites Scriptus (Strachey).

Pal. of Niti, p. 81, Pl. 16, fig. 2.

Ammonites Guttatus (Strach.)

Op. Cit. p. 79, Pl. 13, fig. 2.

Ammonites Wallachii, (Gray.)

Op. Cit. p. 84, Pl. 15, fig. 1 and Pl. 19, figs. 1 and 2.

All these Ammonites are from the Inferior limestone bed of Shaikh Bodeen in the Punjab.

Belemnites Sulcatus, Miller.

Journal Asiat. Soc. p. 125, Pl. 1, fig. 1.

Very abundant in the Ammonite bed at Shaikh Bodeen. Rarer in the beds above.

Belemnites Canaliculatus, Sch.

This is perhaps a variety or a younger shell of the above. Found in the same beds.

Remark. One or two more species of Belemnities were found with the preceding at Shaikh Bodeen.

Gasteropoda.

Acteonina, sp.

In all beds, Shaikh Bodeen.

Turbo, sp. and Scoliostoma, sp.

Both in Ammonite-bed, Shaikh Bodeen.

Natica, sp.

Same locality.

Lamellibranchiata.

Pecten Arcuatus, Sow. ?

Not unlike *P. Comatus*, Munster, (Pal. Niti, Pl. 22, fig. 9). It is more strongly ribbed than Salter's figure of the *P. Comatus* and it is flatter, thus answering perfectly the description of the *P. Arcuatus.*

Ammonite-bed, Shaikh Bodeen.

Hinnites Tubulipora, Verch., n. sp.

Like *Spondylus Tuberculosus*, Goldf., but the ribs of our species are much coarser, fewer, and more foliated and the tubular spines are larger, more in number, and rather lamellar.

It is not rare in the Ammonite-bed, Shaikh Bodeen.

Homomya (Pholadomya) sp.

We have three species of *Pholadomya* without rays from Shaikh Bodeen.

Pholadomya (Ph. Semireticulata, Verch. nov. sp.) Pl. IX. fig. 2.

This pretty shell is mostly found as a cast. It is not rare in the Oxfordian bed and extends to the Corallian above.

Pholadomya (Ph. Quinque-costata, Verch., nov. sp.) Pl. IX. figs. 3 and 3a.

Ammonite bed, Shaikh Bodeen.

Plagiostoma sp. conf. P. Consobrina (D'Orb.)

Ammonite-bed, Shaikh Bodeen.

Ostrœa Gregarea, (Sow.)

Several specimens found near the Ammonite-bed, Shaikh Bodeen.

Ostrœa Marshii, (Sow.) ?

Same bed as above.

Ostrœa Flabelloides, (Desh.) ?

Fragments similar to Pal. of Niti, Pl. 22, fig. 1, found in the Ammonite-bed, Shaikh Bodeen.

Ostrœa conf. O. Deltoidea, (Sow.) ?

The only difference between our specimens and the figures of this species is that our *Ostrœa* have the muscular impression very strongly marked, forming a regular pit with a ridge round it.—From the same bed as the above.

Ostrœa like O. Nana, (Sow.)

In nearly all the beds, Shaikh Bodeen.

Ostrea sp.

A large flat circular oyster, very common in some of the lowest oolitic beds at Shaikh Bodeen.

BRACHIOPODA.

Terebratula Globata, Sow., Pl. IX. fig. 4.

Extremely abundant in the Ammonite-bed and in all the beds near it, at Shaikh Bodeen. It varies considerably.

POST-SCRIPTUM. The *T. Gregaria*, Suess, (Memoirs of Geol. Surv. of India, Vol. V. Part I. page 68, and *T. Tibetensis*, David, (Journ. Geol. Soc. Vol. XXII. p. 37, Pl. I. fig. 11—14, appear to be the same species.

Terebratula Bodeenensis, Verch., nov. sp. or *var.;* Pl. IX. figs. 6 and 6a.

It is very perfectly oval and varies but little in shape. It has, in most specimens, neither sinus or folds, and the line of junction of the valves forms a nearly perfect curve in front. In a few specimens there is a very trifling undulation of this line. The absence of sinus and fold distinguishes from the *T. Globata ;* it is also a smaller shell, but yet may be only a variety of it. Found with the above.

Terebratula Carinata, Lam.

Pal. of Niti, p. 99, Pl. 21. fig 5.

Our specimens are much more like the *T. Carinata* than the figure in Pal. of Niti. It varies considerably, but the shallow sinus is always well marked. Our specimens are larger than the Niti ones.

Shaikh Bodeen, with the other *Terebratulæ.*

Terebratula Numismalis, Lam.

Op. Cit. p. 99, Pl. 21, fig. 4.

Several specimens showing well the depressed aspect of the front of the greater valve, and the well-marked concentric lines of growth.

Ammonite-bed, Shaikh Bodeen.

Remark. Two or three specimens not yet identified were found in the same beds, together with a *Waldheimia* rather globular and of the type of *W. Impressa*, Bach, of the Oxford clay.

Rhynchonella, sp. (*R. Concinna, Sow.* ?) Pl. IX. figs. 5, 5a. and 5b.

See also Pal. of Niti, Pl. 21, fig. 8.

It has generally, but not always, the sinus better marked than in the Niti figure. Very common at Shaikh Bodeen in nearly all the beds.

Remark. Six other species of *Rhynchonella* have been found at Shaikh Bodeen, but are not yet satisfactorily determined.

Bryozoa.

Eschara Asiatica, Verch. n. sp. ?

A fenestella-like Eschara, appearing in large flat and undulated plates on the surface of the rocks. In the Ammonite-bed, Shaikh Bodeen.

Among the corals, a *Fungia* somewhat like the *Fungia Coronula*, Goldf., but too much worn to be identified, and a *Meandrina* like *M. vel Comoseris Vermicularis* (Edw and Haime), were found in the Ammonite bed at Shaikh Bodeen.

Oolite (Corallian.)

Cephalopoda.

Belemnites Canaliculatus, (Sch.)

Upper Bed, Shaikh Bodeen and Mari-on-Indus, Salt Range.

Gasteropoda.

Nerinœa conf. N. Goodhallii., *(Fitton.)*

Fragments and sections of this shell are very common in the upper beds at Shaikh Bodeen. The section of the whorls is precisely similar to the figure in Lyell's Elements, p. 304.

Lamellibranchiata.

Astarte Scalaria, (Roemer.) ? ? *vel A. Lamellosa*, (Roem.)——

An Astarte with lamellous concentric lines, referred to the species above from description only, as I have never seen a specimen or a figure of these species.

Upper beds, Shaikh Bodeen.

Anthozoa.

Thamnastrœa sp.

Upper bed, Shaikh Bodeen and near Palusseen, Wuziristan.

Thamnastrœa sp.

A minute species found with the preceding at Shaikh Bodeen.

Tsastrœa sp.

Much like the *T. Oblongata* (Edw. and Haime.)

Upper beds, Shaikh Bodeen.

Tsastrœa sp.

Another species from Mari-on-the-Indus.

Thecosmilia Annularis (Edw. and Haime.)

Upper bed, Shaikh Bodeen and Mari-on-Indus.

Meandrina sp.

Mari-on-Indus.

Eunomia sp.

Mari-on-Indus.

Rhizangia sp.

Mari-on-Indus.

Areacis sp.

Wuziristan.

Lobocœnia sp.

A very pretty, spreading specimen from Wuziristan.

Turbinolia sp. ?

From Palussen, Wuziristan.

ROCK SPECIMENS.

Pl. X. figs. 1 and 1a.

Amygdaloidal greenstone with gas-vents branching through the mass. Abundant in the Zebanwan in Kashmir. Found also amongst the rolled stones of the torrents which drain the Afghan mountains.

Pl. X. figs. 2 and 2a.

Trachyte with starry crystals of dull white albite for which I have proposed the name of *Soolimanite.* From the Tukht-i-Sulaiman in Kashmir.

EXPLANATION OF PLATES.

Pl. I.

Spirifer Vercheri, (de Verneuil), n. s. Natural size.

Spiriferina Octoplicata (Sow.) Var. *Transversa*, (Verch.), natural size.

Pl. II.

Athyris sp. (*A. Subtilita*, Hall,)—natural size.

Athyris Buddhista, (Verch.), nov. sp.—natural size.

Athyris, probably *A. Royssii*, (L'Eveillé)—natural size.

Strophomena Analoga, (Phill.) ?—half natural size.

Pl. III.

Spirifer sp. ? (Var. of *S. Keilhavii*, (Buch.) ?—natural size.

Strophomena sp. ?—natural size.

Orthis sp.—natural size.

Pl. IV.

Strophalosia ? Arachnoidea, (Verch.), n. sp.—natural size.

Fenestella Sykesii (DeKon).

Fenestella Megastoma (DeKon).

Vincularia Multangulari, (Portlock).

Pl. V.

Fenestella sp.—natural size.

Disteichia ? ? sp.—natural size.

Acanthocladia sp.—natural size.

Eurypterus vel Limulus ? sp.—natural size.

Pl. VI.

Solenopsis sp.—natural size.

Cardinia Himalayana, (Verch.), n. sp.—natural size.

Cardinia Ovalis, Martin), ?—natural size.

Cucullœa ? sp.—natural size.

Pecten sp.—natural size.

Aviculo-pecten sp. (*A. pecten Ovatus* Verch.)—natural size.

Aviculo-pecten sp. (*A pecten Planus*, Verch.)—natural size.

Pl. VII.

Aviculo-pecten Circularis, (Verch.)—natural size.

Aviculo-pecten sp.—natural size.

Aviculo-pecten Testudo, (Verch.)—natural size.

Aviculo-pecten Gibbosus, (Verch.)—natural size.

Pl. VIII.

Pentacrinite ? sp.—natural size.

Cyathophyllum sp.—natural size.

Cyathophyllum sp.—natural size.

Cyathophyllum sp.—natural size.

Sphœronites sp.—natural size.

Sphœronites Ryallii, (Verch.). nov. sp.—natural size.

Pl. IX.

Sphœronites sp.—natural size.

Pholadomya Sesquireticulata, (Verch.), nov. sp.—natural size.

Pholadomya Quinque-costata (Verch.), nov. sp. natural size.

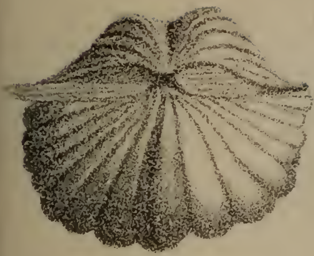
Terebratula Globata, (Sow.)—natural size.

Rhynchonella Concinna, (Sow.) ?—natural size.

Terebratula Bodeenensis, (Verch.), sp. vel var. nov.—natural size.

Amygdaloid with gas-vents—natural size.

Soolimanite.



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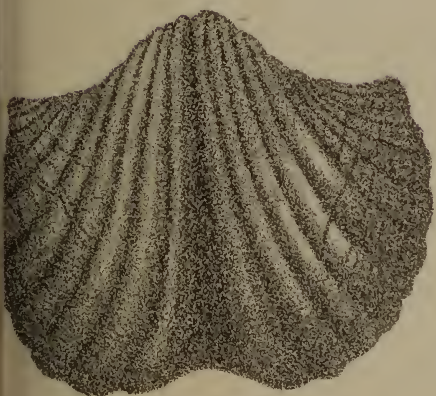

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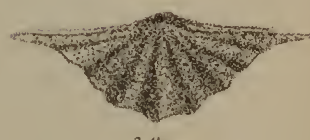

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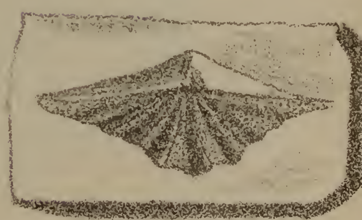

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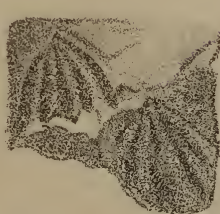

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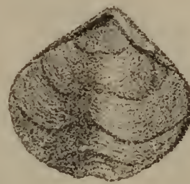

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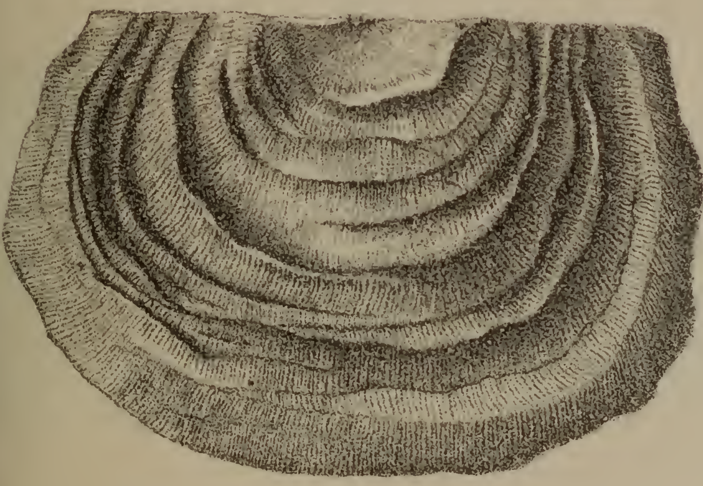

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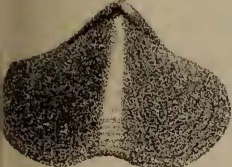

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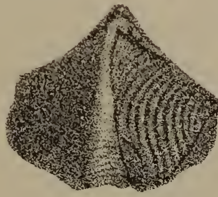

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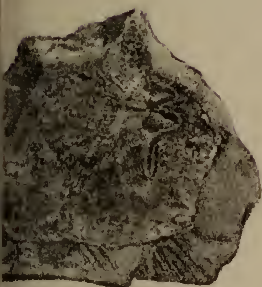

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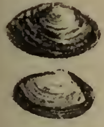

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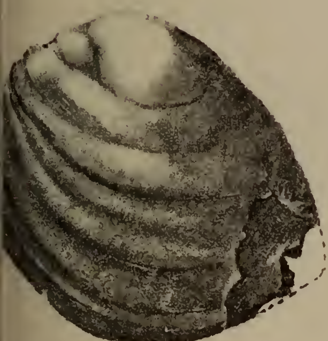

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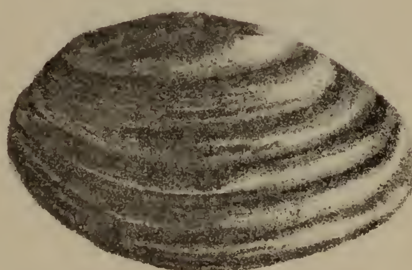
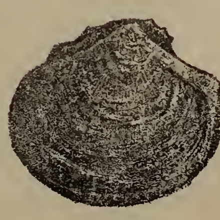


3

6.

6 a.



7.

7. a.

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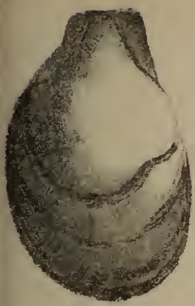
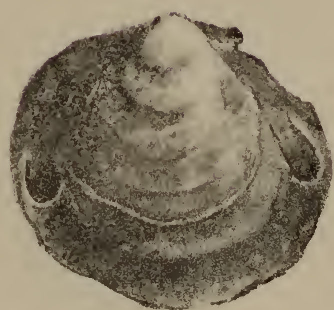


2

2. b

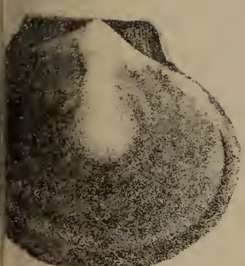
2 a

1



1 a

1 b



4

4 a

3.

3. a.

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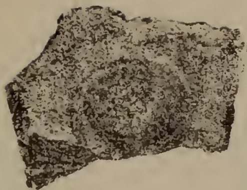
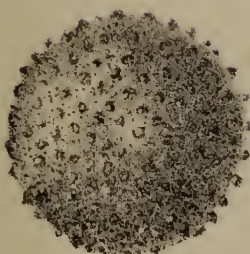
1



2

3



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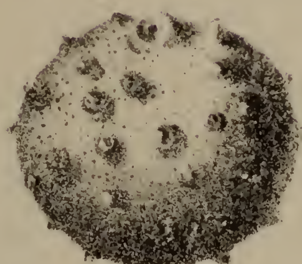

6.

4.

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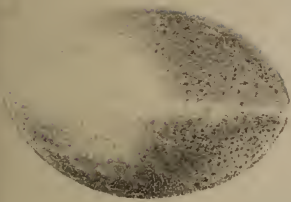
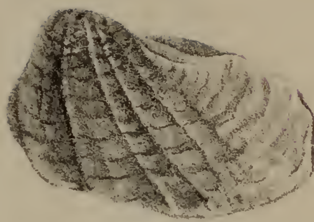
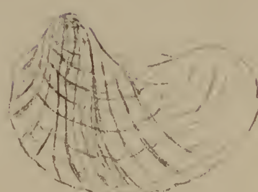




2.

4.

3



3 a

5.

5. a

5. b.

6

6. a

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2.

2 a.

1. a.

1.

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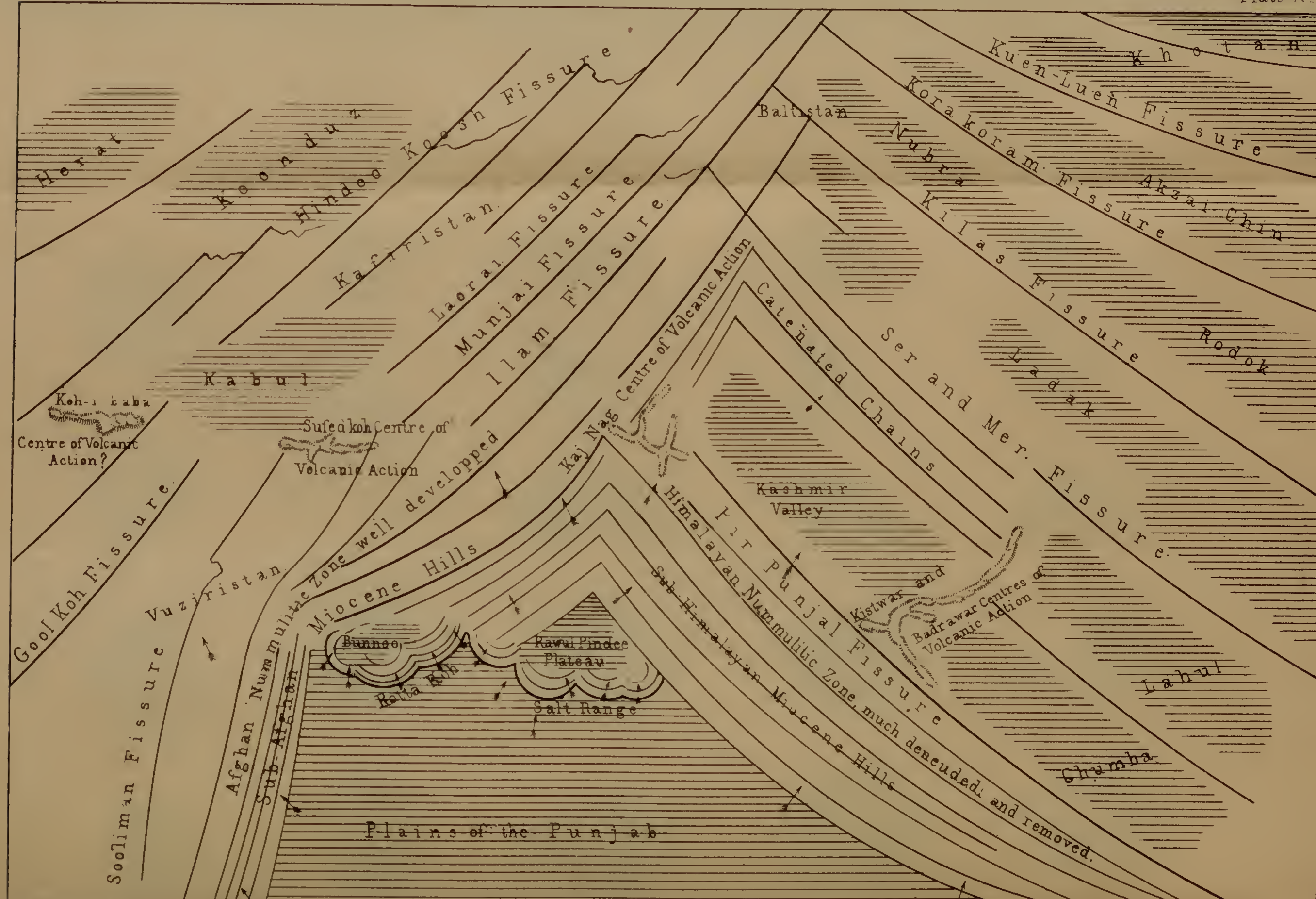
Printed at the Surv. General's Office Calcutta March 186

Plate XI.



On stone by Romanauth Dass

LITH AT THE SURVEYOR GENERAL'S OFFICE CALCUTTA JANY 1867

[illegible]

Fig. 1-12 Neritina [illegible] [illegible] [illegible] [illegible] [illegible] Less.
" 13 to [illegible] [illegible] Var. [illegible] [illegible] cornucopia, Les.
" 17-19 N. [illegible] lia) dep[illegible]

Irawady Shells, Plate II

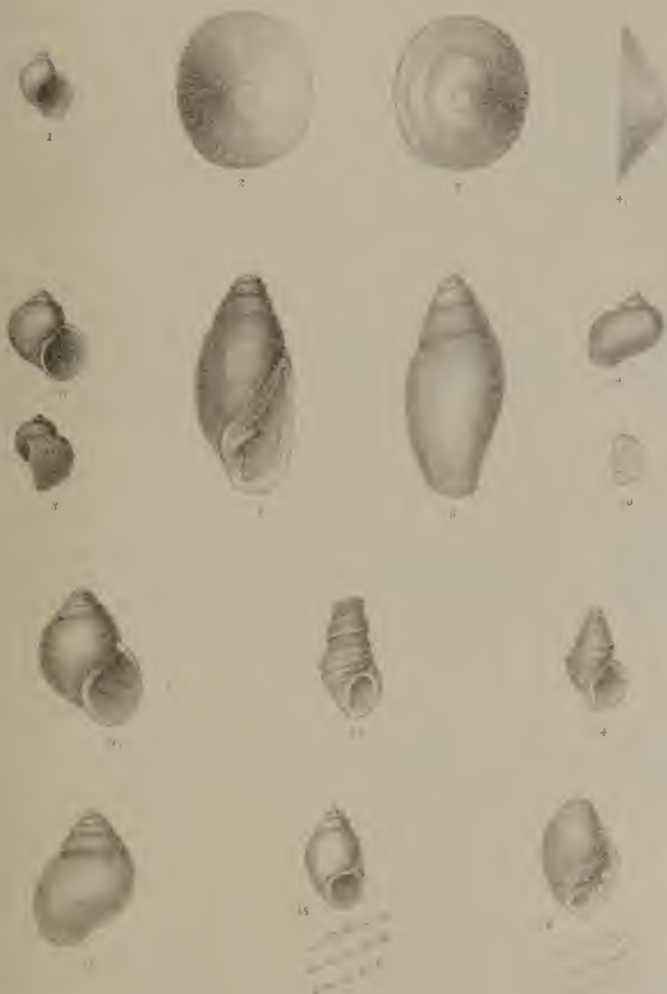


Fig. 1. Larina Burmana, W. Bl. nat. [illegible] 11, 12. [illegible] W. Bl. enlarged 3 diam.
„ 2–4. Tectura fluviatilis, W. Bl. Do. [illegible] W. Bl. [illegible]
5–6. Auricula nitidula, W. Bl. Do. [illegible]
7–10. Auriculella Burmana, W. Bl. Do. 16. [illegible] W. Bl. Do.

Irawady Shells, Plate III.

Fig. 1-3 Martesia fluminalis, W. Bl. enlarged 3 diams. Fig. 7-10, Scaphula deltæ, W. Bl. enlarged 2 diams.
„ 4, Sphenia perversa, W. Bl. adult, D°. „ 11-13, S. pinna, Bens, D°.
„ 5 6 D°. younger D°. „ 14-15, S. celox, Bens, D°.

INDEX TO PART II.

ERRATA in Dr. Verchere's Paper on the Geology of Kashmir and the Western Himalayas.

(Only those errors which change the meaning of a sentence, or render the name of a locality or fossil impossible to recognize, have been noticed here.)

PART II. 1866.

Page	*Line*	*For*	*Read*
92	9	fossil	theories.
100	8	quartz like rock crystals	quartz and rock crystals.
101	1	map	mass.
103	20	(Sect G).	The section is not given.
103	last	intricated	imbricated.
120	2	*Insert after* igneous rocks	and sedimentary rocks.
133	10	sp. nora	sp. nova.
162	12	Pl. VIII.	Pl. VI.
169	23	Fig. 3.	Fig. 2.
174	2	very similar to	viz. the.
185	33 & 37	Arkbal	Archibal.
186,1,9,12&c.		Arkbal	Archibal.

PART II. 1867.

Page	*Line*	*For*	*Read*
10	3	Aksai chain	Aksai chin.
10	31	Crossing	Cropping.
11	last	See Pl. IX.	Plate not given.
12	11	Bolircutes	Boliviensis.
17	4	a Neimas	a Nérinees.
17	4	Zena	Jura.
19	23	dirty	cherty.
21	20	The	No
21	22	...	*omit* round.
23	11	salpetre, of soda,	sulphate of soda.
23	14	Russian	Prussian.
23	29	disposition	deposition.
23	31	Charpentin	Charpentier.
24	note	Sketches	Selections.
24	25	elastic	volcanic.
29	7	Tummoo	Jummoo.
33	17	of	to.
45	29	vales	oases.
9	9	Verziristan	Waziristan.

Page	*Line*	*For*	*Read*
91	26	the other N. W.—S. E.	the other N. E.—S. W.
93	5	lignite	sienite.
93	25	N. W.—N. W.	N. W.—N. E.
95	10	long	large.
101	34	anticlinal dip, which	anticlinal dips which
105	25	salt	silt.
106	29	cows, of	bones of
114	1	Munee Range	Murree Range.
114	3	averted	arrested.
114	18	(not vertical)	(now vertical).
201	2	Faire	Favre.
203	15	...	add Pl. II. fig. 2, 2a & 2b.
203	25	...	add Pl. II. fig. 1 & 1a.
203	29	...	add Pl. II. fig. 3 & 3a.
204	43	...	add Pl I. fig. 1, 13 & 16.
204	20	...	add Pl. VI. fig. 3.
205	17	(sp. hova)	(sp. nova).
206	last	Pl. VIII. fig. 62 & 63	Pl. VIII. fig. 5 & 6 & Pl. IX. fig. 1
207	13	Verneuil	*Verneuilli.*
214	28	*Tenestella*	*Fenestella.*
214	28	...	Omit Pl. IV. bis fig. 1, *a, b, c, d,*
215	5	...	Omit Pl. IV. bis fig. 2, *a, b, c, d,*
215	19	...	Omit Pl. IV. bis fig. 3, *a, b, c, d,*
219	19	*Aviculo Pect Ranus*	*Aviculo Pecten Planus.*
219	27	*b*	(1a).
220	1	*b*	(2a).
222	30	...	add Pl. VIII. fig. 2.
222	32	...	add Pl. VIII. fig. 3.
222	34	...	add Pl. VIII. fig. 4, & 4a.
227,21,22,24		*Tsastrœa*	*Isastrœa.*
228,30,31,32		...	*Omit* Fenestella Sykesii.
		...	,, Fenestella megastoma.
		...	,, Vincularia Multangularis
229	28	...	*add* Pl. X.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of January 1867.

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the sea level, 18.11 feet.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer during the day.			Mean Dry Bulb Thermometer.	Range of the Temperature during the day.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	30.047	30.106	29.999	0.107	68.1	78.9	59.8	19.1
2	.103	.167	30.060	.107	68.6	78.4	60.0	18.4
3	.130	.195	.068	.127	69.3	79.8	61.3	18.5
4	.129	.209	.080	.129	68.8	78.2	60.6	17.6
5	.122	.198	.060	.138	68.3	77.9	60.2	17.7
6	.085	.159	.035	.124	69.8	79.5	61.8	17.7
7	.063	.141	.010	.131	70.3	80.2	62.4	17.8
8	29.997	.075	29.950	.125	67.2	73.0	63.6	9.4
9	30.039	.117	.969	.148	68.2	74.0	64.0	10.0
10	.134	.209	30.074	.135	67.0	75.6	59.0	16.6
11	.154	.248	.085	.163	66.3	75.0	58.0	17.0
12	.090	.158	.020	.138	65.0	72.6	58.4	14.2
13	.032	.104	29.959	.145	65.1	74.0	58.0	16.0
14	.012	.089	.958	.131	65.9	75.0	57.6	17.4
15	.033	.103	.977	.126	68.3	79.2	58.2	21.0
16	.013	.088	.952	.136	70.7	80.5	64.2	16.3
17	.013	.091	.964	.127	70.8	79.8	63.4	16.4
18	.049	.137	.993	.144	69.3	78.6	60.8	17.8
19	.077	.144	30.016	.128	70.1	80.0	63.0	17.0
20	.047	.130	29.971	.159	69.6	80.7	60.2	20.5
21	.006	.087	.945	.142	71.9	82.4	65.8	16.6
22	29.994	.069	.924	.145	72.2	83.2	63.0	20.2
23	.994	.033	.886	.147	74.3	82.8	67.0	15.8
24	.938	.011	.889	.122	74.9	83.0	69.0	14.0
25	.958	.040	.910	.130	75.4	83.2	70.4	12.8
26	30.043	.114	.961	.153	70.8	76.2	66.6	9.6
27	.073	.153	30.021	.132	66.2	75.2	59.0	16.2
28	.081	.163	.027	.136	64.3	74.4	55.2	19.2
29	.036	.108	29.975	.133	65.7	77.0	56.0	21.0
30	.035	.127	.968	.159	67.9	79.5	57.6	21.9
31	.004	.103	.942	.161	70.2	81.3	60.2	21.1

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived, from the hourly observations, made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of January 1867.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	62.7	5.4	58.4	9.7	0.496	5.47	2.08	0.73
2	63.4	5.2	59.2	9.4	.509	.63	.04	.73
3	63.5	5.8	58.9	10.4	.504	.56	.27	.71
4	62.5	6.3	57.5	11.3	.481	.31	.40	.69
5	62.6	5.7	58.0	10.3	.489	.40	.20	.71
6	64.3	5.5	59.9	9.9	.521	.73	.22	.72
7	65.3	5.0	61.3	9.0	.546	6.01	.07	.74
8	64.8	2.4	62.9	4.3	.576	.38	0.97	.87
9	64.9	3.3	62.3	5.9	.565	.23	1·35	.82
10	62.1	4.9	58.2	8.8	.493	5.45	.85	.75
11	60.3	6.0	55.5	10.8	.450	4.99	2.16	.70
12	58.7	6.3	53.7	11.3	.423	.71	.16	.69
13	58.9	6.2	53.9	11.2	.426	.74	.15	.69
14	59.9	6.0	55.1	10.8	.444	.93	.13	.70
15	63.7	4.6	60.0	8.3	.523	5.78	1.82	.76
16	65.5	5.2	61.3	9.4	.546	6.01	2.17	.74
17	63.1	7.7	56.9	13.9	.472	5.17	3.03	.63
18	60.9	8.4	54.2	15.1	.431	4.74	.09	.61
19	63.1	7.0	57.5	12.6	.481	5.29	2.74	.66
20	62.4	7.2	56.6	13.0	.467	.14	.76	.65
21	66.7	5.2	62.5	9.4	.568	6.24	.24	.74
22	64.6	7.6	58.5	13.7	.498	5.44	3.11	.64
23	69.4	4.9	66.0	8.3	.638	6.97	2.15	.76
24	71.6	3.3	69.3	5.6	.711	7.74	1.54	.83
25	70.2	5.2	66.6	8.8	.651	.08	2.35	.75
26	63.0	7.8	56.8	14.0	.470	5.16	3.04	.63
27	58.3	7.9	52.0	14.2	.400	4.43	2.69	.62
28	56.9	7.4	50.2	14.1	.376	.19	.53	.62
29	58.5	7.2	52.7	13.0	.409	.55	.47	.65
30	60.2	7.7	54.0	13.9	.428	.72	.79	.63
31	63.0	7.2	57.2	13.0	.476	5.23	.82	.65

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of January 1867.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer for each hour during the month.			Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Mid-night.	30.052	30.158	29.937	0.221	65.6	73.0	59.4	13.6
1	.042	.151	.922	.229	65.0	72.5	58.6	13.9
2	.034	.142	.913	.229	64.3	72.2	58.0	14.2
3	.026	.134	.906	.228	63.7	71.8	57.4	14.4
4	.020	.126	.899	.227	63.2	71.7	57.0	14.7
5	.031	.146	.912	.234	62.6	71.6	56.6	15.0
6	.047	.169	.928	.241	62.0	71.2	56.2	15.0
7	.069	.194	.943	.251	61.6	70.5	55.2	15.3
8	.092	.225	.968	.257	63.6	70.4	58.0	12.4
9	.116	.248	.989	.259	67.1	72.4	61.2	11.2
10	.124	.241	30.011	.230	70.4	75.5	66.1	9.4
11	.105	.217	29.990	.227	73.2	78.0	65.8	12.2
Noon.	.073	.173	.969	.204	75.3	80.0	67.9	12.1
1	.042	.134	.945	.189	76.6	81.4	68.0	13.4
2	.016	.110	.910	.200	77.7	82.9	71.8	11.1
3	.001	.093	.893	.200	78.3	83.2	72.6	10.6
4	29.996	.088	.886	.202	76.7	81.8	71.4	10.4
5	30.001	.103	.889	.214	75.2	81.0	70.0	11.0
6	.013	.126	.911	.215	72.8	79.0	68.0	11.0
7	.028	.134	.920	.214	70.8	78.2	66.2	12.0
8	.045	.163	.940	.223	69.4	76.4	63.4	13.0
9	.058	.166	.949	.217	68.3	75.4	62.8	12.6
10	.066	.173	.961	.212	67.3	74.4	61.8	12.6
11	.059	.162	.951	.211	66.4	73.6	61.0	12.6

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of January 1867.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
Mid-night.	62.0	3.6	59.1	6.5	0.508	5.63	1.37	0.80
1	61.5	3.5	58.7	6.3	.501	.57	.30	.81
2	61.1	3.2	58.2	6.1	.493	.48	.24	.82
3	60.6	3.1	57.8	5.9	.486	.41	.18	.82
4	60.3	2.9	57.7	5.5	.485	.39	.10	.83
5	59.8	2.8	57.3	5.3	.478	.34	.03	.84
6	59.5	2.5	57.2	4.8	.476	.32	0.93	.85
7	59.2	2.4	57.0	4.6	.473	.29	.88	.86
8	60.4	3.2	57.5	6.1	.481	.36	1.21	.82
9	62.1	5.0	58.1	9.0	.491	.43	.89	.74
10	63.7	6.7	58.3	12.1	.494	.43	2.67	.67
11	64.7	8.5	57.9	15.3	.488	.33	3.49	.60
Noon.	65.3	10.0	58.3	17.0	.494	.37	4.03	.57
1	65.7	10.9	58.1	18.5	.491	.32	.45	.55
2	65.9	11.8	57.6	20.1	.483	.22	.88	.52
3	65.9	12.4	57.2	21.1	.476	.14	5.14	.50
4	65.4	11.3	57.5	19.2	.481	.22	4.58	.53
5	65.4	9.8	58.5	16.7	.498	.41	3.96	.58
6	65.7	7.1	60.0	12.8	.523	.72	2.99	.66
7	65.3	5.5	60.9	9.9	.539	.92	.28	.72
8	64.5	4.9	60.6	8.8	.534	.87	1.99	.75
9	63.7	4.6	60.0	8.3	.523	.78	.82	.76
10	63.2	4.1	59.9	7.4	.521	.77	.60	.78
11	62.7	3.7	59.7	6.7	.518	.74	.43	.80

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta; in the month of January 1867.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage 1 ft. 2 in. above Ground.	Prevailing direction of the Wind.	Max. Pressure of Wind.	General aspect of the Sky.
	o	Inches		lb	
1	136.4	...	S. S. W. & S. S. E.		Clear.
2	137.0	...	S. S. W. & N. E.		Clear. Foggy from 8 to 11 P. M.
3	138.5	...	N. N. E. & E.		Clear. Foggy from 7 to 11 P. M.
4	137.0	...	E. N. E. & N. by W.		Clear. Slightly foggy at 6 to 7 P. M.
5	131.8	...	N. W. & N. N. E.		Chiefly clear. Slightly foggy from 8 to 11 P. M.
6	134.8	...	S. by E. & S. W.		Clear. Slightly foggy from midnight to 9 A. M.
7	139.0	...	S. by E. & S.		Clear to 11 A. M., scatd. _i to 6 P. M., clear afterwards. Foggy from 5 to 8 A. M. Lightning to W. at 11 P. M.
8	119·0	0.48	N. by W. & N. N. E.		Overcast to noon, scatd. \i to 6 P. M., clear afterwards. Rain at 3, 4, & 7 A. M., foggy at 7 & 8 P. M.
9	...	...	N. by W. & N. E.		Overcast to 8 A. M., scattered clouds to 5 P. M, clear afterwards. Foggy from 7 to 11 P. M.
10	137.0	...	N. N.E. & W.N.W.		Clear to 10 A. M, scatd. ⌒i to 3 P. M, clear afterwards. Slightly foggy at midnight & 1 A. M.
11	139.0	...	N.W. & N. N. W.		Chiefly clear.
12	130.4	...	N. N. W. & W. by N.		Clear.
13	129.2	...	W. by N. & W.		Clear. Foggy from 9 to 11 P. M.
14	135.0	...	W. & W. N. W.		Clear. Foggy from midnight to 4 A. M.
15	136.0	...	S. W.		Chiefly clear. Foggy from 5 to 7 A. M.
16	142.0	...	S. S. W. & N. W.		Clear to 9 A. M. scatd. \i to 5 P. M, clear afterwards. Foggy from 4 to 9 A. M. & from 7 to 11 P. M.
17	137.0	...	W. & N. W.		Clear. Slightly foggy from midnight to 6 A. M & from 8 to 11 P. M.
18	136.0	...	N. by W. & W. by S.		Chiefly clear. Slightly foggy at 7 & 8 P. M.
19	137.0	...	N.W. & S. by W.		Clouds of different kinds to 6 P. M, clear afterwards. Foggy from 4 to 8 A. M.
20	137.0		W. by S. & N.W.		Clear.
21	139.4		N. W. & variable.		Clear to 4 A. M, scatd. \i to 11 A. M., clear afterwards.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of January 1867.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage 1 ft. 2 in. above Ground.	Prevailing direction of the Wind.	Max. Pressure of Wind.	General aspect of the Sky.
	o	Inches		lb	
22	141.0	...	N. by E. & variable.	...	Clear to noon, scattd. clouds afterwards. Lightning to S. W. at 8 P. M. Slight rain at $3\frac{1}{2}$ P. M.
23	137.0	...	W. by S.		Clear. Foggy at 7 A. M. & at 9 & 10 P. M.
24	140.0	...	S. & S. W. & E.		Clear to 9 A. M, scattd. clouds afterwards. Slightly foggy from 1 to 9 A. M. & at 8 & 9 P. M.
25	141.0	0.01	N. N. W. & variable.		Light clouds to 8 A. M. \‿i to 6 P. M. Light clouds afterwards. Foggy from 1 to 3 A. M. Thin rain at 4 & 5 A. M.
26	123.0	0.06	N. E. & E. by S		Light clouds to 1 P. M, clear afterwards, Rain at 1 P. M.
27	134.0	...	N. N. W. & N. W.		Clear. Foggy at 10 & 11 P. M.
28	144.0	...	N. N. W. & N. W.		Clear.
29	136.0	...	N. W. & N. N. W.		Clear. Slightly foggy at 11 P. M.
30	138.0	...	N. W. & N. N. W.		Clear.
31	138.0	...	S. by W. & variable		Clear to 3 A. M., \‿i to 1 P. M., clear afterwards.

\i Cirri, —i Strati, ⌒i Cumuli, _i Cirro-strati, ⌒i Cumulo strati, \~i Nimbi, \⌒i Cirro-cumuli.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of January 1867.

MONTHLY RESULTS.

	Inches.
Mean height of the Barometer for the month...	30.048
Max. height of the Barometer occurred at 9 A.M. on the 11th ...	30.248
Min. height of the Barometer occurred at 4 P. M. on the 23rd ...	29.886
Extreme range of the Barometer during the month	0.362
Mean of the daily Max. Pressures	30.125
Ditto ditto Min. ditto	29.989
Mean daily range of the Barometer during the month	0.136

	o
Mean Dry Bulb Thermometer for the month	69.0
Max. Temperature occurred at 3 P. M. on the 1st 22nd & 25th ...	83.2
Min. Temperature occurred at 7 A. M. on the 28th	55.2
Extreme range of the Temperature during the month	28.0
Mean of the daily Max. Temperature	78.4
Ditto ditto Min. ditto, ...	61.4
Mean daily range of the Temperature during the month... ...	17.0

Mean Wet Bulb Thermometer for the month	63.1
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer	5.9
Computed Mean Dew-point for the month	58.4
Mean Dry Bulb Thermometer above computed mean Dew-point ...	10.6
	Inches.
Mean Elastic force of Vapour fo r the month	0.496

	Troy grain.
Mean Weight of Vapour for the month	5.46
Additional Weight of Vapour required for complete saturation ...	2.30
Mean degree of humidity for the month, complete saturation being unity	0.70

	Inches.
Rained 4 days,—Max. fall of rain during 24 hours	0.48
Total amount of rain during the month	0.55
Total amount of rain indicated by the Gauge attached to the anemometer during the month	0.53
Prevailing direction of the Wind... ... N. W. & N. by W.	

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of Jan. 1867.

MONTHLY RESULTS.

Tables shewing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour, when any particular wind was blowing, it rained.

No. of days

Hour.	N.	Rain on.	N. by E.	Rain on.	N. N. E.	Rain on.	N. E.	Rain on.	E. N. E.	Rain on.	E. by N.	Rain on.	E.	Rain on.	E. by S.	Rain on.	E. S. E.	Rain on.	S. E.	Rain on.	S. S. E.	Rain on.	S. by E.	Rain on.
Mid night	1		2				2						1		1						1		2	
1	1		2				2				1		2								1		2	
2	2				1		3				1		1				1				2		2	
3	2		2		1		1		1				2				1				1		3	
4	1		2		3	1	1		1				1						1				3	
5	2		2		4						1		1										2	
6			2		5						1		3										2	
7	1		1		5		1	1	1		1						1						1	
8	4		2		2		3		1						1		1		1					
9	2		1		6		4		2				1						2					
10			1		7		4		1				3				2		1		1			
11	1		1		2		3		1				4		1		2		2					
Noon.	2		1		4		2						3						2		1			
1	2				1		1		1				1		2						1			
2	2				3		1								1		1				3		1	
3	3				2				1				1								3			
4	1	1			2		1				2										1			
5							2		1				1				1							
6							2		2						1									
7							1				1				2									
8					1		1						1		1									
9					1		1								2				2					
10			1		2								2								1		1	
11			1		1		1		1				1						1				1	

Hour.	S.	Rain on.	S. by W.	Rain on.	S. S. W.	Rain on.	S. W.	Rain on.	W. S. W.	Rain on.	W. by S.	Rain on.	W.	Rain on.	W. by N.	Rain on.	W. N. W.	Rain on.	N. W.	Rain on.	N. N. W.	Rain on.	N. by W.	Rain on.
Mid night	2		1		3		2						2		2		2		4		1		1	
1	2		1		3		2				1		2		1		1		3		1		2	
2	1		1		4		2				1		2		1				2		2		1	
3	2	1	1		2		3						1		1						5		1	
4			1		2		2		1				1		1				2	1	4		2	
5			1		2		2						2		2	1	1		1		5		1	
6					1		2				1		2		1		3				5		2	
7					1		2				1		2		2		2				4		4	
8					1		2				1		2		2		1		1		2		4	
9	1				1		1				1		1		1				2		2		3	
10							1				1		1				1		3		1		3	
11							2				1		1				1		4		2		3	
Noon.	1		2				2		1				2				3		3		1		1	
1	3		1				2		2				1		1		2		7	1	2		1	
2							1		1		2		4				3		5		1		2	
3	2								2		1		3		1		2		7		2		1	
4	1		1		1		1				2		2				2		9		1		4	
5	2		1		1		1				2		3		2		2		6		3		3	
6	2		1		1		1				3		2		1		4		4		3		4	
7	2		1		1		2				3		1		2		2		6		3		4	
8	2		1		2		1				3		1		2		2		7		2		4	
9	1		1		3						2		1		2		2		8		2		3	
10	3				2						2		2		2		2		7		2		2	
11	3		1		3		1						2		2		2		6		1		3	

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of February 1867.

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the sea level, 18.11 feet.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer during the day.			Mean Dry Bulb Thermometer.	Range of the Temperature during the day.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	29.995	30.063	29.934	0.129	71.9	80.2	64.8	15.4
2	30.035	.098	.983	.115	69.3	78.0	61.4	16.6
3	.039	.121	.978	.143	68.9	80.0	55.8	24.2
4	.040	.118	.989	.129	70.1	81.0	60.4	20.6
5	.003	.109	.909	.200	71.6	83.4	60.8	22.6
6	29.955	.041	.902	.139	69.2	75.6	64.0	11.6
7	.982	.058	.932	.126	69.5	76.8	64.0	12.8
8	30.006	.085	.965	.120	69.2	78.6	60.4	18.2
9	.010	.091	.966	.125	71.2	80.6	62.6	18.0
10	29.962	.043	.884	.159	73.6	82.4	67.6	14.8
11	.910	29.979	.864	.115	75.5	84.6	70.0	14.6
12	.897	.977	.848	.129	74.4	83.8	66.0	17.8
13	.848	.908	.773	.135	75.3	81.6	71.2	10.4
14	.970	30.063	.888	.175	74.2	83.0	68.0	15.0
15	30.009	.096	.952	.144	71.3	81.6	62.2	19.4
16	29.963	.052	.889	.163	70.4	79.8	60.8	19.0
17	.921	.003	.856	.147	71.3	82.0	60.2	21.8
18	.918	29.995	.867	.128	73.2	84.8	63.0	21.8
19	.922	.998	.866	.132	76.2	86.6	69.0	17.6
20	.897	.964	.815	.149	78.8	88.4	72.8	15.6
21	.927	30.020	.859	.161	76.4	83.6	71.8	11.8
22	.985	.066	.940	.126	72.4	81.8	63.2	18.6
23	.968	.047	.889	.158	73.2	84.4	64.6	19.8
24	.989	.055	.928	.127	74.0	82.8	67.4	15.4
25	30.027	.105	.962	.143	74.2	84.0	65.0	19.0
26	29.973	.050	.893	.157	76.2	87.4	68.4	19.0
27	.940	.022	.891	.131	78.3	88.6	70.2	18.4
28	.945	.023	.871	.152	78.1	88.4	69.2	19.2

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived, from the hourly observations, made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of February 1867.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	66.4	5.5	62.0	9.9	0.559	6.13	2.35	0.72
2	60.4	8.9	53.3	16.0	.418	4.61	3.22	.59
3	60.9	8.0	54.5	14.4	.435	.80	2.94	.62
4	62.8	7.3	57.0	13.1	.473	5.20	.83	.65
5	64.3	7.3	58.5	13.1	.498	.45	.95	.65
6	64.9	4.3	61.5	7.7	.550	6.06	1.75	.78
7	65.0	4.5	61.4	8.1	.548	.04	.84	.77
8	63.7	5.5	59.3	9.9	.511	5.63	2.18	.72
9	65.6	5.6	61.1	10.1	.543	.96	·34	.72
10	68.6	5.0	65.1	8.5	.619	6.77	.16	.76
11	69.4	6.1	65.1	10.4	.619	.75	.71	.71
12	67.2	7.2	62.2	12.2	.563	.14	3.01	.67
13	71.9	3.4	69.5	5.8	.715	7.79	1.61	.83
14	65.7	8.5	59.7	14.5	.518	5.65	3.44	.62
15	62.0	9.3	54.6	16.7	.437	4.79	.54	.58
16	60.9	9.5	53.3	17.1	.418	.60	.50	.57
17	61.6	9.7	53.8	17.5	.425	.66	.67	.56
18	64.8	8.4	58.1	15.1	.491	5.36	.46	.61
19	71.6	4.6	68.4	7.8	.690	7.50	2.16	.78
20	73.4	5.4	69.6	9.2	.717	.76	.68	.74
21	69.5	6.9	64.7	11.7	.611	6.64	3.08	.68
22	62.1	10.3	53.9	18.5	.426	4.67	.93	.54
23	66.2	7.0	60.6	12.6	.534	5.82	.00	.66
24	65.8	8.2	60.1	13.9	.525	.73	.31	.63
25	64.7	9.5	58.0	16.2	.489	.33	.76	.59
26	70.3	5.9	66.2	10.0	.642	6.98	2.68	.73
27	68.9	9.4	62.3	16.0	.565	.11	4.17	.59
28	67.6	10.5	60.2	17.9	.527	5.70	.52	.56

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of February 1867.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer for each hour during the month. Max.	Min.	Diff.	Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month. Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Midnight.	29.969	30.047	29.863	0.184	69.1	74.8	64.7	10.1
1	.961	.033	.858	.175	68.7	75.0	63.4	11.6
2	.951	.027	.846	.181	68.1	74.6	62.8	11.8
3	.943	.025	.834	.191	67.4	74.0	62.4	11.6
4	.937	.023	.823	.200	66.7	73.2	60.0	13.2
5	.948	.030	.832	.198	66.1	72.8	59.6	13.2
6	.964	.050	.840	.210	65.6	73.0	59.2	13.8
7	.984	.068	.854	.214	65.4	72.8	55.8	17.0
8	30.007	.087	.878	.209	67.9	75.5	61.4	14.1
9	.033	.118	.905	.213	71.2	78.6	65.5	13.1
10	.044	.121	.908	.213	74.6	81.2	66.0	15.2
11	.033	.108	.896	.212	77.4	84.1	69.8	14.3
Noon.	.006	.078	.869	.209	79.5	85.4	72.6	12.8
1	29.974	.048	.836	.212	81.1	87.6	73.8	13.8
2	.944	.020	.809	.211	81.8	88.4	75.6	12.8
3	.922	29.999	.785	.214	82.5	88.4	74.7	13.7
4	.911	30.000	.773	.227	81.9	88.6	74.2	14.4
5	.911	29.998	.795	.203	80.6	87.8	74.0	13.8
6	.920	.993	.818	.175	77.6	83.5	72.0	11.5
7	.932	30.008	.826	.182	75.2	81.0	70.8	10.2
8	.954	.035	.855	.180	73.5	79.0	69.2	9.8
9	.970	.055	.871	.184	72.3	78.0	68.4	9.6
10	.980	.067	.874	.193	71.1	76.7	67.4	9.3
11	.974	.055	.873	.182	70.2	75.8	66.2	9.6

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of February 1867.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
Mid-night.	65.1	4.0	61.9	7.2	0.557	6.14	1.64	0.79
1	64.7	4.0	61.5	7.2	.550	.07	.62	.79
2	64.3	3.8	61.3	6.8	.546	.03	.52	.80
3	63.8	3.6	60.9	6.5	.539	5.96	.43	.81
4	63.4	3.3	60.8	5.9	.537	.95	.28	.82
5	63.0	3.1	60.5	5.6	.532	.90	.20	.83
6	62.6	3.0	60.2	5.4	.527	.85	.15	.84
7	62.5	2.9	60.2	5.2	.527	.85	.10	.84
8	63.8	4.1	60.5	7.4	.532	.89	.62	.78
9	65.1	6.1	60.2	11.0	.527	.78	2.52	.70
10	66.0	8.6	60.0	14.6	.523	.69	3.51	.62
11	67.0	10.4	59.7	17.7	.518	.61	4.40	.56
Noon.	67.5	12.0	59.1	20.4	.508	.48	5.18	.51
1	68.1	13.0	59.0	22.1	.506	.44	.73	.49
2	68.3	13.5	58.8	23.0	.503	.39	6.01	.47
3	68.3	14.2	58.4	24.1	.496	.31	.33	.46
4	68.4	13.5	58.9	23.0	.504	.41	.03	.47
5	68.1	12.5	59.3	21.3	.511	.50	5.51	.50
6	68.2	9.4	61.6	16.0	.552	.97	4.10	.59
7	68.1	7.1	63.1	12.1	.580	6.31	3.06	.67
8	67.3	6.2	63.0	10.5	.578	.31	2.59	.71
9	66.8	5.5	62.4	9.9	.567	.20	.38	.72
10	66.3	4.8	62.5	8.6	.568	.24	.04	.75
11	65.8	4.4	62.3	7.9	.565	.21	1.84	.77

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of February 1867.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage 1 ft. 2 in. above Ground.	Prevailing direction of the Wind.	Max. Pressure of Wind.	General aspect of the Sky.
	o	Inches		lb	
1	120.8	...	W. & variable.		Chiefly clear.
2	120.0	...	N. N. E. & N. W.		Clear.
3	122.0	...	N. E. & W.		Clear.
4	119.0	...	N. E. & E. S. E.		Clear.
5	121.0	...	N. N. E. & N. E.		Clear.
6	...	0.58			Clear to 5 A. M. Scattered \⌒i to 5 P. M. Overcast afterwards. Lightning at 9 & 10 P. M. Thunder at 10 P. M. Rain at 8½ A. M. 7½ & 10 P. M.
7	119.0	...			Scattered clouds to Noon. Clear afterwards.
8	119·8	...	E. by N.		Clear. Slightly foggy at 7 & 8 P. M.
9	121.4	...	E. N. E. & variable.		Clear.
10	123.8	...	S. S. E. & variable.		Scatd. \i & _i to 5 A. M., scattered \⌒i to 4 P. M, clear afterwards.
11	125.0	...	N. N. W. & N. W.		Clear to 5 A. M. Thin clouds to 8 A. M., clear afterwards. Slightly foggy at 8 & 9 P. M.
12	122.0	...	W .N. W. & N. E.		Clear. Slightly foggy at 7 & 8 P. M.
13	...	...	S. & W. S. W.		Clear to 4 A. M. Scatd. ⌒i to 8 P.M., clear afterwards. Foggy at 6 & 7 A. M.
14	124.0	...	NNE.&NE&N.byE.		Clear to 5 A. M., scattered \‾i to 9 A. M., clear afterwards.
15	123.6	...	N. N. E. &W. N. W.		Clear. Slightly foggy from 8 to 11 P. M.
16	120.8	...	W.N.W & variable.		Clear.
17	121.0	...	N.W. &W.		Clear. Slightly foggy at 7 P. M.
18	120.4	...	W. & S. S. W.		Clear.
19	120.0	...	S. W. & S. S. W.		Clear to 4 A. M. Thin clouds to 8 A. M., scatd. ⌒i to 4. P. M. Clear afterwards. Foggy from 6 to 9 A. M.
20	127.5	0.12	S. S. W. & S. byW.		Clear to 3 A. M., scattered ⌒i afterwards. Lightning at 7 & 10 P. M. Thunder at 10 P. M. Rain at 10½ P. M.
21	123.5	...	N. W.		\⌒i to 10 A. M. clear afterwards
22	120.0	...	N. E. & E. N. E.		Clear. Slightly foggy at 9 & 10 P. M.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of February 1867.

Solar Radiation, Weather. &c.

Date.	Max. Solar radiation.	Rain Guage 1 ft. 2 in. above Ground.	Prevailing direction of the Wind.	Max. Pressure of Wind.	General aspect of the Sky.
	o	Inches		lb	
23	122.5	0.12	Variable.	...	Clear to 1 P. M. clouds of different kinds afterwards. Lightning at 7 & 8 P. M.. Thunder at 8 P. M. Rain from 6½ to 8 P. M.
24	121.5	...	Variable.		Clouds of different kinds to 4 A. M., clear to 11 A. M. \i to 6 P. M., clear afterwards.
25	130.0	...	W. by N. & variable		Clear.
26	128.0	...	SW & S SW & WSW		Clear to 3 A. M. Thin clouds to 11 A. M., clear afterwards. Slightly foggy from 4 to 7 A. M.
27	130.0	...	W. S. W. & N. W.		Clear.
28	128.0	...	W.		Clear.

\i Cirri, —i Strati, ⌒i Cumuli, \—i Cirro-strati, ⌒—i Cumulo strati, \⌒—i Nimbi, \⌒i Cirro cumuli.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of February 1867.

MONTHLY RESULTS.

	Inches.
Mean height of the Barometer for the month...	29.966
Max. height of the Barometer occurred at 10 A. M. on the 3rd ...	30.121
Min. height of the Barometer occurred at 4 P. M. on the 13th ...	29.773
Extreme range of the Barometer during the month	0.348
Mean of the daily Max. Pressures	30.045
Ditto ditto Min. ditto	29.903
Mean daily range of the Barometer during the month	0.142

	o
Mean Dry Bulb Thermometer for the month	73.1
Max. Temperature occurred at 4 P. M. on the 27th	88.6
Min. Temperature occurred at 7 A. M. on the 3rd	55.8
Extreme range of the Temperature during the month	32.8
Mean of the daily Max. Temperature	82.6
Ditto ditto Min. ditto, ...	65.2
Mean daily range of the Temperature during the month... ...	17.4

Mean Wet Bulb Thermometer for the month	65.9
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer	7.2
Computed Mean Dew-point for the month	60.1
Mean Dry Bulb Thermometer above computed mean Dew-point ...	13.0
	Inches.
Mean Elastic force of Vapour for the month	0.525

	Troy grain.
Mean Weight of Vapour for the month	5.74
Additional Weight of Vapour required for complete saturation ...	3.05
Mean degree of humidity for the month, complete saturation being unity	0.65

	Inches.
Rained 3 days,—Max. fall of rain during 24 hours	0.58
Total amount of rain during the month	0.82
Total amount of rain indicated by the Gauge attached to the anemometer during the month	0.76
Prevailing direction of the Wind... ... N. N. W. & N. E.	

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of Feb. 1867.

MONTHLY RESULTS.

Tables shewing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour, when any particular wind was blowing, it rained.

Hour.	N.	Rain on.	N. by E.	Rain on.	N. N. E.	Rain on.	N. E.	Rain on.	E. N. E.	Rain on.	E. by N.	Rain on.	E.	Rain on.	E. by S.	Rain on.	E. S. E.	Rain on.	S. E.	Rain on.	S. S. E.	Rain on.	S. by E.	Rain on.	S.	Rain on.	S. by W.	Rain on.	S. S. W.	Rain on.	S. W.	Rain on.	W. S. W.	Rain on.	W. by S.	Rain on.	W.	Rain on.	W. by N.	Rain on.	W. N. W.	Rain on.	N. W.	Rain on.	N. N. W.	Rain on.	N. by W.	Rain on.
																					No. of days																											
Mid night			2		1		1				2								1		4				1		1		4		3		1						2				1					
1					3		2				1				1				2		3				1		1		1		5						1		2								1	
2			1		2		3		2				1						1		1		2		1		1		1		3						2		1				1		1			
3			2		3		4		1										1		1		2		2						1		2				2		1		1		1					
4	1		1		4		2		1												1		2						2		1		2				1						1		4			
5	1		1		2		2		1				1								2				2						2		2				1						2		3		1	
6	3		1		2		2		1						1						1		1		1						1		2		1		3						1		3		1	
7	2				4		2		2		1						1						2		1								2				3						1		4			
8					2		6		2		1		1				1						1		1		1				1		2				2						2		2			
9					2		3		3		4		1												1						4		1				1				1		2		2			
10					1		4		4		1								1						1				1		3		1				2						3		2		1	
11	1		1				6						1				1		1						1						4				2				2		1		2		2			
Noon.	2				5		1						1		1				2						1				1		1		2		1		3				1		3					
1					4		3				1								1										1		2				1		3		1		3		2		2		1	
2	1				1				1										1		2				1				2		1		2				2		1		4		3		3		1	
3					1		5		2																1				2				2		3				2		4		3		1			
4					1		1		1				1				2				1		1		1		1				1		1		1		1		2		3		4		1		1	
5							1		1		1				1		1				1				1		2		2		1						1		2		5		3		1		1	
6					1				1		1				1		1						1		2	1	1		3								2		2		5		4					
7					1				1		1						1										1		3		4	1			1		1		2		6		2		1			
8	1				1		1		1		1										1				2	1	2		3				2		1				1		5		1		2			
9					2		3		1		1		1								1				1		1		4		1		1				1		2		1		1		2			
10	1						3				2				1						2		1				1		5		3		1				1		1				1		1			
11			2		1		1		1		1						1		1		2		1		2				3		4		1				1						1					

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of March 1867.

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the sea level, 18.11 feet.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer during the day.			Mean Dry Bulb Thermometer.	Range of the Temperature during the day.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	29.889	29.971	29.809	0.162	78.7	90.0	70.0	20.0
2	.856	.913	.812	.101	81.0	90.4	73.6	16.8
3	.883	.945	.828	.117	81.4	94.2	73.4	20.8
4	.925	.995	.853	.142	81.2	92.0	73.2	18.8
5	.897	.983	.793	.190	80.8	92.0	72.6	19.4
6	.822	.898	.743	.155	79.6	89.0	72.8	16.2
7	.819	.898	.773	.125	80.9	90.0	73.6	16.4
8	.922	30.012	.833	.179	80.3	87.6	74.9	12.7
9	30.000	.080	.909	.171	79.6	89.0	73.6	15.4
10	29.994	.061	.923	.138	78.5	88.0	72.0	16.0
11	.955	.032	.884	.148	78.4	87.0	70.4	16.6
12	.935	.003	.865	.138	80.2	90.6	69.6	21.0
13	.891	29.954	.815	.139	80.4	88.8	74.0	14.8
14	.909	.969	.854	.115	81.8	91.7	74.4	17.3
15	.918	.990	.834	.156	82.0	92.8	73.0	19.8
16	.846	.925	.781	.144	81.1	92.4	71.4	21.0
17	.856	.927	.791	.136	83.4	91.0	71.4	19.6
18	.856	.941	.779	.162	81.4	91.4	75.0	16.4
19	.876	.957	.774	.183	80.5	92.6	73.0	19.6
20	.843	.921	.756	.165	79.2	88.2	72.4	15.8
21	.800	.858	.725	.133	80.8	90.8	72.8	18.0
22	.816	.897	.725	.172	82.4	92.0	73.8	18.2
23	.897	.983	.829	.154	80.3	90.0	73.6	16.4
24	.917	.979	.843	.136	79.3	88.9	74.2	14.7
25	.898	.975	.838	.137	78.3	85.8	71.9	13.9
26	.887	.961	.825	.136	81.0	90.4	72.2	18.2
27	.905	.957	.840	.117	79.9	91.2	71.8	19.4
28	.944	30.050	.876	.174	78.6	88.6	69.4	19.2
29	.960	.074	.899	.175	78.0	86.4	71.4	15.0
30	.921	.002	.855	.147	75.1	81.2	69.4	11.8
31	.867	29.963	.799	.164	78.5	89.4	68.6	20.8

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived, from the hourly observations, made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of March 1867.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	71.0	7.7	65.6	13.1	0.630	6.82	3.59	0.66
2	74.2	6.8	69.4	11.6	.713	7.67	.47	.69
3	73.0	8.4	67.1	14.3	.661	.12	4.15	.63
4	73.3	7.9	67.8	13.4	.677	.29	3.92	.65
5	71.7	9.1	65.3	15.5	.623	6.71	4.36	.61
6	72.7	6.9	67.9	11.7	.679	7.33	3.36	.69
7	73.4	7.5	68.1	12.8	.684	.35	.75	.66
8	70.9	9.4	64.3	16.0	.603	6.50	4.41	.60
9	74.2	5.4	70.4	9.2	.736	7.95	2·74	.74
10	72.1	6.4	67.6	10.9	.672	.28	3.07	.70
11	70.1	8.3	64.3	14.1	.603	6.53	.78	.63
12	71.7	8.5	65.7	14.5	.632	.81	4.07	.63
13	75.2	5.2	71.6	8.8	.766	8.25	2.69	.75
14	75.3	6.5	70.7	11.1	.744	.00	3.40	.70
15	73.8	8.2	68.1	13.9	.684	7.34	4.13	.64
16	71.8	9.3	65.3	15.8	.623	6.71	.46	.60
17	74.6	8.8	68.4	15.0	.690	7.39	.57	.62
18	73.8	7.6	68.5	12.9	.692	.45	3.82	.66
19	73.6	6.9	68.8	11.7	.699	.52	.46	.69
20	72.9	6.3	68.5	10.7	.692	.48	.08	.71
21	75.5	5.3	71.8	9.0	.771	8.30	2.77	.75
22	76.1	6.3	71.7	10.7	.768	.24	3.37	.71
23	74.1	6.2	69.8	10.5	.722	7.78	.13	.71
24	74.6	4.7	71.3	8.0	.758	8.20	2.39	.77
25	73.1	5.2	69.5	8.8	.715	7.74	.54	.75
26	72.9	8.1	67.2	13.8	.661	.14	4.00	.64
27	70.3	9.6	63.6	16.3	.590	6.36	.42	.59
28	69.5	9.1	63.1	15.5	.580	.26	.12	.60
29	69.6	8.4	63.7	14.3	.591	.41	3.78	.63
30	67.6	7.5	62.3	12.8	.565	.15	.19	.66
31	70.1	8.4	64.2	14.3	.601	.50	.85	.63

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of March 1867.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer for each hour during the month.			Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Mid-night.	29.901	30.003	29.806	0.197	75.8	78.8	71.4	7.4
1	.891	29.996	.800	.196	75.2	78.2	71.0	7.2
2	.882	.992	.794	.198	74.8	77.8	70.2	7.6
3	.873	.988	.783	.205	74.2	77.4	69.8	7.6
4	.869	.979	.775	.204	73.6	77.4	69.3	8.1
5	.880	.993	.792	.201	73.2	76.8	68.6	8.2
6	.896	30.007	.806	.201	72.8	76.6	68.7	7.9
7	.915	.025	.817	.208	73.3	78.2	69.5	8.7
8	.943	.054	.837	.217	76.2	81.8	71.0	10.8
9	.962	.078	.854	.224	79.0	84.6	74.2	10.4
10	.966	.080	.858	.222	82.1	86.6	78.0	8.6
11	.955	.067	.844	.223	84.6	89.2	78.8	10.1
Noon.	.931	.036	.830	.206	86.8	90.6	79.6	11.0
1	.899	.004	.795	.209	88.3	92.0	80.2	11.8
2	.868	29.969	.759	.210	89.0	93.4	81.2	12.2
3	.843	.942	.737	.205	89.6	94.0	81.2	12.8
4	.832	.923	.725	.198	89.3	94.2	79.9	14.3
5	.832	.931	.725	.206	87.4	92.2	75.0	17.2
6	.842	.938	.729	.209	84.0	88.2	76.0	12.2
7	.859	.969	.755	.214	81.7	86.0	75.4	10.6
8	.881	30.031	.777	.254	79.5	84.2	73.6	10.6
9	.904	.025	.798	.227	78.4	82.4	73.0	9.4
10	.916	.058	.821	.237	77.2	80.0	72.0	8.0
11	.907	.032	.815	.217	76.2	79.5	71.8	7.7

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of March 1867.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
Midnight.	71.9	3.9	69.2	6.6	0.708	7.70	1.84	0.81
1	71.8	3.4	69.4	5.8	.713	.77	.60	.83
2	71.5	3.3	69.2	5.6	.708	.72	.54	.83
3	71.3	2.9	69.3	4.9	.711	.75	.34	.85
4	71.0	2.6	69.2	4.4	.708	.75	.18	.87
5	70.7	2.5	68.7	4.5	.697	.61	.21	.86
6	70.4	2.4	68.5	4.3	.692	.59	.12	.87
7	70.6	2.7	68.4	4.9	.690	.54	.30	.85
8	71.9	4.3	68.9	7.3	.701	.63	2.03	.79
9	73.0	6.0	68.8	10.2	.699	.56	.94	.72
10	73.7	8.4	67.8	14.3	.677	.27	4.24	.63
11	73.9	10.7	66.4	18.2	.646	6.91	5.48	.56
Noon.	74.3	12.5	66.8	20.0	.655	.97	6.24	.53
1	74.6	13.7	66.4	21.9	.646	.85	.95	.50
2	74.6	14.4	66.0	23.0	.638	.75	7.33	.48
3	74.5	15.1	65.4	24.2	.626	.62	.71	.46
4	74.3	15.0	65.3	24.0	.623	.60	.61	.46
5	74.0	13.4	66.0	21.4	.638	.78	6.67	.50
6	73.5	10.5	66.1	17.9	.640	.84	5.33	.56
7	73.2	8.5	67.2	14.5	.664	7.13	4.24	.63
8	72.6	6.9	67.8	11.7	.677	.30	3.36	.69
9	72.5	5.9	68.4	10.0	.690	.47	2.84	.73
10	72.1	5.1	68.5	8.7	.692	.51	.44	.76
11	71.9	4.3	68.9	7.3	.701	.63	.03	.79

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of March 1867.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage 1 ft. 2 in. above Ground.	Prevailing direction of the Wind.	Max. Pressure of Wind.	General aspect of the Sky.
	o	Inches		lb	
1	128.0	...	S. S. W. & N. W.		Clear. Foggy from 4 to 8 A. M.
2	127.5	...	S. S. W. & variable.		Clear to 1. P. M. Scatd. \i to 6 P. M. Clear afterwards. Slightly foggy at 5 & 6 A. M.
3	130.0	...	S. S. W. & variable.		Clear.
4	131.0	...	S. & S. S. W.		Clear.
5	131.0	...	S. & S. S. W.		Clear to 5 A. M. Scatd. \i to 7 P. M., clear afterwards.
6	124.4	...	S. W. & S. by W.		Clear to 10 A. M. Scatd. \i afterwards. Lightning to N. at 9 P. M.
7	130.0	...	Variable.		Clear to 6 A. M. Scatd. \⌣i to noon. Scatd. \i to 5 P. M., clear afterwards.
8	127·0	...	W. by S. & E. by S.		Clear to 2 A. M. Scatd. \⌣i &\i to 5. M. P., clear afterwards.
9	131.0	0.10	S. S. E. & variable.		Clear to 5 P. M. Scatd. ⌒i to 5 P. M. Overcast afterwards. Lightning at 7,8 & 11 P. M. Thunder at 8 P. M. Light rain from 7 to 10 P. M.
10	129.5	...	N. W. & variable.		Clear to 2 A. M. Scatd. \⌣i to 8 P. M. Overcast afterwards. Lightning. Thunder, & slight rain at 9 & 10 P. M.
11	129.4	...	S. S. W. &W.S. W.		⌣i to 5 A. M. Scatd. \⌣i afterwards.
12	132.0	...	W. by S. & variable.		Clear to 11 A. M., clouds of different kinds afterwards.
13	122.0	...	S. by W. & S. S. W.		Scatd. ⌒i to 3 P. M. Scatd. \i to 6 P. M., clear afterwards. Slightly foggy at 6 & 7 A. M.
14	130.0	...	S. & S. S. W.		Scatd. ⌒i to 5 A. M. Scatd \⌣i to 10 A. M. Scatd. \i afterwards.
15	132.6	0.02	S. S. W.		Clear to 5 P. M. Overcast afterwards. High wind at 8 & 9 P. M. Slight rain at 9 P. M.
16	...	...	S. & W.		Clear nearly the whole day.
17	...	...	S.		Scatd. \⌣i to 3 A. M., clear afterwards.
18	...	...	S. & S. E.		Scatd. \i nearly the whole day.
19	...	...	S. & S. W.		Scatd. \i to 9 A. M. Clear to 3 P. M. ⌒i afterwards. Thunder at 6 & 7 P. M. Lightning from 6 to 8 P. M. Slight rain at 7 P. M.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of March 1867.

Solar Radiation. Weather, &c.

Date.	Max. Solar radiation.	Rain Guage 1 ft. 2 in. above Ground.	Prevailing direction of the Wind.	Max. Pressure of Wind.	General aspect of the Sky.
	o	Inches		lb	
20	...	0.01	S. S. E. & variable.	...	Overcast to 5 A. M. Scatd. ⌒i afterwards. Lightning to E at 9 P. M. Light rain at 2½ A. M. & 5½ P. M.
21	122.0	...	S. S. W. & variable.		Scatd \i to 4 A. M. Scatd. ⌒i afterwards.
22	137.5	0.14	S. S. E. & S. W.		Scatd. ⌒i to 5 P. M. Overcast afterwards. High wind at 8 & 11 P. M. Lightning at 7 & 8 P. M. Rain at 8, 10 & 11 P. M.
23	127.5	...	N. W. & S.		Thin clouds to 8 A. M. \⌒i to 5 P. M. Scatd. \i afterwards.
24	128.0	1.15	N. W. & N. N. E.		\i to 5 A. M. ⌒i & \⌒i to 7 P. M. ⌒—i afterwards. High wind. Lightning & Thunder at 4 P. M. Rain at 4 & 5 P. M.
25	122.5	...	N. W. & N.		Scatd. \i to 3 A. M. Overcast to 7 A. M. \⌒i to 5 P. M., clear afterwards.
26	132.0	...	S. W. & S. by W.		Clear to 6 A. M. Scatd. \i to 1 P. M. Scatd. \⌒i to 5 P. M., clear afterwards. Lightning to W. at 10 & 11 P. M.
27	127.5	0.15	Varriable.		Scatd. ⌒i to 5 A. M. Scatd \i to 2 P. M. Overcast afterwards. High wind from 8 to 11 P. M. Lightning from 1 to 3 A. M. & at 10 P. M. Thunder at 7 & 10 P. M. Rain from 5 to 7 P. M. & at 10 & 11 P. M.
28	124.5	...	W.N.W. & variable		Chiefly \i
29	119.6		N. & N. W.		Clear to 5 A. M. \⌒i to 5 P. M., clear afterwards.
30	119.6	...	N. N. W.		Clear to 5 A. M. Scatd. \i to 9 A. M. Overcast afterwards. Slight rain at 4 & 5 P. M.
31	123.0	...	S. & S. W.		Clear.

\i Cirri. —i Strati, ⌒i Cumuli, \—i Cirro-strati, ⌒—i Cumulo strati, ⌒—i Nimbi, \⌒i Cirro cumuli.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of March 1867.

Monthly Results.

	Inches.
Mean height of the Barometer for the month...	29.894
Max. height of the Barometer occurred at 10 A. M. on the 9th ...	30.080
Min. height of the Barometer occurred at 4 & 5 P. M. on the 21st & 22nd	29.725
Extreme range of the Barometer during the month	0.355
Mean of the daily Max. Pressures	29.970
Ditto ditto Min. ditto	29.821
Mean daily range of the Barometer during the month	0.149

	o
Mean Dry Bulb Thermometer for the month	80.1
Max. Temperature occurred at 4 P. M. on the 3rd	94.2
Min. Temperature occurred at 5 A. M. on the 31st	68.6
Extreme range of the Temperature during the month	25.6
Mean of the daily Max. Temperature	89.9
Ditto ditto Min. ditto, ...	72.5
Mean daily range of the Temperature during the month... ...	17.4

Mean Wet Bulb Thermometer for the month	72.7
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer	7.4
Computed Mean Dew-point for the month	67.5
Mean Dry Bulb Thermometer above computed mean Dew-point ...	12.6
	Inches.
Mean Elastic force of Vapour for the month	0.670

	Troy grain.
Mean Weight of Vapour for the month	7.23
Additional Weight of Vapour required for complete saturation ...	3.61
Mean degree of humidity for the month, complete saturation being unity	0.67

	Inches.
Rained 9 days,—Max. fall of rain during 24 hours	1.15
Total amount of rain during the month	1.57
Total amount of rain indicated by the Gauge attached to the anemometer during the month	1.36
Prevailing direction of the Wind...	S. & S. S. W.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of Feb. 1867.

MONTHLY RESULTS.

Tables shewing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour, when any particular wind was blowing, it rained.

No. of days

Hour.	N.	Rain on.	N. by E.	Rain on.	N. N. E.	Rain on.	N. E.	Rain on.	E. N. E.	Rain on.	E. by N.	Rain on.	E.	Rain on.	E. by S.	Rain on.	E. S. E.	Rain on.	S. E.	Rain on.	S. S. E.	Rain on.	S. by E.	Rain on.
Mid night							1												1		4			
1	1		1				1														4		1	
2	1		1						1										1		1			
3	1				1						1				1				1		2			
4	1														1		1		2		2		1	
5	2												1						3		3		1	
6	2						1						1				2	1	2		2		2	
7	2										1						2		2		2		2	
8	1		1		1						1								1		4		2	
9	1						1												1		1		1	
10	1						1		1												1		1	
11			1				1						1								1			
Noon.	2												2										1	
1					1		1		1		1		1								2			
2					1						1		1				1				1			
3	1		1												1		1				1			
4	2	1	1		1						1										3		1	
5	1				1	1									1				1		1			
6	2				2										1									
7	1						1								1				1					
8							1								1				1		1		1	
9	1	1	1												1						1		1	
10					1				1								1				1		3	
11					1												2				5	1	1	

Hour.	S.	Rain on.	S. by W.	Rain on.	S. S. W.	Rain on.	S. W.	Rain on.	W. S. W.	Rain on.	W. by S.	Rain on.	W.	Rain on.	W. by N.	Rain on.	W. N. W.	Rain on.	N. W.	Rain on.	N. N. W.	Rain on.	N. by W.	Rain on.
Mid night	7		1		4		4		1						1				2				1	
1	4		2		4		3						1				2		2		1			
2	3		2		5		5		3										4					
3	3		2		4		3		3						1				3		1			
4	3		1		5		2				1		1		1		1		3		1			
5	3		1		2		4				1						1		3		1			
6	4		1		2		4		2		1						1		3		1			
7	3		2		4		4		1		1		1				1		2		1			
8	5				3		5				1		2				1		2		1			
9	4				4		5		5				2						5				1	
10	5				3		4		4		4				1		1		2		1		1	
11	1		1		3		5		5		3		2		1				3		3			
Noon.	3				5		2		2		6		2		1				3				1	
1	1		1		4		8		1		3				1		1		3					
2	1				2		3		4		2		2		1		3		6		1			
3	3		1		2		1		5		2		1		2		2		4		3			
4	2		1		2		4		2		2		2		2				4	1	1			
5	3		2		2		6	1			3		3		2				5	1				
6	4		1		10	1	4	1	1		3								2					
7	5		4		6		4	2	4	1	1								2		1			
8	9		4		5				2				1		1		1	1	3	1				
9	12	2	2		5		2		2										1		1			
10	8	2	2		7		2	1											2		1	1		
11	8	1	3		3		2						1						1		1			

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of April 1867.

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the sea level, 18.11 feet.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer during the day.			Mean Dry Bulb Thermometer.	Range of the Temperature during the day.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	29.795	29.883	29.718	0.165	82.4	95.2	73.0	22.2
2	.743	.819	.674	.145	84.6	96.6	75.2	21.4
3	.727	.818	.650	.168	85.6	98.0	75.8	22.2
4	.725	.802	.670	.132	85.5	96.8	76.3	20.5
5	.702	.754	.639	.115	87.4	101.2	77.8	23.4
6	.746	.815	.698	.117	88.7	102.5	77.6	24.9
7	.769	.868	.706	.162	88.0	98.5	80.0	18.5
8	.770	.852	.710	.142	86.3	98.0	77.2	20.8
9	.797	.885	.723	.162	86.3	97.9	77.4	20.5
10	.815	.886	.726	.160	82.9	97.4	75.8	21.6
11	.802	.872	.720	.152	81.0	93.0	71.4	21.6
12	.846	.936	.778	.158	81.8	91.0	74.0	17.0
13	.895	.954	.810	.144	80.1	88.0	73.4	14.6
14	.799	.881	.696	.185	82.8	92.8	73.4	19.4
15	.769	.839	.712	.127	85.3	95.8	78.2	17.6
16	.803	.919	.740	.179	84.0	92.7	76.2	16.5
17	.898	.962	.829	.134	79.7	88.4	71.2	17.2
18	.895	.969	.821	.148	82.1	92.2	75.0	17.2
19	.852	.942	.760	.182	84.5	96.6	74.5	22.1
20	.787	.858	.714	.144	85.8	97.4	76.4	21.0
21	.742	.802	.698	.104	84.1	97.8	77.4	20.4
22	.786	.845	.694	.151	84.6	95.6	76.4	19.2
23	.821	.901	.749	.152	85.1	94.6	76.0	18.6
24	.777	.830	.675	.155	85.4	93.6	78.6	15.0
25	.771	.827	.694	.133	85.2	93.6	79.5	14.1
26	.851	.930	.756	.174	84.6	91.8	78.1	13.7
27	.847	.915	.767	.148	85.9	97.0	76.6	20.4
28	.780	.868	.706	.162	87.5	97.4	79.6	17.8
29	.748	.829	.668	.161	89.2	99.6	81.2	18.4
30	.734	.803	.657	.146	89.6	99.4	81.4	18.0

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived, from the hourly observations, made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of April 1867.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	74.2	8.2	68.5	13.9	0.692	7.44	4.17	0.64
2	74.6	10.0	67.6	17.0	.672	.19	5.20	.58
3	75.7	9.9	68.8	16.8	.699	.45	.31	.58
4	76.0	9.5	69.3	16.2	.711	.58	.14	.60
5	76.8	10.6	70.4	17.0	.736	.82	.63	.58
6	77.2	11.5	70.3	18.4	.734	.79	6.17	.56
7	75.6	12.4	68.2	19.8	.686	.28	.40	.53
8	73.2	13.1	64.0	22.3	.597	6.36	.66	.49
9	74.8	11.5	66.7	19.6	.653	.94	·08	.53
10	72.5	10.4	65.2	17.7	.621	.66	5.13	.57
11	73.7	7.3	68.6	12.4	.695	7.49	3.65	.67
12	75.0	6.8	70.2	11.6	.732	.86	.54	.69
13	73.6	6.5	69.0	11.1	.704	.59	.25	.70
14	74.7	8.1	69.0	13.8	.704	.54	4.21	.64
15	78.3	7.0	73.4	11.9	.811	8.66	3.98	.69
16	73.6	10.4	66.3	17.7	.644	6.89	5.28	.57
17	72.0	7.7	66.6	13.1	.651	7.02	3.70	.66
18	74.4	7.7	69.0	13.1	.704	.56	.95	.66
19	74.9	9.6	68.2	16.3	.686	.34	5.01	.59
20	75.4	10.4	68.1	17.7	.684	.28	.55	.57
21	75.2	8.9	69.0	15.1	.704	.53	4.68	.62
22	75.5	9.1	69.1	15.5	.706	.53	.86	.61
23	77.4	7.7	72.0	13.1	.776	8.28	.29	.66
24	79.0	6.4	74.5	10.9	.840	.98	3.70	.71
25	78.8	6.4	74.3	10.9	.835	.92	.69	.71
26	78.6	6.0	74.4	10.2	.838	.97	.42	.72
27	78.4	7.5	73.1	12.8	.803	.56	4.31	.67
28	79.5	8.0	74.7	12.8	.846	.99	.50	.67
29	79.8	9.4	74.2	15.0	.832	.82	5.34	.62
30	80.7	8.9	75.4	14.2	.865	9.17	.16	.64

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of April 1867.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer for each hour during the month.			Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Mid-night.	29.802	29.949	29.721	0.228	79.6	84.6	74.6	10.0
1	.793	.939	.711	.228	79.1	84.4	73.8	10.6
2	.781	.923	.705	.218	78.6	83.7	73.0	10.7
3	.774	.916	.687	.229	78.0	83.0	72.8	10.2
4	.769	.900	.675	.225	77.5	82.0	71.4	10.6
5	.783	.895	.680	.215	77.0	81.5	71.4	10.1
6	.801	.915	.709	.206	76.9	81.4	71.2	10.2
7	.824	.955	.718	.237	78.5	82.6	73.5	9.1
8	.847	.960	.741	.219	82.0	87.0	76.0	11.0
9	.862	.969	.749	.220	85.3	90.4	78.6	11.8
10	.864	.964	.754	.210	88.3	93.6	81.6	12.0
11	.854	.963	.748	.215	90.5	96.2	81.8	14.4
Noon.	.832	.954	.727	.227	92.6	98.3	83.5	14.8
1	.803	.923	.691	.232	94.2	100.4	86.4	14.0
2	.773	.892	.670	.222	95.1	102.0	87.4	14.6
3	.744	.860	.653	.207	95.0	102.5	86.6	15.9
4	.730	.835	.649	.186	93.8	102.0	87.4	14.6
5	.726	.829	.639	.190	91.2	100.6	79.0	21.6
6	.734	.838	.657	.181	88.4	96.8	77.4	19.4
7	.751	.854	.668	.186	86.2	92.6	78.8	13.8
8	.775	.873	.691	.182	84.0	89.9	77.0	12.9
9	.797	.900	.710	.190	82.7	88.6	76.6	12.0
10	.807	.930	.724	.206	81.6	86.0	75.8	10.2
11	.804	.936	.723	.213	80.6	85.4	75.8	9.6

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of April 1867.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
Midnight.	74.9	4.7	71.6	8.0	0.766	8.27	2.42	0.77
1	74.8	4.3	71.8	7.3	.771	.33	.20	.79
2	74.5	4.1	71.6	7.0	.766	.28	.10	.80
3	74.3	3.7	71.7	6.3	.768	.33	1.86	.82
4	74.2	3.3	71.9	5.6	.773	.38	.66	.84
5	74.0	3.0	71.9	5.1	.773	.40	.49	.85
6	73.9	3.0	71.8	5.1	.771	.37	.49	.85
7	74.7	3.8	72.0	6.5	.776	.38	.97	.81
8	76.0	6.0	71.8	10.2	.771	.28	3.19	.72
9	76.5	8.8	70.3	15.0	.734	7.84	4.80	.62
10	77.0	11.3	70.2	18.1	.732	.76	6.04	.56
11	77.0	13.5	68.9	21.6	.701	.40	7.32	.50
Noon.	77.2	15.4	68.0	24.6	.681	.16	8.47	.46
1	77.5	16.7	67.5	26.7	.670	.03	9.33	.43
2	77.6	17.5	67.1	28.0	.661	6.92	.87	.41
3	77.7	17.3	67.3	27.7	.666	.96	.78	.42
4	78.2	15.6	68.8	25.0	.699	7.33	8.85	.45
5	77.3	13.9	69.0	22.2	.706	.42	7.60	.49
6	76.9	11.5	70.0	18.4	.727	.71	6.13	.56
7	76.8	9.4	70.2	16.0	.732	.79	5.20	.60
8	76.2	7.8	70.7	13.3	.744	.97	4.20	.66
9	75.6	7.1	70.6	12.1	.741	.95	3.77	.68
10	75.4	6.2	71.1	10.5	.753	8.10	.24	.71
11	75.1	5.5	71.2	9.4	.756	.15	2.86	.74

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of April 1867.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage 1 ft. 2 in. above Ground.	Prevailing direction of the Wind.	Max. Pressure of Wind.	General aspect of the Sky.
	o	Inches		lb	
1	127.5	...	S. S. W. & S. W.	1.4	Clear.
2	129.0	...	S. by W. & S.S. W.	2.7	Chiefly clear. Lightning to S & S E at 8 P. M.
3	130.0	...	S. W. & S. S. E.	1.2	Clear.
4	134.8	...	S. S. E. & S. S. W.	1.4	Chiefly clear.
5	132.8	...	S. S. W. & S. S. E.	1.4	Clear.
6	134.0	...	N. W. & variable.	0.4	Chiefly clear.
7	134.0	...	W. & variable.	3.2	Clear to 7 A. M. Stratoni to 11 A. M. Scatd. \⌣i afterwards.
8	132·2	...	Variable.	2.7	Scatd \i to 6 A. M. Scatd. \⌣i afterwards.
9	132.5	...	S. W. & variable.	0.5	Clear to 4 A. M. Scatd. \i to 8 A. M. Scatd. \⌣i afterwads. Lightning to W. & N. at 9 & 10 P. M.
10	130.0	0.04	E. S. E. & variable.	22.0	Clear to 4 A. M. Stratoni to 4 P. M. Overcast afterwards, high wind & slight rain at 5 & 6 P. M. Thunder at 6 & 7 P. M. Lightning to S at 7 & 8 P. M.
11	125.0	0.05	S. S.W. & S. & S.S.E.	4.4	⌣i to 4 A. M., clear to 10 A. M. Scatd. ⌒i to 5 P. M. Overcast to 8 P. M., clear afterwards. Thunder, Lightning & slight rain at 6 & 7 P. M. High wind at $1\frac{3}{4}$ P. M.
12	126.0	...	S. E. & S. S. W.	2.6	Clear to 7 A. M. Scatd. \⌣i to 7 P. M. Overcast afterwards. Light rain at $4\frac{1}{2}$ & 9 P. M.
13	122.0	...	S. W. & variable.	0.2	\i to 6 A. M. Stratoni to 10 A. M. Scatd. \⌣i to 3 P. M. Scatd. ⌒i afterwards.
14	126.0	...	S. S. E. & N. W.	0.3	Clear to 9 A. M. Scatd. ⌒i to 5 P. M., clear afterwards.
15	126.0	...	S. W. & S.	1.4	Scuds from S to 8 A. M. Clouds of different kinds afterwards.
16	129.9	...	Variable.	5.3	Scatd. \i to 7 A. M. Scatd. \⌣i afterwards. High wind at $9\frac{1}{2}$ P. M.
17	125.0	0.13	S. W. & variable	10.0	Overcast to 6 A. M. Scatd. \⌣i to 5 P. M., clear afterwards. High wind at $2\frac{1}{2}$ A. M. Rain at 1 & 3 A. M.
18	127.5	...	S. S. W. & S. W.	2.0	\⌣i nearly the whole day. Light rain at $6\frac{1}{2}$ P. M.
19	129.0	...	S. W. & W. S. W.	0.7	Clear nearly the whole day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of April 1867.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage 1 ft. 2 in. above Ground.	Prevailing direction of the Wind.	Max. Pressure of Wind.	General aspect of the Sky.
	o	Inches		lb	
20	132.2		S. W. & W. N. W.	...	\⌒i to 2 A. M., clear to 10 A. M. Scatd. \⌒i to 7 P. M., clear afterwards. Light rain at 6 P. M.
21	130.5	0.05	S. W. & W. S. W.	6.8	Clear to 2 P. M., clouds of different kinds afterwards. High wind at 4½ P. M., Slight rain at 5 & 6 P. M.
22	125.0	...	Variable.	1.3	\⌒i to 4 A. M., clear to 3 P. M. ⌒i afterwards. Lightning to N. E. from 7 to 9 P. M.
23	128.0	...	S. S. E. & S. E.	0.4	Scatd. \⌒i to 6 A. M. Scatd. ⌒i to 7 P. M., clear afterwards. Light rain at 5½ P. M.
24	126.0	...	S. & S. W.	3.9	Chiefly clear. High wind & Lightning at 8 & 9 P. M.
25	135.0	...	S. W. & S.	4.0	Clear to 4 A. M. Scatd. \⌒i to 2 P. M. \⌒-i afterwards. High wind from 7½ to Noon & at 8 P. M. Thunder at 3 P. M. Lightning to W. at 8 P. M.
26	116.0	...	S. W.	4.0	Scatd. \⌒i & _i to 7 A. M. Stratoni to 4 P. M. \⌒i afterwards. High wind & Light rain at 9½ P. M.
27	130.0	...	S. by W. & S.	1.4	Chiefly clear.
28	130.4	...	S. W. & S. S. W	1.0	Clear to 6 A. M. Scatd. \i to 5 P. M., clear afterwards.
29	132.0	...	S. S. W. & variable.	1.0	Clear to 2 A. M. Scatd. \i to 10 A. M. Scatd. \⌒i to 7 P. M., clear afterwards.
30	130.0	...	S. S. W. & S. W.	0.9	\i to 1 P. M. Scatd. ⌒i to 6 P. M., clear afterwards.

/i Cirri, —i Strati, ⌒i Cumuli, _i Cirro-strati, ⌒-i Cumulo strati, \⌒-i Nimbi, ⌒\i Cirro cumuli.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of April 1867.

Monthly Results.

	Inches.
Mean height of the Barometer for the month...	29.793
Max. height of the Barometer occurred at 9 A. M. on the 18th ...	29.969
Min. height of the Barometer occurred at 5 P. M. on the 5th ...	29.639
Extreme range of the Barometer during the month	0.330
Mean of the daily Max. Pressures	29.869
Ditto ditto Min. ditto	29.719
Mean daily range of the Barometer during the month	0.150

	o
Mean Dry Bulb Thermometer for the month	84.9
Max. Temperature occurred at 3 P. M. on the 6th	102.5
Min. Temperature occurred at 6 A. M. on the 17th	71.2
Extreme range of the Temperature during the month	31.3
Mean of the daily Max. Temperature	95.7
Ditto ditto Min. ditto.	76.5
Mean daily range of the Temperature during the month... ...	19.2

Mean Wet Bulb Thermometer for the month	76.0
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer	8.9
Computed Mean Dew-point for the month	69.8
Mean Dry Bulb Thermometer above computed mean Dew-point ...	15.1
	Inches.
Mean Elastic force of Vapour for the month	0.722

	Troy grain.
Mean Weight of Vapour for the month	7.71
Additional Weight of Vapour required for complete saturation ...	4.78
Mean degree of humidity for the month, complete saturation being unity	0.62

	Inches.
Rained 10 days,—Max. fall of rain during 24 hours	0.13
Total amount of rain during the month	0.27
Total amount of rain indicated by the Gauge attached to the anemometer during the month	0.21
Prevailing direction of the Wind...	S. W. & S. S. W.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of April 1867.

MONTHLY RESULTS.

Tables shewing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour, when any particular wind was blowing, it rained.

No. of days

Hour.	N.	Rain on.	N. by E.	Rain on.	N. N. E.	Rain on.	N. E.	Rain on.	E. N. E.	Rain on.	E. by N.	Rain on.	E.	Rain on.	E. by S.	Rain on.	E. S. E.	Rain on.	S. E.	Rain on.	S. S. E.	Rain on.	S. by E.	Rain on.
Mid night					1				1		1								3		3		2	
1	1	1															2		3		2		1	
2													2				1		2		4		1	
3							1										1		1		5			
4							1										1		1		5		1	
5																	1		3		6		2	
6			1														1		4		4		1	
7															1		1		2				2	
8									1										1		2			
9													1											
10																			1				1	
11																							1	
Noon.																								
1																								
2							1																	
3													1						1				1	
4																			1		1		1	
5																			1		1			
6											1		1	1							1			
7	1	1											2								2		1	
8									1								2		1		4		1	
9													2						1		7		1	1
10																	1		1		8			
11					1		2												2		5		1	

Hour.	S.	Rain on.	S. by W.	Rain on.	S. S. W.	Rain on.	S. W.	Rain on.	W. S. W.	Rain on.	W. by S.	Rain on.	W.	Rain on.	W. by N.	Rain on.	W. N. W.	Rain on.	N. W.	Rain on.	N. N. W.	Rain on.	N. by W.	Rain on.
Mid night	6		2		6		5																	
1	6		1		8		5										1							
2	3		1		9		5				1				1									
3	4		2		5		8		1		1		1	1										
4	6		2		5		5		1		1													
5	2		2		5		6		1						1									
6			4		9		4		1		1													
7	6		1		4		9		3				1											
8	1		3		6		9		2		4						1							
9	2				9		8		3		1		3				1		2					
10	2		1		6		9		2		4				1		2		1					
11	2		1		5		10		1		2		1		2		3		2					
Noon.	2		1		3		8		2		3		3		5		2		1					
1	1				3		9		5		2		1		3		2		4					
2					4		10		1		5		2		1		2		4					
3	2				6		6		3				4		1		3		2					
4	6		1		3		8	1	3				4						2					
5	11	1			6		5						1				2		3	1				
6	4	1	1		10	1	5		1		1				1		2	1	1	1	1			
7	5		1		7	1	5		1				2				1		1	1	1			
8	5		2		5		5		1				2				1						1	
9	5				6		3		2	1					1		1							
10	4	1	1		5		5						1		1				1		2	1		
11	6		1		4		5		1				1		1									

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of May 1867.

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the sea level, 18.11 feet.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer during the day.			Mean Dry Bulb Thermometer.	Range of the Temperature during the day.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	29.735	29.803	29.649	0.154	88.3	99.8	78.3	21.5
2	.750	.834	.651	.183	88.2	99.0	80.8	18.2
3	.753	.834	.678	.156	87.6	99.0	78.0	21.0
4	.727	.802	.636	.166	89.6	100.6	82.2	18.4
5	.681	.746	.589	.157	90.2	103.9	81.0	22.9
6	.676	.740	.605	.135	89.0	100.2	81.0	19.2
7	.653	.717	.581	.136	88.4	97.4	81.0	16.4
8	.661	.737	.575	.162	88.9	97.6	81.2	16.4
9	.636	.692	.564	.128	88.0	96.0	82.2	13.8
10	.725	.825	.653	.172	87.3	95.0	80.8	14.2
11	.773	.838	.692	.146	81.7	94.5	76.6	17.9
12	.741	.802	.671	.131	76.9	79.3	76.0	3.3
13	.674	.729	.608	.121	78.2	86.4	72.5	13.9
14	.680	.732	.623	.109	81.5	90.0	74.6	15.4
15	.681	.745	.611	.134	85.6	94.0	77.4	16.6
16	.660	.720	.608	.112	83.4	88.4	80.2	8.2
17	.674	.729	.601	.128	86.1	96.4	77.8	18.6
18	.660	.715	.589	.126	89.5	101.0	81.2	19.8
19	.638	.719	.545	.174	88.8	99.2	80.0	19.2
20	.644	.696	.589	.107	89.2	98.8	81.0	17.8
21	.668	.730	.599	.131	89.3	98.6	82.6	16.0
22	.641	.701	.536	.168	87.7	98.4	81.0	17.4
23	.579	.632	.507	.125	87.6	95.4	81.2	14.2
24	.561	.613	.489	.124	90.0	99.0	83.0	16.0
25	.488	.541	.419	.122	91.5	99.0	86.0	13.0
26	.433	.481	.374	.107	92.5	102.2	86.0	16.2
27	.451	.511	.401	.110	92.5	106.0	85.5	20.5
28	.494	.552	.407	.145	62.2	103.8	86.0	17.8
29	.529	.585	.441	.144	91.6	100.7	85.4	15.3
30	.555	.614	.469	.145	89.5	99.2	81.0	18.2
31	.593	.642	.507	.135	88.4	101.6	81.2	20.4

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived, from the hourly observations, made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of May 1867.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	77.0	11.3	70.2	18.1	0.732	7.76	6.04	0.56
2	78.1	10.1	72.0	16.2	.776	8.23	5.53	.60
3	78.2	9.4	72.6	15.0	.790	.40	.12	.62
4	81.2	8.4	76.2	13.4	.887	9.41	4.92	.66
5	79.6	10.6	73.2	17.0	.806	8.52	6.07	.58
6	80.8	8.2	75.9	13.1	.879	9.32	4.76	.66
7	81.4	7.0	77.2	11.2	91.6	.73	.11	.70
8	80.4	7.6	75.8	12.2	.876	.31	.37	.68
9	81.7	6.3	77.9	10.1	.937	.96	3·72	.73
10	80.2	7.1	75.9	11.4	.879	.36	4.05	.70
11	74.4	7.3	69.3	12.4	.711	7.64	3.73	.67
12	73.7	3.2	71.5	5.4	.763	8.30	1.56	.84
13	74.5	3.7	71.9	6.3	.773	.38	.87	.82
14	76.6	4.9	73.2	8.3	.806	.68	2.63	.77
15	79.6	6.0	75.4	10.2	.865	9.24	3.52	.72
16	79.9	3.5	77.4	6.0	.922	.89	2.07	.83
17	79.2	6.9	74.4	11.7	.838	8.93	4.02	.68
18	79.9	9.6	74.1	15.4	.830	.80	5.49	.62
19	80.1	8.7	74.9	13.9	.851	9.02	4.98	.64
20	80.0	9.2	74.5	14.7	.840	8.90	5.26	.63
21	81.5	7.8	76.8	12.5	.905	9.57	4.64	.67
22	81.3	6.4	77.5	10.2	.925	.84	3.72	.73
23	81.5	6.1	77.8	9.8	.934	.93	.59	.73
24	83.3	6.7	79.3	10.7	.979	10.36	4.14	.71
25	86.0	5.5	82.7	8.8	1.090	11.51	3.64	.76
26	85.9	6.6	81.9	10.6	.063	.19	4.40	.72
27	85.4	7.1	81.1	11.4	.037	10.92	.67	.70
28	75.3	6.9	81.2	11.0	.040	.96	.49	.71
29	84.1	7.5	79.9	12.0	0.989	.43	.76	.69
30	81.8	7.7	77.2	12.3	.916	9.71	.58	.68
31	80.3	8.1	75.4	13.0	.865	.18	.66	.66

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of May 1867.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer for each hour during the month.			Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Mid-night.	29.650	29.802	29.435	0.367	83.0	87.8	76.0	11.8
1	.641	.785	.434	.351	82.7	87.6	75.4	12.2
2	.632	.761	.419	.342	82.2	87.4	74.5	12.9
3	.624	.758	.415	.343	81.9	87.2	73.6	13.6
4	.622	.760	.422	.338	81.7	86.8	72.6	14.2
5	.636	.770	.436	.334	81.3	86.6	72.5	14.1
6	.650	.775	.443	.332	81.3	86.6	73.0	13.6
7	.667	.793	.439	.354	82.5	87.3	73.6	13.7
8	.685	.820	.463	.357	85.5	89.8	74.0	15.8
9	.697	.834	.481	.353	88.1	93.0	74.3	18.7
10	.696	.831	.471	.360	90.6	96.2	75.7	20.5
11	.685	.822	.477	.345	92.7	98.7	77.0	21.7
Noon.	.670	.801	.462	.339	94.5	101.2	77.4	23.8
1	.646	.775	.440	.335	95.5	103.0	77.0	26.0
2	.619	.742	.414	.328	96.5	105.6	77.7	27.9
3	.594	.705	.398	.307	96.6	106.0	77.8	28.2
4	.572	.692	.380	.312	95.7	103.6	79.3	24.3
5	.570	.713	.375	.338	94.0	103.9	79.2	24.7
6	.589	.736	.374	.362	90.3	98.0	76.2	21.8
7	.606	.778	.393	.385	87.8	95.4	77.0	18.4
8	.627	.801	.415	.386	86.5	92.0	76.6	15.4
9	.648	.836	.433	.403	85.3	90.6	76.4	14.2
10	.659	.838	.450	.388	84.5	88.5	76.6	11.9
11	.655	.820	.443	.377	83.6	88.4	76.6	11.8

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of May 1867.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
Midnight.	79.1	3.9	76.4	6.6	0.893	9.58	2.24	0.81
1	78.9	3.8	76.2	6.5	.887	.52	.20	.81
2	78.9	3.3	76.6	5.6	.899	.65	1.89	.84
3	78.9	3.0	76.8	5.1	.905	.73	.71	.85
4	78.9	2.8	76.9	4.8	.908	.76	.61	.86
5	78.8	2.5	77.0	4.3	.910	.81	.43	.87
6	78.9	2.4	77.2	4.1	.916	.87	.37	.88
7	79.5	3.0	77.4	5.1	.922	.91	.73	.85
8	80.7	4.8	77.3	8.2	.919	.82	2.90	.77
9	81.2	6.9	77.1	11.0	.913	.70	4.02	.71
10	81.8	8.8	76.5	14.1	.896	.48	5.28	.64
11	81.8	10.9	75.3	17.4	.862	.08	6.60	.58
Noon.	82.0	12.5	74.5	20.0	.840	8.81	7.70	.53
1	82.3	13.2	74.4	21.1	.838	.77	8.22	.52
2	82.4	14.1	73.9	22.6	.824	.60	.88	.49
3	82.2	14.4	73.6	23.0	.817	.52	9.00	.49
4	82.1	13.6	73.9	21.8	.824	.61	8.47	.50
5	81.9	12.1	74.6	19.4	.843	.85	7.42	.54
6	80.8	9.5	75.1	15.2	.857	9.06	5.57	.62
7	80.2	7.6	75.6	12.2	.871	.25	4.35	.68
8	80.1	6.4	76.3	10.2	.890	.50	3.60	.73
9	79.6	5.7	75.6	9.7	.871	.29	.35	.74
10	79.6	4.9	76.2	8.3	.887	.51	2.84	.77
11	79.3	4.3	76.3	7.3	.890	.55	.48	.79

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of May 1867.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage 1 ft. 2 in. above Ground.	Prevailing direction of the Wind.	Max. Pressure of Wind.	General aspect of the Sky.
	o	Inches		lb	
1	133.5	...	S. S. W. & S. W.	0.5	Clear to 9 A. M. Scatd. \⌣i to 3 P. M. Stratoni afterwards. Lightning at 9 P. M.
2	129.4	...	S. W.	4.0	Clear to 5 A. M. Scatd. \⌣i to 5 P. M. Overcast afterwards. High wind at 6 P. M. Thunder & Lightning from 7 to 9 P. M. Slight rain at 9 P. M.
3	133.5	...	W. & S. W.	1.4	Clear to 5 A. M. Scatd. \⌣i to 7 P. M., clear afterwards.
4	132.0	...	S. S. W. & S. S. E.	1.2	Clear to 3 A. M. Scatd. \i to 1 P. M. \i & ⌒i afterwards. Slight rain at 4½ P. M.
5	133.7	...	S. W. & variable.	5.0	Clear to 1 P. M. Scatd. ⌒i to 6 P. M., clear afterwards. High wind at 5 P. M.
6	130.0	...	S. S. W. & S.	2.4	Clear nearly the whole day. High wind at 6½ P. M.
7	127.5	...	S. S. W. & S.	3.5	Scatd \i to 3 A. M. Clear to 7 P. M. Overcast afterwards. Lightning to N at 8 P. M. High wind & slight rain at 9½ P. M.
8	127·5	...	S. S. E. & S. S.W.	3.2	Overcast to 5 A. M. Scuds to 10 A. M., Clear to 5 P. M., Scatd. \⌣i afterwards.
9	127.8	...	S. S. E. & S. S. W.	4.6	Clear to 3 A. M. ⌒i & \⌣i afterwards. High wind from 8 to 11 A. M.
10	128.0	0.08	S. E. & S. W.	2.9	\⌣i nearly the whole day. Rain at 12¾ A. M.
11	...	...	S. S. E. & N. E.	4.8	Clear to 4 A. M. \⌣i to 10 A. M. ⌒i & \⌣_i to 4 P. M. Overcast afterwards. Thunder at noon, 1 & 5 P. M. Lightning at 1 & 7 P. M. Slight rain at 12¾ A. M. High wind at 12½ A. M.
12	...	0.04	S. E.	0.3	Stratoni to 7 A. M. Overcast afterwards. Light rain from 8 A. M. to 3 P. M. & at 10 & 11 P. M.
13	121.0	0.52	S. E. & variable.	...	Overcast to 10 A. M. Scatd. ⌒i afterwards. Rain from midnight to 4 A. M. & at 7 & 8 A. M.
14	124.0	...	N. N. W. & N. W.	...	Clouds of different kinds to 9 A. M. \⌣i &_i to 1 P. M. Scatd. ⌒i afterwards.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of May 1867.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage 1 ft. 2 in. above Ground.	Prevailing direction of the Wind.	Max. Pressure of Wind.	General aspect of the Sky.
	o	Inches		lb	
15	131.4	...	E. by N. & N. E.	0.2	Clear to 3 A. M. Stratoni to 7 A. M. Scatd. ⌒i afterwards
16	...	0.28	Variable.	3.9	Clear to 3 A. M. Scatd. ╲i to 7 A. M. ╲⌒—i to 5 P. M. Overcast afterwards. Rain & high wind at 11 A. M.
17	128.6	...	S. W. & S.	1.5	╲⌒i to noon. Scatd. ⌒i to 6 P. M. Clear afterwards.
18	133.0	...	S. W. & N. N. W.	0.2	Clear to 10 A. M. Scatd. ⌒i to 2 P. M., clear afterwards.
19	131.4	...	W. & S.	0.2	Clear to 7 A. M. Scatd. ⌒i to 5 P. M., clear afterwards.
20	131.0	...	W. by S. & E.S.E.	0.4	Clear to 10 A M. Scatd. ⌒i to 5 P. M. Scatd. ╲i afterwards.
21	137.8	...	S. by E. & S.	0.2	Scatd. ╲⌒i to 2 A.M. Clear to 6 A. M. Scatd. ⌒i to 5 P. M., clear afterwards.
22	...	0.45	S. S. E. & E. S. E.	6.5	Scatd. ╲⌒i to 3 P. M. ╲⌒—i afterwards. Thunder & Rain at 6 P. M. High wind at $5\frac{1}{2}$ P. M.
23	124.5	...	E. S. E. & E. N. E.	0.5	Stratoni to 7 A. M. Scatd. ⌒i to 2 P. M. Scatd. ╲i & ╲_i afterwards.
24	129.0	...	S. E. & S. S. E.	3.0	Stratoni to 2 A. M. ╲i to 11 A. M. Scatd. ⌒i to 6 P. M., clear afterwards.
25	129.5	...	S. S. W. & S.	1.7	Clear to 2 A. M. Scuds from S to 7 A. M. Scatd. clouds to 8 P. M. Clear afterwards.
26	131.0	...	S. & S. S. E.	2.8	Stratoni to 9 A. M. Scatd. ╲⌒i to 2 P. M. Scatd. ⌒i to 6 P. M. clear afterwards.
27	135.0	...	S. & S. S. E.	3.1	Scatd ╲⌒i to 8 AM. clear afterwards
28	133.0	...	S. S. E. & S.	2.5	Clear to 3 A. M. Scuds from S to 6 A. M. clear to 5 P. M. Stratoni afterwards.
29	131.0	...	S. S. E.	3.0	Stratoni nearly the whole day.
30	133.0	...	S. S. E. & S.	3.3	Scatd. ╲⌒i to 9 A. M. Scatd ⌒i afterwards. High wind at $6\frac{3}{4}$ P. M. Lightning to N at 7 & 8 P. M.
31	131.0	1.09	Variable	14.9	Clear to 7 A. M. Scatd. ⌒i to 5 P. M. Overcast to 8 P.M. Stratoni afterwards. High wind at 6 P. M. Rain from 6 to 8 P. M.

╲i Cirri, —i Strati, ⌒i Cumuli, ╲_i Cirro-strati, ⌒-i Cumulo strati, ╲⌒—i Nimbi, ╲⌒i Cirro cumuli.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of May 1867.

Monthly Results.

	Inches.
Mean height of the Barometer for the month...	29.639
Max. height of the Barometer occurred at 10 P. M. on the 11th ...	29.838
Min. height of the Barometer occurred at 6 P.M. on the 26th ...	29.374
Extreme range of the Barometer during the month	0.464
Mean of the daily Max. Pressures	29.702
Ditto ditto Min. ditto	29.563
Mean daily range of the Barometer during the month	0.139

	o
Mean Dry Bulb Thermometer for the month	87.7
Max. Temperature occurred at 3 P. M. on the 27th	106.0
Min. Temperature occurred at 5 A. M. on the 13th	72.5
Extreme range of the Temperature during the month	33.5
Mean of the daily Max. Temperature	97.4
Ditto ditto Min. ditto, ...	80.7
Mean daily range of the Temperature during the month... ...	16.7

Mean Wet Bulb Thermometer for the month	80.4
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer	7.3
Computed Mean Dew-point for the month	76.0
Mean Dry Bulb Thermometer above computed mean Dew-point ...	11.7
	Inches.
Mean Elastic force of Vapour for the month	0.882

	Troy grain.
Mean Weight of Vapour for the month	9.37
Additional Weight of Vapour required for complete saturation ...	4.19
Mean degree of humidity for the month, complete saturation being unity	0.69

	Inches.
Rained 10 days,—Max. fall of rain during 24 hours	1.09
Total amount of rain during the month	2.46
Total amount of rain indicated by the Gauge attached to the anemometer during the month	2.33
Prevailing direction of the Wind... ... S., S. S. E. & S. S. W.	

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of May 1867.

MONTHLY RESULTS.

Tables shewing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour, when any particular wind was blowing, it rained.

Hour.	N.	Rain on.	N. by E.	Rain on.	N. N. E.	Rain on.	N. E.	Rain on.	E. N. E.	Rain on.	E. by N.	Rain on.	E.	Rain on.	E. by S.	Rain on.	E. S. E.	Rain on.	S. E.	Rain on.	S. S. E.	Rain on.	S. by E.	Rain on.	S.	Rain on.	S. by W.	Rain on.	S. S. W.	Rain on.	S. W.	Rain on.	W. S. W.	Rain on.	W. by S.	Rain on.	W.	Rain on.	W. by N.	Rain on.	W. N. W.	Rain on.	N. W.	Rain on.	N. N. W.	Rain on.	N. by W.	Rain on.
																			No. of days																													
Mid night													1						7	1	4				8		2		1		4				1										1			
1									1								1		6	1	5		4		4				2		2				2										1		1	
2					1						1				1				5	1	6		3		5				2		1		1		1		1								1			
3							1				1				1				4	1	5		2		6		1		3		1				1		2								1			
4			1								2								6	1	4		2		3		2		4		1				1		2								1			
5					1						1						1		5		4		1		7		1		2				1		1		2						2					
6									1						1		2		5		5		2		6				4		2						1						2					
7					1		1		1				1				4		1		4		1		6		1		7	1	2				1													
8					2	1							1		1		1				6	1	2		4		1		6		3		3				1											
9					1		2		1	1							1		1		3		2		8				5		4		2				1											
10			1												2	1					2		2		5				6		6		1				1				1		1		2		1	
11	1	1							1				1						5	1					5		1		4		5		3				1		1		2				1			
Noon.							1		1		1						2	1	2		1		1		5		1		5		4		1				1		1		2		1		1			
1							1		2				2	1			2		1	1	2		3		2		1	1	3		5		1		1		1				2		2					
2	1						3						1				2		2	1	2				3		1		3		7		1				3				1		1					
3	1				1		2										2		3	1	3		1		4		1		4		4		1		1		1		1						1			
4							1		1						2		2		3		2		2		1		3		5		5						2								2			
5							2						2				1		4		4	1	1		5				5		3						2		1						1			
6							2		1						1		2	1	4		3				6				6		3						1				1	1			1			
7									2				2		1				5	1	6		3		6		2		1		1						1				1							
8					1								2				2		3		9	1	1		5				5				1				1											
9							3						1						2		8		1		7	1	2		2		1		1				1											
10							1						1	1	1		1		4	1	6		2		4		1		3		2		2				1											
11	1								1				1				2		5	1	5		2		4				3		2				1		1											

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of June 1867.

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the sea level, 18.11 feet.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer during the day.			Mean Dry Bulb Thermometer.	Range of the Temperature during the day.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	29.589	29.654	29.513	0.141	89.1	98.8	81.0	17.8
2	.587	.654	.521	.133	90.3	99.6	83.6	16.0
3	.612	.696	.507	.189	87.3	98.0	78.5	19.5
4	.586	.653	.515	.138	88.3	98.5	79.8	18.7
5	.554	.615	.496	.119	90.2	97.4	84.4	13.0
6	.539	.586	.467	.119	88.9	99.2	79.4	19.8
7	.648	.756	.555	.201	80.5	86.0	73.8	12.2
8	.647	.701	.573	.128	83.5	91.2	78.0	13.2
9	.638	.699	.564	.135	84.5	92.8	78.5	14.3
10	.656	.730	.582	.148	86.5	95.0	79.6	15.4
11	.658	.722	.589	.133	85.9	92.0	81.2	10.8
12	.616	.665	.550	.115	86.1	94.5	80.8	13.7
13	.609	.639	.563	.076	84.1	90.4	81.2	9.2
14	.629	.669	.583	.086	82.4	88.0	80.0	8.0
15	.647	.684	.600	.084	82.3	87.2	80.2	7.0
16	.621	.686	.543	.143	82.5	87.0	80.0	7.0
17	.506	.594	.419	.175	83.7	90.0	79.8	10.2
18	.400	.455	.325	.130	83.8	87.2	80.2	7.0
19	.391	.446	.346	.100	85.3	91.2	81.4	9.8
20	.437	.521	.401	.120	84.3	89.0	81.4	7.6
21	.532	.593	.480	.113	82.3	86.0	80.5	5.5
22	.569	.609	.529	.080	81.4	85.4	78.0	7.4
23	.585	.632	.532	.100	84.4	90.4	81.0	9.4
24	.579	.629	.525	.104	86.0	92.0	82.4	9.6
25	.634	.707	.589	.118	85.9	92.3	83.0	9.3
26	.657	.696	.596	.100	83.7	88.6	80.0	8.6
27	.584	.661	.507	.154	85.0	92.2	81.6	10.6
28	.494	.541	.413	.128	84.6	93.0	78.8	14.2
29	.497	.561	.411	.150	83.8	92.2	79.0	13.2
30	.576	.626	.536	.090	81.5	84.6	80.0	4.6

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived, from the hourly observations, made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of June 1867.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	82.9	6.2	79.2	9.9	0.976	10.35	3.77	0.73
2	83.8	6.5	79.9	10.4	.998	.56	4.07	.72
3	79.7	7.6	75.1	12.2	.857	9.12	.29	.68
4	81.0	7.3	76.6	11.7	.899	.54	.26	.69
5	84.1	6.1	80.4	9.8	1.014	10.72	3.87	.74
6	81.6	7.3	77.2	11.7	0.916	9.71	4.33	.69
7	75.9	4.6	72.7	7.8	.792	8.54	2.44	.78
8	78.9	4.6	75.7	7.8	.873	9.36	.64	.78
9	79.4	5.1	75.8	8.7	.876	.37	.98	.76
10	80.1	6.4	76.3	10.2	.890	.50	3.60	.73
11	80.6	5.3	76.9	9.0	.908	.68	.19	.75
12	80.8	5.3	77.1	9.0	.913	.74	.21	.75
13	80.3	3.8	77.6	6.5	.928	.93	2.28	.81
14	79.9	2.5	78.1	4.3	.943	10.14	1.47	.87
15	80.3	2.0	78.9	3.4	.967	.41	.17	.90
16	80.2	2.3	78.6	3.9	.958	.30	.34	.89
17	80.9	2.8	78.9	4.8	.967	.37	.70	.86
18	81.2	2.6	79.4	4.4	.983	.54	.56	.87
19	81.2	4.1	78.3	7.0	.949	.14	2.50	.80
20	80.5	3.8	77.8	6.5	.934	9.99	.29	.81
21	79.7	2.6	77.9	4.4	.937	10.08	1.50	.87
22	79.2	2.2	77.7	3.7	.931	.02	.25	.89
23	80.9	3.5	78.4	6.0	.952	.19	2.12	.83
24	82.3	3.7	79.7	6.3	.992	.59	.32	.82
25	82.4	3.5	79.9	6.0	.998	.65	.22	.83
26	81.4	2.3	79.8	3.9	.995	.66	1.41	.88
27	81.7	3.3	79.4	5.6	.983	.49	2.04	.84
28	80.6	4.0	77.8	6.8	.934	9.99	.40	.81
29	80.5	3.3	78.2	5.6	.946	10.13	1.97	.84
30	80.0	1.5	78.9	2.6	.967	.41	0.90	.92
31								

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of June 1867.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer for each hour during the month. Max.	Min.	Diff.	Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month. Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Mid-night.	29.587	29.693	29.394	0.299	82.4	87.5	79.6	7.9
1	.577	.675	.379	.296	82.1	87.0	79.2	7.8
2	.568	.661	.373	.288	81.9	87.0	79.0	8.0
3	.562	.657	.365	.292	81.6	87.0	78.8	8.2
4	.561	.668	.360	.308	81.4	87.0	78.4	8.6
5	.576	.689	.370	.319	81.1	87.0	78.2	8.8
6	.589	.703	.383	.320	81.3	86.8	78.0	8.8
7	.602	.721	.398	.323	82.3	88.4	78.0	10.4
8	.614	.730	.403	.327	84.2	89.6	77.0	12.6
9	.623	.756	.401	.355	86.4	91.8	74.0	17.8
10	.621	.736	.410	.326	87.6	94.2	73.8	20.4
11	.608	.696	.404	.292	88.5	96.2	74.4	21.8
Noon.	.593	.684	.396	.288	89.3	97.6	75.6	22.0
1	.572	.670	.383	.287	89.9	98.6	79.8	18.8
2	.549	.679	.365	.314	89.8	99.6	80.0	19.6
3	.534	.649	.344	.305	89.7	99.4	80.0	19.4
4	.522	.625	.325	.300	89.1	99.2	80.8	18.4
5	.522	.620	.335	.285	87.8	97.2	81.6	15.6
6	.535	.620	.340	.280	85.8	93.6	81.4	12.2
7	.552	.639	.356	.283	84.3	91.0	80.0	11.0
8	.571	.664	.372	.292	83.5	89.0	79.4	9.6
9	.589	.681	.388	.293	83.1	88.0	79.4	8.6
10	.600	.686	.405	.281	82.7	87.8	78.8	9.0
11	.593	.672	.399	.273	82.5	87.8	79.4	8.4

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of June 1867.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
Midnight.	79.9	2.5	78.1	4.3	0.943	10.14	1.47	0.87
1	79.7	2.4	78.0	4.1	.940	.11	.40	.88
2	79.7	2.2	78.2	3.7	.946	.17	.27	.89
3	79.6	2.0	78.2	3.4	.946	.19	.15	.90
4	79.4	2.0	78.0	3.4	.940	.13	.14	.90
5	79.2	1.9	77.9	3.2	.937	.10	.07	.90
6	79.4	1.9	78.1	3.2	.943	.16	.08	.90
7	80.0	2.3	78.4	3.9	.952	.23	.35	.88
8	80.8	3.4	78.4	5.8	.952	.19	2.05	.83
9	81.3	5.1	77.7	8.7	.931	9.92	3.14	.76
10	81.5	6.1	77.8	9.8	.934	.93	.59	.73
11	81.9	6.6	77.9	10.6	.937	.94	.94	.72
Noon.	82.4	6.9	78.3	11.0	.949	10.05	4.16	.71
1	82.6	7.3	78.2	11.7	.946	.00	.46	.69
2	82.5	7.3	78.1	11.7	.943	9.97	.45	.69
3	82.4	7.3	78.0	11.7	.940	.95	.42	.69
4	82.0	7.1	77.7	11.4	.931	.88	.24	.70
5	81.6	6.2	77.9	9.9	.937	.96	3.64	.73
6	81.0	4.8	77.9	8.2	.937	10.00	2.95	.77
7	80.2	4.1	77.3	7.0	.919	9.84	.44	.80
8	80.2	3.3	77.9	5.6	.937	10.04	1.96	.84
9	80.2	2.9	78.2	4.9	.946	.15	.71	.86
10	80.0	2.7	78.1	4.6	.943	.12	.60	.86
11	79.9	2.6	78.1	4.4	.943	.14	.50	.87

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of June 1867.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage 1 ft. 2 in. above Ground.	Prevailing direction of the Wind.	Max. Pressure of Wind.	General aspect of the Sky.
	o	Inches		lb	
1	130.0	...	S. & variable.	0.6	Clear to 4 A. M. Scatd. ⌒i to 11 A. M. clear afterwards.
2	130.0	...	S. S. E.	1.0	Clear to 8 A. M. Scatd. ⌒i to 5 P. M. Clear afterwards. Lightning to N. W. at 11. P. M.
3	127.0	0.20	S. S. E. & variable.	4.0	Scatd. clouds to 9 A. M. Scatd. \⌒i to 6 P. M. Overcast afterwards. High wind at 2 A. M. & 7 P. M. Lightning to N. W. at midnight. Rain at 7½ P. M.
4	...	...	S. & S. S. W.	2.0	Overcast to 4 A. M. Clear to 2 P. M. Scatd. \⌒i to 7 P. M. Clear afterwards.
5	133.0	...	S. & S. S. W.	5.5	Chiefly clear. High wind at 10 P. M.
6	125.0	0.26	S. S. W. & S.	10.0	Clear to 4 A. M. Scatd. i to 6 P. M. Overcast afterwards. High wind at Noon & from 6½ to 10 P. M. Rain from 7 to 9 P. M.
7	114.0	0.32	Variable.	...	Overcast to 2 P. M. ⌒i & \⌣i afterwards. High wind at 3 A. M. Rain from 8 to 10 A. M.
8	125·0	0.94	S. E. & E. S. E.	2.0	Stratoni to 4 A. M. Scatd. ⌒i to 5 P. M. Clouds of different kinds afterwards. Thunder at 6 & 7 P. M. Lightning to N. W. at 9 P. M. Rain at 7 A. M. & 6 P. M.
9	126.2	...	E. & S. E.	3.8	Clear to 8 A. M. Scatd. ⌒i to 6 P. M. Clear afterwards. High wind at 5½ P. M.
10	127.0	...	S. S. E. & E. by S.	0.9	Clear to 7 A. M. Scatd. ⌒i to 6 P. M., clear afterwards.
11	126.6	...	E., E. S. E. & S. E.	1.0	Clear to 7 A. M. Scatd. ⌒i to 11 A. M. Scatd. \⌒i afterwards. Slight rain at 1 P. M.
12	130.0	...	S. E., E. &E. S. E.	1.2	Clear to 5 A. M. Scatd. ⌒i to 1 P. M. \⌣i to 7 P. M. \⌒i afterwards. Thin rain at 4½ P. M.
13	...	0.06	E. & E. S. E.	4.8	Clear to 7 A. M. \⌣i to 1 P. M. Overcast to 8 P. M. Scatd. \i afterwards. High wind at 2 P. M. Light rain at 10½ A. M.
14	...	0.66	E, E. by N. & variable	0.2	Scatd. \i to 9 A. M. Overcast to 6 P. M. Stratoni to 9 P. M. Scatd. \i afterwards. Thunder at 1 & 4 P. M. Rain at 6½ A. M. & from 11½ A. M. to 4 P. M.
15	...	0.23	S. E. & E.	...	Scatd \i to 6 A. M. Overcast to 6 P. M. Stratoni afterwards. Rain at 9½ A. M. & from 2 to 4½ P. M.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of June 1867.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage 1 ft. 2 in. above Ground.	Prevailing direction of the Wind.	Max. Pressure of Wind.	General aspect of the Sky.
	o	Inches		lb	
16	...	*0.23	S. & S. E.	...	Stratoni to 2 A. M. Overcast to 10 A. M. Clouds of different kinds afterwards. Rain at 3, 4, 9 & 10 A. M.
17	125.2	0.12	Variable.	...	Scatd. ╲i to 3 A. M. ⌒i to Noon Overcast to 4 P. M. ╲_i afterwards. Rain from 1 to 3 P. M.
18	...	0.14	Variable.	...	Scatd. ╲i to 7 A. M. Overcast afterwards. Rain at 10 A. M. 4½ & 10½ P. M.
19	113.5	0.06	E. S. E. & S. E.	0.5	╲⌒i to 5 A. M. ⁀i & ╲_i to 5 P. M. Clear afterwards. Slight rain at midnight 1 A. M. & 1½ P. M.
20	128.0	0.04	S. E. & E. N. E.	3.4	Stratoni to 5 A. M. Overcast to 3 P. M. Scatd. ⁀i afterwards. Light rain at 6 A. M. 3, 4, 7½ & 9½ P. M.
21	...	...	S. S. E.& variable.	1.6	Scatd.╲i to 4 A. M. Stratoni to 4 P. M. ╲_i afterwards. Slight rain at 7½ & 10½ A. M.
22	...	1.10	S, S. S. E.&S. S. W.	1.5	Overcast nearly the whole day. Rain from midnight to 10 A. M. at Noon, 7 and 8 P. M.
23	...	0.06	S. S. W. & S. byW.	1.9	Clouds of different kinds. Rain at 5½ P. M.
24	124.0	...	S. W. & S. S. W.	0.4	╲⌒i to 7 A. M. Stratoni to 7 P. M., clear afterwards.
25	134.0	...	S. & S, S. W.	0.3	Scatd. ⌒i to 9 A. M. Overcast to 8 P. M. Stratoni afterwards Light rain at 5 & 6½ P. M.
26	...	0.26	S. S. W. & S.	4.6	Overcast nearly the whole day. High wind at 5½ P. M. Rain at 1½, 7½ & 10 A. M., & from 6 to 8 P. M.
27	124.0	0.37	S, S. W. & S. S. W.	1.0	Stratoni to 5 A. M. Scatd. ⌒i to 2 P. M. Stratoni afterwards. Rain at 3½ & 7 P. M.
28	118.0	0.24	S. S. W. & W.S.W.	1.0	╲_i to 4 A. M. Stratoni to 4 P. M. Overcast afterwards. Rain from 5 to 10 P. M.
29	...	0.69	Variable.	...	Scatd. ╲⌒i to 7 A. M. ⌒i to 2 P. M. Overcast to 8 P. M. Clear afterwards. Rain at 4 P. M,
30	...	0.14	S. E. & S. S. E.	1.05	Clear to 4 A. M.. ╲⌒i to 10 A. M. Overcast afterwards. Rain from 11 A. M. to 3 P. M.

╲i Cirri, —i Strati, ⌒i Cumuli, ╲_i Cirro-strati, ⁀i Cumulo strati, ╲⁀ Nimbi, ╲⌒i Cirro cumuli.

*Fell since 2 P. M. of the 15th

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of June 1867.

MONTHLY RESULTS.

	Inches.
Mean height of the Barometer for the month...	29.576
Max. height of the Barometer occurred at 9 A. M. on the 7th ...	29.756
Min. height of the Barometer occurred at 4 P.M. on the 18th ...	29.325
Extreme range of the Barometer during the month	0.431
Mean of the daily Max. Pressures	29.636
Ditto ditto Min. ditto	29.511
Mean daily range of the Barometer during the month	0.125

	o
Mean Dry Bulb Thermometer for the month	84.9
Max. Temperature occurred at 2 P. M. on the 2nd	99.6
Min. Temperature occurred at 10 A. M. on the 7th	73.8
Extreme range of the Temperature during the month	25.8
Mean of the daily Max. Temperature	91.7
Ditto ditto Min. ditto, ...	80.2
Mean daily range of the Temperature during the month... ...	11.5

Mean Wet Bulb Thermometer for the month	80.7
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer	4.2
Computed Mean Dew-point for the month	77.8
Mean Dry Bulb Thermometer above computed mean Dew-point ...	7.1
	Inches.
Mean Elastic force of Vapour for the month	0.934

	Troy grain.
Mean Weight of Vapour for the month	9.99
Additional Weight of Vapour required for complete saturation ...	2.50
Mean degree of humidity for the month, complete saturation being unity	0.80

	Inches.
Rained 23 days,—Max. fall of rain during 24 hours	1.10
Total amount of rain during the month	6.12
Total amount of rain indicated by the Gauge attached to the anemometer during the month	5.40
Prevailing direction of the Wind... ... S. E., S. S. W. & S.	

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of June 1867.

MONTHLY RESULTS.

Tables shewing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour, when any particular wind was blowing, it rained.

No. of days

Hour.	N.	Rain on.	N. by E.	Rain on.	N. N. E.	Rain on.	N. E.	Rain on.	E. N. E.	Rain on.	E. by N.	Rain on.	E.	Rain on.	E. by S.	Rain on.	E. S. E.	Rain on.	S. E.	Rain on.	S. S. E.	Rain on.	S. by E.	Rain on.	S.	Rain on.	S. by W.	Rain on.	S. S. W.	Rain on.	S. W.	Rain on.	W. S. W.	Rain on.	W. by S.	Rain on.	W.	Rain on.	W. by N.	Rain on.	W. N. W.	Rain on.	N. W.	Rain on.	N. N. W.	Rain on.	N. by W.	Rain on.
Mid night													2		1		2		4		5	1			8		1	1	2		1																	
1									2				1				4		2		5				4		3	1	2		3	1																
2							1		2				5		1		2				4		1		3	1	2		3	1	1						1											
3									2		2		5		2		2				1				4	1	1		5		2																	
4							1		2		4		3		1		2		2		1		1	1	1		1		5		2																	
5							1		3		2		7		3				2		1		3	1	2		2		2		2																	
6									2		2		7	1	3				4		1		1		2	1	4		3		1																	
7									2		2	2	7		1		2		3		1				3	1	3		3		2		1															
8	1	1									1		5				3		4		3		1		1		2	1	5	1	1		1		1						1							
9					1	1	1						2				3		6		4	1			1		1		4	1	5		1				1											
10									1	1			2				3		7	2			1		4		1		5	2	3	1	2		1													
11													3				3	1	8		2				1	1			7		3		1				2											
Noon.											2		3		1		1		4	1	3		1		2				4	1	4		3								2	1						
1									1				2		2		2	2	4		2				1		1		8	1	4		1		1	1			1									
2													2	2	1		2		3	1	5		1		5		1		4		1		3	1	1				1									
3							1						2	2	1		2	1	7	2	3		2		5		1		4		2																	
4															1		3	1	7	2	4	1	2		3		4		4						1												1	1
5									1	1							2		5	2	3		1		6	2	3		7	1							1											
6													1				4		5	1	3		2		6		3	1	3		2	2					1											
7													1				4		4		6	1	2		3	1	1		5	2	1	1	1	1					1				1	1				
8							1	1					1		1		2		3	1	5		2		6	1	1		3	1	1	1					1	1	1									
9							1		1								2		5		5	1	2		5		2		3	1			1						1									
10									1								2		4	1	7		3	1	7		1		3																			
11													2				2		4		8		2	1	7				2												1							

Calcutta

Table shewing the mean monthly readings (reduced to 32° Fahr.) and the mean hourly variations of the Barometer in the Surveyor General's Office for the 10 years 1856/65

		January	February	March	April	May	June	July	August	September	October	November	December
Mean Monthly readings		30.017	29.941	29.861	29.753	29.645	29.541	29.532	29.591	29.681	29.820	29.961	30.020
Mean hourly Variations from the monthly means.	Midnight	+ .001	+ .003	+ .003	+ .008	+ .009	+ .013	+ .015	+ .019	+ .013	− .000	− .001	− .001
	1 AM	− .005	− .004	− .008	− .004	− .001	+ .003	+ .002	+ .006	− .000	− .010	− .009	− .008
	2 AM	− .013	− .014	− .019	− .015	− .013	− .007	− .007	− .005	− .011	− .018	− .017	− .017
	3 AM	− .021	− .024	− .027	− .022	− .018	− .013	− .018	− .016	− .021	− .025	− .023	− .025
	4 AM	− .023	− .028	− .030	− .020	− .015	− .016	− .016	− .017	− .021	− .023	− .026	− .026
	5 AM	− .018	− .015	− .015	− .005	− .002	− .007	− .012	− .012	− .013	− .011	− .012	− .015
	6 AM	− .001	+ .001	+ .004	+ .014	+ .016	+ .009	+ .004	+ .005	+ .004	+ .008	+ .007	+ .002
	7 AM	+ .021	+ .023	+ .026	+ .034	+ .034	+ .023	+ .018	+ .019	+ .023	+ .028	+ .029	+ .024
	8 AM	+ .052	+ .050	+ .057	+ .056	+ .051	+ .035	+ .032	+ .035	+ .043	+ .052	+ .054	+ .052
	9 AM	+ .074	+ .073	+ .073	+ .070	+ .059	+ .042	+ .038	+ .044	+ .054	+ .063	+ .070	+ .072
	10 AM	+ .078	+ .082	+ .077	+ .069	+ .058	+ .041	+ .039	+ .045	+ .055	+ .061	+ .067	+ .073
	11 AM	+ .060	+ .068	+ .065	+ .057	+ .045	+ .034	+ .033	+ .037	+ .043	+ .043	+ .046	+ .054
	Noon	+ .030	+ .041	+ .041	+ .037	+ .028	+ .019	+ .019	+ .021	+ .023	+ .017	+ .018	+ .023
	1 PM	− .004	+ .007	+ .010	+ .008	+ .003	− .000	+ .001	+ .001	− .004	− .011	− .015	− .010
	2 PM	− .029	− .024	− .022	− .022	− .024	− .021	− .020	− .023	− .030	− .037	− .037	− .035
	3 PM	− .047	− .046	− .045	− .048	− .047	− .039	− .038	− .043	− .050	− .050	− .049	− .049
	4 PM	− .054	− .056	− .057	− .069	− .067	− .056	− .051	− .057	− .059	− .051	− .052	− .053
	5 PM	− .049	− .056	− .060	− .071	− .069	− .054	− .051	− .056	− .056	− .043	− .044	− .046
	6 PM	− .042	− .050	− .052	− .060	− .056	− .044	− .041	− .046	− .043	− .036	− .033	− .035
	7 PM	− .025	− .034	− .036	− .039	− .033	− .025	− .023	− .029	− .023	− .016	− .015	− .018
	8 PM	− .008	− .013	− .014	− .016	− .009	− .003	− .002	− .004	+ .001	+ .003	+ .002	− .002
	9 PM	− .004	+ .002	+ .003	+ .007	+ .009	+ .014	+ .016	+ .016	+ .020	+ .015	+ .012	+ .010
	10 PM	− .008	+ .009	+ .012	+ .015	+ .019	+ .025	+ .029	+ .029	+ .027	+ .019	+ .016	+ .015
	11 PM	− .005	+ .007	+ .010	+ .014	+ .016	+ .024	+ .029	+ .027	+ .024	+ .016	+ .010	+ .009

Sd/ J. T. Walker Lt. Coll.

Supt. G. T. Survey

Photolithographed at the Surveyor General's Office,
Calcutta June 1863.

TABLE OF BAROMETRIC CURVES FOR EACH MONTH OF THE YEAR, FROM 1855 TO 1864 AS REGISTERED AT THE SURVEYOR GENERAL'S OFFICE CALCUTTA.
AND OF MEAN RAIN FALL.

TABLE OF HYGROMETRIC CURVES FOR EACH MONTH OF THE YEAR, FROM 1855 TO 1864. AS REGISTERED AT THE SURVEYOR GENERAL'S OFFICE CALCUTTA.

N.B. The Readings are Reduced to the Standard temperature of 32° Fahr.

N.B. The Readings are Reduced to the Standard temperature of 32° Fahr.

James E. Gastrell Colonel
Deputy Surveyor General

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of July 1867.

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the sea level, 18.11 feet.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer during the day.			Mean Dry Bulb Thermometer.	Range of the Temperature during the day.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	29.591	29.631	29.524	0.107	82.8	89.4	80.0	9.4
2	.553	.608	.489	.119	81.1	87.2	78.2	9.0
3	.548	.627	.498	.129	77.1	79.4	74.8	4.6
4	.656	.708	.594	.114	81.6	88.6	76.0	12.6
5	.701	.740	.650	.090	83.2	87.2	80.2	7.0
6	.706	.748	.634	.114	84.6	91.2	81.4	9.8
7	.681	.731	.636	.095	84.2	87.5	79.6	7.9
8	.675	.722	.619	.103	83.2	88.6	79.0	9.6
9	.684	.730	.625	.105	83.1	88.0	79.0	9.0
10	.666	.708	.605	.103	84.1	89.3	80.4	8.9
11	.645	.690	.579	.111	84.5	90.2	82.0	8.2
12	.666	.715	.597	.118	85.2	90.0	81.4	8.6
13	.610	.663	.525	.138	86.4	91.6	82.0	9.6
14	.537	.599	.458	.141	86.0	93.5	81.4	12.1
15	.482	.536	.401	.135	87.3	93.7	83.0	10.7
16	.451	.494	.375	.119	86.7	92.4	83.0	9.4
17	.436	.486	.388	.098	85.1	90.2	82.0	8.2
18	.482	.525	.430	.095	84.5	89.4	81.7	7.7
19	.490	.541	.422	.119	84.0	88.4	80.5	7.9
20	.436	.481	.370	.111	84.7	90.2	82.2	8.0
21	.396	.444	.314	.130	85.5	91.2	81.4	9.8
22	.465	.536	.385	.151	81.7	86.0	79.6	6.4
23	.513	.557	.457	.100	83.5	87.2	80.4	6.8
24	.501	.544	.447	.097	83.9	88.5	81.2	7.3
25	.494	.537	.449	.088	82.6	86.0	81.0	5.0
26	.521	.559	.476	.083	83.0	87.8	80.6	7.2
27	.523	.567	.453	.114	83.8	88.6	80.0	8.6
28	.487	.534	.419	.115	83.2	86.0	81.2	4.8
29	.485	.561	.426	.135	81.7	85.0	78.5	6.5
30	.584	.641	.526	.115	82.1	87.5	78.4	9.1
31	.598	.650	.546	.104	82.9	88.2	79.0	9.2

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived, from the hourly observations, made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of July 1867.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	80.7	2.1	79.2	3.6	0.976	10.48	1.27	0.89
2	79.7	1.4	78.7	2.4	.961	.37	0.80	.93
3	75.9	1.2	75.1	2.0	.857	9.30	.62	.94
4	78.7	2.9	76.7	4.9	.902	.70	1.64	.86
5	80.6	2.6	78.8	4.4	.964	10.36	.53	.87
6	81.3	3.3	79.0	5.6	.970	.37	2.02	.84
7	81.5	2.7	79.6	4.6	.989	.58	1.66	.86
8	80.6	2.6	78.8	4.4	.964	.36	.53	.87
9	79.8	3.3	77.5	5.6	.925	9.92	·94	.84
10	80.9	3.2	78.7	5.4	.961	10.31	.90	.84
11	81.5	3.0	79.4	5.1	.983	.51	.84	.85
12	82.0	3.2	79.8	5.4	.995	.64	.97	.84
13	82.4	4.0	79.6	6.8	.989	.54	2.52	.81
14	82.2	3.8	79.5	6.5	.986	.51	.40	.81
15	82.9	4.4	80.3	7.0	1.011	.76	.65	.80
16	81.9	4.8	79.0	7.7	0.970	.33	.85	.78
17	81.1	4.0	78.3	6.8	.949	.14	.43	.81
18	81.2	3.3	78.9	5.6	.967	.34	.01	.84
19	81.2	2.8	79.2	4.8	.976	.45	1.72	.86
20	81.6	3.1	79.4	5.3	.983	.51	.91	.85
21	81.6	3.9	78.9	6.6	.967	.32	2.40	.81
22	79.4	2.3	77.8	3.9	.934	.05	1.32	.88
23	80.9	2.6	79.1	4.4	.973	.45	.55	.87
24	81.1	2.8	79.1	4.8	.973	.42	.71	.86
25	80.6	2.0	79.2	3.4	.976	.50	.18	.90
26	80.0	3.0	77.9	5.1	.937	.06	.76	.85
27	80.6	3.2	78.4	5.4	.952	.21	.89	.84
28	80.4	2.8	78.4	4.8	.952	.21	.68	.86
29	79.6	2.1	78.1	3.6	.943	.14	.23	.89
30	80.1	2.0	78.7	3.4	.961	.35	.16	.90
31	80.8	2.1	79.3	3.6	.979	.51	.28	.89

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of July 1867.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer for each hour during the month. Max.	Min.	Diff.	Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month. Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Mid-night.	29.572	29.718	29.393	0.325	81.9	84.7	77.2	7.5
1	.562	.715	.393	.322	81.8	84.4	76.4	8.0
2	.553	.711	.385	.326	81.6	84.2	76.0	8.2
3	.545	.705	.399	.306	81.4	83.6	76.3	7.3
4	.539	.702	.411	.391	81.2	83.4	76.0	7.4
5	.549	.714	.406	.308	81.0	83.4	76.0	7.4
6	.560	.726	.413	.313	81.1	83.6	76.2	7.4
7	.577	.745	.416	.329	81.9	84.7	77.9	6.8
8	.587	.745	.436	.309	82.9	86.4	77.8	8.6
9	.596	.748	.443	.305	84.1	88.5	78.3	10.2
10	.596	.743	.439	.304	85.3	89.4	77.4	12.0
11	.590	.747	.416	.331	86.4	91.2	77.8	13.4
Noon.	.577	.726	.404	.322	87.0	91.8	76.8	15.0
1	.557	.695	.383	.312	87.3	92.8	76.0	16.8
2	.535	.679	.369	.310	87.1	93.7	74.8	18.9
3	.518	.678	.352	.326	86.5	93.2	75.8	17.4
4	.506	.659	.314	.345	86.1	92.8	75.8	17.0
5	.504	.650	.316	.334	85.4	91.3	76.2	15.1
6	.515	.670	.332	.338	84.1	90.6	76.4	14.2
7	.534	.689	.357	.332	83.4	87.6	76.6	11.0
8	.555	.704	.368	.336	83.0	85.4	76.6	8.8
9	.573	.719	.387	.332	82.7	85.8	77.0	8.8
10	.586	.735	.405	.330	82.4	85.6	77.0	8.6
11	.581	.732	.399	.333	82.0	85.0	77.4	7.6

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of July 1867.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
Midnight.	80.2	1.7	79.0	2.9	0.970	10.44	1.00	0.91
1	80.1	1.7	78.9	2.9	.967	.41	0.99	.91
2	80.0	1.6	78.9	2.7	.967	.41	.93	.92
3	79.8	1.6	78.7	2.7	.961	.35	.92	.92
4	79.7	1.5	78.6	2.6	.958	.32	.89	.92
5	79.6	1.4	78.6	2.4	.958	.34	.80	.93
6	79.8	1.3	78.9	2.2	.967	.43	.74	.93
7	80.1	1.8	78.8	3.1	.964	.38	1.06	.91
8	80.6	2.3	79.0	3.9	.970	.42	.37	.88
9	81.1	3.0	79.0	5.1	.970	.40	.81	.85
10	81.5	3.8	78.8	6.5	.964	.29	2.35	.81
11	82.0	4.4	78.9	7.5	.967	.30	.76	.79
Noon.	82.0	5.0	79.0	8.0	.970	.33	.96	.78
1	82.0	5.3	78.8	8.5	.964	.25	3.16	.76
2	82.1	5.0	79.1	8.0	.973	.36	2.97	.78
3	81.7	4.8	78.8	7.7	.964	.27	.83	.78
4	81.6	4.5	78.4	7.7	.952	.15	.80	.78
5	81.1	4.3	78.1	7.3	.943	.08	.60	.80
6	80.9	3.2	78.7	5.4	.961	.31	1.90	.84
7	80.6	2.8	78.6	4.8	.958	.28	.68	.86
8	80.5	2.5	78.7	4.3	.961	.33	.49	.87
9	80.4	2.3	78.8	3.9	.964	.36	.36	.88
10	80.3	2.1	78.8	3.6	.964	.36	.25	.89
11	80.1	1.9	78.8	3.2	.964	.38	.09	.91

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of July 1867.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage 1 ft. 2 in. above Ground.	Prevailing direction of the Wind.	Max. Pressure of Wind.	General aspect of the Sky.
	o	Inches		lb	
1	...	0.09	S.S.W. & variable.	3.7	Stratoni to 8 A. M. ⌒i to 1 P.M. Stratoni afterwards. Thunder at 3 P. M., slight rain at 5 & 10½ A. M. 1, 3 & 4 P. M. High wind at 2½ P. M.
2	...	1.37	S. S. W. & S. W.	1.0	Clear to 4 A.M. Stratoni to 8 A.M. Overcast afterwards. Rain from 1 to 4 P. M. & at 8 & 10½ P. M.
3	...	3.98	W. S. W.	12.0	Overcast. High wind at 2½ & 7½ A. M. Lightning at 1 A. M. Rain whole day.
4	119.0	*1.68	S. S. E.	1.0	Overcast to 6 A. M. ╲i & ⌒i to 6 P. M. Clear afterwards. Rain from midnight to 6 A. M.
5	...	0.05	S. & S. S. W.	...	Stratoni to 10 A. M. ⌒i afterwards, slight rain at midnight & at 9½ P. M.
6	119.5	0.21	S. S. W. & S. W.	5.0	Clear to 5 A. M. ⌒i to 3 P. M. Overcast afterwards. Thunder at 4 P. M. Rain at 4 & 5 P. M. High wind at 4¼ P. M.
7	...	0.75	S. S. W.	1.1	Overcast nearly the whole day. Rain at 11 P. M.
8	...	0.55	S. W. & S. S. W.	1.0	Overcast nearly the whole day. Rain at 6 P. M. & from 9 to 11 P. M.
9	129.0	0.23	S. S. W. & S.	3.8	Overcast to 5 A. M. ╲⌒i to 7 P. M. Overcast afterwards. High wind at 8¾ P. M. Rain at midnight 1½ A.M & from 8½ to 11 P.M
10	...	...	S. S. W. & S. W.	0.7	Overcast to 10 A. M., clouds of different kinds afterwards.
11	122.0	...	S. S. W.	1.0	╲⌒i to 6 A. M. ╲⌒i to 11 A. M. Overcast to 5 P. M., clouds of different kinds afterwards.
12	126·4	0.05	W. S. W. & S. S.W.	0.2	Overcast to 5 A. M. ╲⌒i to 9 A.M ⌒i to 2 P.M Overcast afterwards Slight rain from 1 to 4 A. M.
13	126.5	...	S. & S. S.W.	...	╲⌒i to 7 A. M. ⌒i to 3 P. M., stratoni to 7 P. M. ╲⌒i afterwards.
14	125.0	1.02	S. S. W. & variable	2.0	Scuds from S, to 8 A. M., scatd. ⌒i to 4 P. M. Overcast afterwards. Rain from 5 to 7. P. M.
15	116.0	0.03	S. & S. E.	0.8	Stratoni to 5 A. M. ╲i to 8 A. M. ⌒i afterwards. Rain at 3½ P. M.
16	128.0	...	E. N. E. & E.	1.2	╲i to 6 A. M. ⌒i & ╲⌒i to 5 P. M. ╲i afterwards.

*Fell since 4 P. M. of the 3rd to 6 A. M. of the 4th

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of July 1867.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage 1 ft. 2 in. above Ground.	Prevailing direction of the Wind.	Max. Pressure of Wind.	General aspect of the Sky.
	o	Inches		lb	
17	104.0	0.08	E. & E. S. E.	4.2	Stratoni to 10 A. M. ⌒i to 4 P. M. ╲i to 8 P. M., stratoni afterwards. Brisk gale at 1¼ P. M. Rain at 11 A. M. noon & 5 P. M.
18	...	0.19	E. S. E. & S. S. E.	5.7	Stratoni to noon ⌒i & ╲⌒i afterwards. High wind at 10½ A. M. Rain from 10 A. M., to 2 P. M., & at 6½ & 11 P. M.
19	...	0.25	S. S. E. & S. E.	...	╲i to 3 A M Overcast to 9 A M ╲⌒_i to 2 P M ╲⌒i to 5 P M ╲_i afterwards. Rain from 4 to 7½ A M.
20	129.0	...	S. S. E.	...	Stratoni to 7 A. M. ⌒i & stratoni afterwards.
21	128.0	0.04	E. & variable.	0.8	Scatd. ⌒i to 6 P. M. Overcast afterwards. Light rain at 2 A. M. 2½, 3½ P. M. & from 8 to 11 P. M.
22	...	0.26	S, W. & S. S. W.	6.4	Overcast to 1 P. M. ⌒i to 7 P. M. Clear afterwards. High wind from 10 A. M. to noon. Rain from midnight to 3 A. M. & from 8 A. M. to noon.
23	...	0.20	S. W, S. & S. by E.	0.2	╲⌒i to 2 A M Overcast to noon ╲⌒i afterwards. Rain at 3, 6, 11 & noon
24	...	0.12	S. by E, S. & S. S. W.	0.2	╲⌒i to 7 P. M., clear afterwards. Rain from 6½ to 9 A M. & at 12½ A M
25	113.0	0.24	S. & S. S. W.	0.2	Scatd, clouds to 8 A. M. Overcast to 3 P. M, scatd., clouds to 7 P. M., clear afterwards. Rain after intervals.
26	124.0	0.60	S. S. W. & variable.	...	╲⌒i to noon. Overcast to 5 P. M. Scatd. ╲_i afterwards. Rain from 2½ to 5 P. M.
27	...	0.11	S. W. & W. S. W.	1.5	Scatd. ╲_i to 2 A. M. clear to 6 A. M. Overcast afterwards. Lightning to N at 8 P. M. Rain at 3 P. M. & from 7 to 9 P. M.
28	...	0.05	S. W. & S. S. W.	0.3	Overcast. Rain at 8 & 9 A. M.
29	...	1.68	S. W. & S. S. W.	0.4	Overcast. Rain from 7½ A. M. to 1 P. M. & from 6 to 10 P. M.
30	...	0.23	S. & S. by E.	...	Overcast to noon ⌒i to 8 P. M. ╲i afterwards. Lightning to N W at 8 P. M. Rain from 3½ to 8 A M.
31	...	1.38	S. & S. S. W.	1.6	Clear to 3 A. M. Stratoni to 9 A. M. Overcast to 6 P. M. Stratoni afterwards. Thunder & Lightning at 2½ P. M. Rain at 10 A. M. & from 2 to 6 P. M.

╲i Cirri, —i Strati, ⌒i Cumuli, ╲_i Cirro-strati, ∼i Cumulo strati, ╲⌒ Nimbi, ╲⌒i Cirro cumuli.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of July 1867.

Monthly Results.

	Inches.
Mean height of the Barometer for the month...	29.557
Max. height of the Barometer occurred at 9 A. M. on the 6th ...	29.748
Min. height of the Barometer occurred at 4 P.M. on the 21st ...	29.314
Extreme range of the Barometer during the month	0.434
Mean of the daily Max. Pressures	29.607
Ditto ditto Min. ditto	29.494
Mean daily range of the Barometer during the month	0.113

	o
Mean Dry Bulb Thermometer for the month	83.7
Max. Temperature occurred at 2 P. M. on the 15th	93.7
Min. Temperature occurred at 2 P. M. on the 3rd	74.8
Extreme range of the Temperature during the month	18.9
Mean of the daily Max. Temperature	88.6
Ditto ditto Min. ditto, ...	80.3
Mean daily range of the Temperature during the month... ...	8.3

Mean Wet Bulb Thermometer for the month	80.7
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer	3.0
Computed Mean Dew-point for the month	78.6
Mean Dry Bulb Thermometer above computed mean Dew-point ...	5.1
	Inches.
Mean Elastic force of Vapour for the month	0.958

	Troy grain.
Mean Weight of Vapour for the month	10.28
Additional Weight of Vapour required for complete saturation ...	1.79
Mean degree of humidity for the month, complete saturation being unity	0.85

	Inches.
Rained 26 days,—Max. fall of rain during 24 hours	3.98
Total amount of rain during the month	15.44
Total amount of rain indicated by the Gauge attached to the anemometer during the month	13.54
Prevailing direction of the Wind... ... S. S. W, S. W. & S.	

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of July 1867.

MONTHLY RESULTS.

Tables shewing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour, when any particular wind was blowing, it rained.

Hour.	N.	Rain on.	N. by E.	Rain on.	N. N. E.	Rain on.	N. E.	Rain on.	E. N. E.	Rain on.	E. by N.	Rain on.	E.	Rain on.	E. by S.	Rain on.	E. S. E.	Rain on.	S. E.	Rain on.	S. S. E.	Rain on.	S. by E.	Rain on.	S.	Rain on.	S. by W.	Rain on.	S. S. W.	Rain on.	S. W.	Rain on.	W. S. W.	Rain on.	W. by S.	Rain on.	W.	Rain on.	W. by N.	Rain on.	W. N. W.	Rain on.	N. W.	Rain on.	N. N. W.	Rain on.	N. by W.	Rain on.
																			No. of days																													
Mid night													1				2				5	1	1		4		7		5		3	1											1	1	1			
1					1								3								5		1		4		3		8		4	2											1					
2							2	1					2				1				4	1	1		4		2		10	1	3	1	1	1														
3									1		2		1				2				2		1		4		1		8	1	6	2	1				1	1										
4									1		2				1		1				1		1		7	2	1		8		5		1	1			1	1										
5									2		2	1	1				1				1				6	2	2		7		6		1				1	1										
6									3				2				1				2		1		4	2	1		7	1	8	1	1															
7							1		2				2				1		1		1		2		5	2			7		7		1	1														
8									3		1		1				1		1		1		1	1	5				6		9	3	1	1														
9							1		2				2				2				1		2		1		1		8	1	8	2	2	1														
10							2		1				2				2		2	1	1		1		4		1		1		10	3	3				1	1										
11					1				1				1						3	2	4		2		3	1	1		5	1	5		4								1	1						
Noon.							1		1				1		1	1			5	1	4	1			4	1			4	1	7	1	3	1														
1							2	2					3				1		3	1	1		1	1	9				4	1	6	2	1															
2									2		1		1		1		1	1	1		2	1	1	1	4				9		6	1	1		1	1												
3																			5	1	4	3	5		5		2		6		2	1									1	1	1	1				
4									1						1				2	2	3	1	2		7	1	4		5		3	1					3	3										
5													1				1		2	1	2		1		4		6		6		2	1	2	1	1		1	1					1	1	1	1		
6									1	1	1		2						2		3				5		3		8	1	1	1			1		4	3										
7													1	1			3		1		4	1	3		3		2		9		1		1	1	1	1	1	1							1			
8											1		1	1			1		1		3		4		2		3		10		3	3	1															
9									1				1	1			1				4		3		4		4		7	1	5	3																
10									1								1		1		3		2		5		3	1	9	2	5	2																
11									1								1				4	1	4		4	1	4		7	1	5	2																

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of August 1867.

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the sea level, 18.11 feet.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer during the day.			Mean Dry Bulb Thermometer.	Range of the Temperature during the day.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	29.581	29.628	29.523	0.105	83.0	89.5	80.0	9.5
2	.618	.667	.576	.091	83.6	88.5	80.2	8.3
3	.633	.676	.571	.105	82.7	87.0	80.0	7.0
4	.639	.691	.586	.105	82.8	86.8	80.0	6.8
5	.634	.691	.558	.133	83.3	89.7	80.4	9.3
6	.591	.639	.537	.102	83.3	88.6	79.5	9.1
7	.574	.622	.510	.112	84.7	89.0	81.0	8.0
8	.576	.622	.518	.104	82.5	86.5	80.0	6.5
9	.625	.687	.574	.113	82.5	89.4	78.0	11.4
10	.630	.691	.559	.132	83.6	89.5	80.0	9.5
11	.557	.599	.459	.140	84.0	88.0	81.0	7.0
12	.527	.582	.432	.150	83.7	88.8	80.5	8.3
13	.577	.635	.529	.106	81.9	88.0	79.2	8.8
14	.540	.616	.473	.143	79.0	80.8	77.5	3.3
15	.500	.538	.443	.095	78.2	80.0	76.5	3.5
16	.572	.656	.509	.147	79.0	82.2	76.3	5.9
17	.663	.714	.616	.098	81.9	85.5	78.5	7.0
18	.675	.732	.613	.119	83.6	87.1	81.7	5.4
19	.608	.656	.517	.139	82.5	87.2	79.8	7.4
20	.559	.611	.495	.116	80.5	82.5	77.9	4.6
21	.570	.634	.511	.123	81.8	86.6	78.4	8.2
22	.636	.691	.589	.102	82.5	86.0	80.5	5.5
23	.653	.704	.595	.109	84.4	89.3	81.4	7.9
24	.661	.733	.604	.129	81.7	83.6	77.0	6.6
25	.622	.668	.553	.115	81.6	86.5	78.0	8.5
26	.640	.696	.583	.113	83.4	87.5	79.8	7.7
27	.658	.700	.600	.100	84.9	90.0	81.0	9.0
28	.672	.726	.609	.117	84.9	90.5	81.0	9.5
29	.656	.718	.562	.156	85.0	90.0	81.5	8.5
30	.592	.653	.509	.144	85.8	91.6	82.0	9.6
31	.565	.628	.437	.141	85.8	91.4	82.0	9.4

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived, from the hourly observations, made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of August 1867.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	80.1	2.9	78.1	4.9	0.943	10.12	1.70	0.86
2	80.2	3.4	77.8	5.8	.934	.01	2.02	.83
3	79.9	2.8	77.9	4.8	.937	.06	1.66	.86
4	79.9	2.9	77.9	4.9	.937	.06	.69	.86
5	80.3	3.0	78.2	5.1	.946	.15	.78	.85
6	80.7	2.6	78.9	4.4	.967	.39	.54	.87
7	80.9	3.8	78.2	6.5	.946	.11	2.31	.81
8	79.7	2.8	77.7	4.8	.931	.00	1.64	.86
9	79.6	2.9	77.6	4.9	.928	9.97	·67	.86
10	80.6	3.0	78.5	5.1	.955	10.25	.78	.85
11	80.8	3.2	78.6	5.4	.958	.28	.89	.85
12	80.3	3.4	77.9	5.8	.937	.04	2.03	.83
13	79.4	2.5	77.6	4.3	.928	9.99	1.45	.87
14	77.8	1.2	77.0	2.0	.910	.85	0.65	.94
15	77.2	1.0	76.5	1.7	.896	.71	.54	.95
16	77.5	1.5	76.4	2.6	.893	.66	.84	.92
17	79.5	2.4	77.8	4.1	.934	10.05	1.39	.88
18	81.2	2.4	79.5	4.1	.986	.57	.46	.88
19	80.4	2.1	78.9	3.6	.967	.39	.25	.89
20	78.8	1.7	77.6	2.9	.928	.01	0.97	.91
21	79.3	2.5	77.5	4.3	.925	9.96	1.44	.87
22	80.0	2.5	78.2	4.3	.946	10.17	.47	.87
23	81.3	3.1	79.1	5.3	.973	.42	.89	.85
24	80.2	1.5	79.1	2.6	.973	.47	0.90	.92
25	79.4	2.2	77.9	3.7	.937	.08	1.26	.89
26	80.2	3.2	78.0	5.4	.940	.09	.87	.84
27	81.3	3.6	78.8	6.1	.964	.31	2.18	.83
28	81.5	3.4	79.1	5.8	.973	.40	.09	.83
29	81.2	3.8	78.5	6.5	.955	.21	.32	.82
30	81.0	4.8	77.6	8.2	.928	9.91	.92	.77
31	81.4	4.4	78.3	7.5	.949	10.12	.71	.79

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of August 1867.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer for each hour during the month. Max.	Min.	Diff.	Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month. Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Midnight.	29.626	29.698	29.523	0.175	81.3	83.5	78.8	4.7
1	.615	.690	.519	.171	81.0	83.6	77.0	6.6
2	.605	.678	.509	.169	80.8	83.6	76.8	6.8
3	.595	.670	.505	.165	80.6	83.5	76.5	7.0
4	.590	.688	.496	.192	80.4	83.5	76.5	7.0
5	.598	.694	.490	.204	80.1	83.5	76.3	7.2
6	.610	.698	.493	.205	80.2	83.4	76.6	6.8
7	.623	.704	.509	.195	80.9	83.0	76.8	6.2
8	.641	.724	.519	.205	81.9	85.5	77.0	8.5
9	.652	.732	.529	.203	83.3	87.0	77.8	9.2
10	.653	.733	.533	.200	84.8	87.5	77.0	10.5
11	.641	.720	.523	.197	85.4	89.4	77.0	12.4
Noon.	.626	.704	.506	.198	86.1	90.0	78.2	11.8
1	.605	.682	.488	.194	86.0	91.5	78.4	13.1
2	.582	.659	.473	.186	85.9	91.4	78.5	12.9
3	.561	.639	.450	.189	85.4	91.6	78.0	13.6
4	.548	.627	.432	.195	85.4	90.5	78.6	11.9
5	.548	.618	.445	.173	84.5	88.8	79.5	9.3
6	.561	.627	.452	.175	83.7	88.0	79.6	8.4
7	.579	.655	.478	.177	82.8	86.0	79.5	6.5
8	.603	.682	.500	.182	82.3	85.5	78.5	7.0
9	.623	.697	.510	.187	82.0	85.0	77.6	7.4
10	.638	.712	.536	.176	81.8	84.4	78.2	6.2
11	.635	.712	.530	.182	81.6	84.0	77.9	6.1

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of August 1867.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
Mid-night.	79.7	1.6	78.6	2.7	0.958	10.32	0.92	0.92
1	79.5	1.5	78.4	2.6	.952	.25	.89	.92
2	79.3	1.5	78.2	2.6	.946	.19	.88	.92
3	79.3	1.3	78.4	2.2	.952	.27	.74	.93
4	79.2	1.2	78.4	2.0	.952	.27	.67	.94
5	79.0	1.2	78.2	1.9	.946	.21	.63	.94
6	79.1	1.1	78.3	1.9	.949	.24	.64	.94
7	79.5	1.4	78.5	2.4	.955	.31	.79	.93
8	79.8	2.1	78.3	3.6	.949	.20	1.24	.89
9	80.3	3.0	78.2	5.1	.946	.15	.78	.85
10	80.8	4.0	78.0	6.8	.940	.05	2.41	.81
11	81.1	4.3	78.1	7.3	.943	.08	.60	.80
Noon.	81.0	5.1	77.4	8.7	.922	9.83	3.12	.76
1	81.2	4.8	77.8	8.2	.934	.97	2.94	.77
2	81.1	4.8	77.7	8.2	.931	.94	.93	.77
3	80.8	4.6	77.6	7.8	.928	.91	.77	.78
4	81.0	4.4	77.9	7.5	.937	10.00	.68	.79
5	80.6	3.9	77.9	6.6	.937	.02	.33	.81
6	80.2	3.5	77.7	6.0	.931	9.98	.09	.83
7	80.0	2.9	78.0	4.8	.940	10.09	1.66	.86
8	79.8	2.5	78.0	4.3	.940	.11	.47	.87
9	79.8	2.2	78.3	3.7	.949	.20	.27	.89
10	79.7	2.1	78.2	3.6	.946	.17	.23	.89
11	79.6	2.0	78.2	3.4	.946	.19	.15	.90

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of August 1867.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage 1 ft. 2 in. above Ground.	Prevailing direction of the Wind.	Max. Pressure of Wind.	General aspect of the Sky.
	o	Inches		lb	
1	125.0	0.71	S. & W.	2.9	Stratoni to 8 A. M. ⌒i to 3 P. M. Overcast to 8 P. M. \⌒i afterwards. Rain at 2 & 5 P. M.
2	120.0	0.22	S. by E. & S. S. E.	...	Scatd. \i & ⌒i to 6 P. M. Scatd. _i afterwards. Rain from $11\frac{1}{2}$ A. M. to 1 P. M.
3	120.5	0.79	S. S . E & E.	0.6	Clear to 4 A. M. Scatd. ⌒i to 11 A. M. Stratoni to 6 P. M., clear afterwards. Rain from $10\frac{1}{2}$ to noon & at 3 P. M.
4	120.0	0.29	S. E. & S. S. E.	...	Clear to 5 A. M. Scatd. ⌒i & \i to 11 A. M., clouds of different kinds afterwards. Thunder at $1\frac{1}{2}$ P. M. Rain at $11\frac{1}{2}$ A. M. $2\frac{1}{2}$ & 6 P. M.
5	122.2	0.52	S. S. E.	0.5	Stratoni to 5 A. M. ⌒i to 1 P.M. Overcast to 4 P. M. ⌒i to 8 P. M., clear afterwards. Rain at 2 & 3 P. M.
6	...	1.95	S. S. E. & S. W.	...	Overcast nearly the whole day. Thunder at 6 A. M. Rain at 2 A. M. & from 4 to 7 A. M.
7	129.2	...	S. S. E. &S. S. W.	...	Clear to 5 A. M. Scatd. \i to 11 A. M., clouds of different kinds afterwards.
8	...	...	S. S. E. & S. S. W.	...	Stratoni to 3 A. M. ⌒i to noon. Overcast to 4 P. M. \⌒_i afterwards. Slight rain at 9 & 10 P.M.
9	133·0	0.46	S. by W, S. & S. by E.	...	Scatd. _i to 5 A. M. Overcast to 10 A.M. ⌒i afterwards. Rain from $6\frac{1}{2}$ to 9 A. M. & at $4\frac{1}{2}$ P.M.
10	131.0	...	S. & S. S. E.	...	Scatd. \i & ⌒i nearly the whole day.
11	129.4	0.11	S. & S. by E.	0.2	Scatd. \i to 5 A.M. ⌒i to 3 PM \⌒i afterwards. Rain at $12\frac{1}{2}$ A. M.
12	121.4	0.14	E. S. E. & E.	5.6	Scatd. \⌒i to 10 A. M. Scatd. ⌒i to 5 P. M., clouds of different kinds afterwards. High wind at $7\frac{1}{4}$ P. M. Rain at $1\frac{1}{2}$ & 11 A. M. 2 & from $4\frac{1}{2}$ to 7 P. M.
13	123.0	0.40	E.S. E. & E. by S.	1.2	Stratoni to 4 A.M. Overcast to 9 A. M. ⌒i to 1 P. M. Overcast afterwards. Rain after intervals.
14	...	0.82	E. S. E, S. E.& S.	...	Overcast nearly the whole day. Rain from midnight to $5\frac{1}{2}$ P. M. & at $9\frac{1}{2}$ P. M.
15	...	4.64	W.& S. W.	1.4	Overcast. Rain nearly the whole day.

Solar Radiation, Weather, &c.—*(Continued.)*

Date.	Max. Solar radiation.	Rain Guage 1 ft. 2 in. above Ground.	Prevailing direction of the Wind.	Max. Pressure of Wind.	General aspect of the Sky.
	o	Inches		lb	
16	...	2.66	S. S. W.	3.7	Overcast. High wind at 9½ A. M. Rain after intervals.
17	120.0	0.26	S. S.W.,S. W. & S.	0.5	Overcast to 10 A. M. Scatd. \⌒i afterwards. Rain at 1, 2, & 4 AM.
18	119.6	...	S. S. E. & S.	...	\⌒i to 3 A. M. Overcast to 3 P. M. \i to 7 P. M. Scatd. _i afterwards. Slight rain at 4½ & 6½ AM
19	...	0.10	S. S. W. & S.S. E.	...	\⌒i to 7 A. M. ⌒i to noon. Overcast & ⌒‿i afterwards. Thunder at 2 P. M. Rain at 10½ A. M. & 4½ P. M.
20	...	0.19	W.S.W. & S. S.W.	...	\⌒i to 6 A. M. Overcast afterwards. Light rain at 9 A. M., from 11 A. M. to 3 P. M. & from 9 to 11 P. M.
21	134.8	0.16	S. by E,SSE& SW.	...	Overcast to 6 A. M. Scatd. ⌒i to 7 P. M. Clear afterwards. Rain at midnight 1, 3 & 4 A. M.
22	132.0	...	S. & S. S. E.	...	Scatd. ⌒i & _i to 3 A. M. Scatd. ⌒i to 2 P. M. \i & ⌒‿i to 6 P. M., clear afterwards. Slight rain at 6 & 11 A. M.
23	130.5	...	S, S. W. & S. S. W.	...	Scatd. \⌒i to 8 A. M. ⌒i to 3 P. M. Scatd. clouds afterwards. Thunder at 3½ P. M. Lightning to W. at 8 P. M.
24	...	3.40	S.by E, S.&WS.W.	4.6	Stratoni to 2 A. M. Overcast to 7 P. M. Scatd. clouds afterwards. High wind at 6½ A.M. Thunder from 7 to 10 A. M. Lightning at 8 & 9 A. M. Rain from 7 to noon & at 2 P M.
25	...	0.48	N.W,S.W.& S. S.E	...	Overcast to 10 A. M. ⌒i to 3 P.M. \⌒i to 6 P. M., clear afterwards. Rain from midnight to 4 & at 8 A. M.
26	134.4	0.20	S.S.E,SSW&SbyW	0.4	Stratoni to 6 A.M. ⌒i to 7 P.M. clear afterwards. Rain at 5½, 9 & 12½ A. M.
27	127.0	...	S. & S. by W	0.2	Clear to 4 A. M. \⌒i to 7 A. M. \i & ⌒i to 7 P.M. clear afterwards
28	126.0	...	S.& S. S. E.	0.2	Clear to 2 A.M Scatd. clouds to 4 A. M. \⌒i to 7 A. M. ⌒i to 7 P. M., clear afterwards. Lightning at 10 & 11 P. M. Slight at 4 & 8½ P. M.
29	132.4	...	S. & S. S. E.	...	Clear to 7 A. M. ⌒i afterwards.
30	137.0	...	S. & S. by W.	...	Clear to 5 A. M. \i & ⌒i to 7 PM. clear afterwards.
31	127.0	...	S. by W.& S. S. E.	...	Clear to 5 A.M. ⌒i to 9 P.M. clear afterwards.

\i Cirri, —i Strati, ⌒i Cumuli, _i Cirro-strati, ⌒‿i Cumulo strati, \⌒ Nimbi, \⌒i Cirro cumuli.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of August 1867.

Monthly Results.

	Inches.
Mean height of the Barometer for the month...	29.607
Max. height of the Barometer occurred at 10 A. M. on the 24th ...	29.733
Min. height of the Barometer occurred at 4 P.M. on the 12th ...	29.432
Extreme range of the Barometer during the month	0.301
Mean of the daily Max. Pressures	29.661
Ditto ditto Min. ditto	29.542
Mean daily range of the Barometer during the month	0.119

	°
Mean Dry Bulb Thermometer for the month	82.8
Max. Temperature occurred at 3 P. M. on the 30th	91.6
Min. Temperature occurred at 5 A. M. on the 16th	76.3
Extreme range of the Temperature during the month	15.3
Mean of the daily Max. Temperature	87.3
Ditto ditto Min. ditto, ...	79.7
Mean daily range of the Temperature during the month... ...	7.6

Mean Wet Bulb Thermometer for the month	80.1
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer	2.7
Computed Mean Dew-point for the month	78.2
Mean Dry Bulb Thermometer above computed mean Dew-point ...	4.6
	Inches.
Mean Elastic force of Vapour for the month	0.946

	Troy grain.
Mean Weight of Vapour for the month	10.15
Additional Weight of Vapour required for complete saturation ...	1.60
Mean degree of humidity for the month, complete saturation being unity	0.86

	Inches.
Rained 24 days,—Max. fall of rain during 24 hours	4.64
Total amount of rain during the month	18.50
Total amount of rain indicated by the Gauge attached to the anemometer during the month	17.09
Prevailing direction of the Wind... ...	S. S. E., S. & S. S. W.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of Augt. 1867.

MONTHLY RESULTS.

Tables shewing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour, when any particular wind was blowing, it rained.

No. of days

Hour.	N.	Rain on.	N. by E.	Rain on.	N. N. E.	Rain on.	N. E.	Rain on.	E. N. E.	Rain on.	E. by N.	Rain on.	E.	Rain on.	E. by S.	Rain on.
Mid night													1	1		
1									1	1						
2											1	1	1			
3									1				1	1	1	
4									1				2			
5													3		1	
6									1				1		1	
7							1		1						1	1
8													2	1	1	
9									1							
10													2			
11													1	1	1	
Noon.													1		2	1
1					1								1		1	
2													1			
3													2	1		
4													4		1	
5																
6													1	1		
7																
8																
9																
10																
11											1		1			

Hour.	E. S. E.	Rain on.	S. E.	Rain on.	S. S. E.	Rain on.	S. by E.	Rain on.	S.	Rain on.	S. by W.	Rain on.	S. S. W.	Rain on.	S. W.	Rain on.
Mid night	2	1	1		4		7	1	11	1	2		1		2	2
1	1		3		4	1	7	1	8		2		2		2	2
2			3		6	2	3	1	9		2		2		2	1
3			2		4		3		8		3		2		4	2
4	1	1	1		5		1		9		2		3		3	3
5	2	1			5				7		5	2	5	1	1	
6	3	1	1	1	3	1			8	1	4		5	2	1	
7	1		2		6		3	1	3		4	1	5	1		
8	2		2	1	7		4	1	3				1		5	1
9	2		3	1	7		4	2	4				2		4	
10	3		3		7						2		8	1	2	1
11	2	2	3	1	5		2		3				7	1	4	
Noon.	2		1	1	6		1	1	4		4		4		1	
1	1	1	2	1	4		3		6	2	2		3		3	1
2	2	1	3	1	4	1	3	1	3		1		7	2	4	1
3	2	1	3		5				4	1	1		7	1	5	2
4			3	1	3		3	1	7	1	5		3		1	
5	1		3	2	10	2	2		7	1			6	2	2	
6					11	1	5	1	4	1	1		6		1	
7	1		2		10	1	3		5		4		5	1		
8	1	1	1		10		4		8				5	1		
9	2	1	1		9		3		9	1	1		4	2		
10	2				8		7		6		1		4	2	1	1
11					8		6		7		3		3	1		

Hour.	W. S. W.	Rain on.	W. by S.	Rain on.	W.	Rain on.	W. by N.	Rain on.	W. N. W.	Rain on.	N. W.	Rain on.	N. N. W.	Rain on.	N. by W.	Rain on.
Mid night																
1											1	1				
2	1	1									1	1				
3					1	1					1	1				
4					1	1	1	1			1	1				
5					1	1					1					
6	1				1	1					1					
7	1				2	1					1	1				
8	3	1			1	1										
9	1	1	1	1	2	1										
10	2		1	1	1											
11	2	1			1	1										
Noon.	5	3														
1	4	1														
2	2	2			1											
3	1				1											
4	1															
5																
6	1	1			1											
7					1											
8	1				1											
9	1	1			1											
10	1	1			1											
11	1	1			1											

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of September 1867.

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the sea level, 18.11 feet.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer during the day.			Mean Dry Bulb Thermometer.	Range of the Temperature during the day.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	29.577	29.636	29.489	0.147	86.8	92.5	82.8	9.7
2	.588	.632	.543	.089	84.0	88.6	81.5	7.1
3	.619	.670	.574	.096	82.5	88.9	79.8	9.1
4	.648	.708	.581	.127	82.3	88.0	79.9	8.1
5	.673	.734	.614	.120	80.6	84.3	78.5	5.8
6	.711	.771	.661	.110	80.1	82.5	78.0	4.5
7	.710	.794	.640	.154	83.4	88.5	79.0	9.5
8	.686	.758	.601	.157	84.3	89.5	80.0	9.5
9	.635	.701	.549	.152	85.2	90.8	80.9	9.9
10	.630	.695	.559	.136	86.0	92.0	81.5	10.5
11	.659	.722	.552	.170	86.0	89.6	82.0	7.6
12	.675	.731	.606	.125	86.4	92.5	81.9	10.6
13	.635	.691	.575	.116	84.7	92.2	81.5	10.7
14	.550	.617	.455	.162	85.2	92.4	81.5	10.9
15	.480	.537	.413	.124	81.6	86.6	78.5	8.0
16	.425	.491	.343	.148	80.8	84.6	78.5	6.1
17	.467	.551	.374	.177	81.5	84.5	79.8	4.7
18	.561	.628	.505	.123	82.0	86.6	79.5	7.1
19	.612	.676	.565	.111	83.2	86.0	80.0	6.0
20	.630	.672	.591	.081	81.5	86.5	77.4	9.1
21	.653	.711	.605	.106	79.8	83.0	77.0	6.0
22	.682	.745	.638	.107	79.8	85.0	76.0	9.0
23	.720	.781	.661	.120	81.8	88.2	76.5	11.7
24	.735	.804	.665	.139	83.6	88.6	78.6	10.0
25	.688	.750	.601	·149	85.2	90.7	80.5	10.2
26	.663	.711	.591	.120	86.3	91.7	82.0	9.7
27	.714	.786	.660	.126	85.4	92.0	80.0	12.0
28	.772	.840	.719	.121	83.4	90.7	80.5	10.2
29	.793	.848	.737	.111	81.8	85.5	79.8	5.7
30	.799	.844	.764	.080	79.1	81.5	78.0	3.5

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived, from the hourly observations, made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of September 1867.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	82.2	4.6	79.4	7.4	0.983	10.47	2.47	0.79
2	81.0	3.0	78.9	5.1	.967	.37	1.80	.85
3	80.0	2.5	78.2	4.3	.946	.17	.47	.87
4	80.0	2.3	78.4	3.9	.952	.23	.35	.88
5	78.6	2.0	77.2	3.4	.916	9.89	.12	.90
6	78.9	1.2	78.1	2.0	.943	10.18	0.66	.94
7	80.1	3.3	77.8	5.6	.934	.01	1.95	.84
8	80.7	3.6	78.2	6.1	.946	.13	2.15	.83
9	80.6	4.6	77.4	7.8	.922	9.85	·76	.78
10	81.4	4.6	78.2	7.8	.946	10.09	.82	.78
11	81.6	4.4	78.5	7.5	.955	.18	.73	.79
12	81.9	4.5	78.7	7.7	.961	.24	.82	.78
13	81.1	3.6	78.6	6.1	.958	.26	.16	.83
14	82.3	2.9	80.3	4.9	1.011	.80	1.81	.86
15	79.7	1.9	78.4	3.2	0.952	.25	.09	.90
16	79.3	1.5	78.2	2.6	.946	.19	0.88	.92
17	80.2	1.3	79.3	2.2	.979	.55	.76	.93
18	80.4	1.6	79.3	2.7	.979	.53	.94	.92
19	81.4	1.8	80.1	3.1	1.005	.77	1.12	.91
20	79.7	1.8	78.4	3.1	0.952	.25	.06	.91
21	78.5	1.3	77.6	2.2	.928	.03	0.72	.93
22	77.4	2.4	75.7	4.1	.873	9.43	1.32	.88
23	78.8	3.0	76.7	5.1	.902	.70	.70	.85
24	80.8	2.8	78.8	4.8	.964	10.34	.69	.86
25	81.7	3.5	79.2	6.0	.976	.43	2.18	.83
26	82.6	3.7	80.0	6.3	1.001	1.68	.34	.82
27	81.4	4.0	78.6	6.8	0.958	.23	.45	.81
28	80.1	3.3	77.8	5.6	.934	.01	1.95	.84
29	79.1	2.7	77.2	4.6	.916	9.85	.55	.86
30	77.8	1.3	76.9	2.2	.908	.82	0.71	.93

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of September 1867.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer for each hour during the month.			Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Mid-night.	29.658	29.792	29.450	0.342	81.5	84.5	77.0	7.5
1	.646	.779	.432	.347	81.3	84.2	77.0	7.2
2	.635	.773	.411	.362	81.0	84.0	76.5	7.5
3	.625	.764	.394	.370	80.7	83.8	76.5	7.3
4	.622	.769	.374	.395	80.5	83.4	76.4	7.0
5	.631	.774	.392	.382	80.4	84.2	76.4	7.8
6	.648	.787	.412	.375	80.4	84.0	76.0	8.0
7	.664	.800	.443	.357	81.0	84.5	76.0	8.5
8	.685	.836	.477	.359	82.3	85.7	76.8	8.9
9	.700	.845	.491	.354	84.1	87.7	78.4	9.3
10	.701	.846	.474	.372	85.0	89.3	79.0	10.3
11	.689	.848	.450	.398	85.6	90.0	78.5	11.5
Noon.	.666	.813	.395	.418	86.5	91.5	78.0	13.5
1	.642	.811	.398	.413	86.8	92.2	78.0	14.2
2	.618	.797	.376	.421	86.7	92.5	77.4	15.1
3	.598	.777	.362	.415	85.9	92.5	78.5	14.0
4	.590	.773	.343	.430	85.7	92.2	78.5	13.7
5	.592	.773	.354	.419	85.0	92.0	78.7	13.3
6	.608	.787	.378	.409	83.7	89.0	79.0	10.0
7	.627	.800	.398	.408	83.1	88.0	79.0	9.0
8	.650	.811	.408	.403	82.6	86.2	79.0	7.2
9	.668	.821	.414	.407	82.2	86.0	78.0	8.0
10	.678	.833	.420	.413	82.0	85.8	77.5	8.3
11	.674	.827	.432	.395	81.6	85.4	76.4	9.0

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of September 1867.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
Midnight.	79.7	1.8	78.4	3.1	0.952	10.25	1.06	0.91
1	79.6	1.7	78.4	2.9	.952	.25	0.99	.91
2	79.5	1.5	78.4	2.6	.952	.25	.89	.92
3	79.3	1.4	78.3	2.4	.949	.24	.80	.93
4	79.2	1.3	78.3	2.2	.949	.24	.74	.93
5	79.0	1.4	78.0	2.4	.940	.15	.79	.93
6	79.1	1.3	78.2	2.2	.946	.21	.73	.93
7	79.6	1.4	78.6	2.4	.958	.34	.80	.93
8	80.3	2.0	78.9	3.4	.967	.41	1.17	.90
9	80.8	3.3	78.5	5.6	.955	.23	·.98	.84
10	81.4	3.6	78.9	6.1	.967	.34	2.19	.83
11	81.4	4.2	78.5	7.1	.955	.21	.55	.80
Noon.	81.6	4.9	78.7	7.8	.961	.24	.86	.78
1	81.7	5.1	78.6	8.2	.958	.21	3.00	.77
2	81.3	5.4	78.1	8.6	.943	.04	.14	.76
3	81.0	4.9	77.6	8.3	.928	9.91	2.96	.77
4	81.0	4.7	77.7	8.0	.931	.94	.86	.78
5	80.7	4.3	77.7	7.3	.931	.96	.57	.80
6	80.6	3.1	78.4	5.3	.952	10.21	1.86	.85
7	80.5	2.6	78.7	4.4	.961	.33	.53	.87
8	80.3	2.3	78.7	3.9	.961	.33	.35	.88
9	80.2	2.0	78.8	3.4	.964	.38	.16	.90
10	80.0	2.0	78.6	3.4	.958	.32	.15	.90
11	79.7	1.9	78.4	3.2	.952	.25	.09	.90

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of September 1867.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage 1 ft. 2 in. above Ground.	Prevailing direction of the Wind.	Max. Pressure of Wind.	General aspect of the Sky.
	o	Inches		lb	
1	131.4	...	S. & E. N. E.	...	\i to 6 A. M. ⌒i to 7 P. M., clear afterwards. Slight rain at 4½ P. M.
2	...	0.15	S., E. & E. by S.	0.3	Scatd. clouds to 4 A. M. \⌒i to 9 A. M., overcast to 7 P. M., clear afterwards. Thunder at 11½ A. M. Rain at 10 & 11 A. M. & at 4½ & 5½ P. M.
3	...	0.96	E. N. E. & S. E.	3.0	_i to 5 A. M., overcast afterwards. High wind at 1¼ P. M. Thunder at 8½ A. M. & 1½ P. M. Lightning at 1½ P. M. Rain at 8¼ A. M. & from 1½ to 3½ P. M.
4	...	0.49	E., S. E. & S. W.	...	Clear to 2 A. M. Stratoni to 6 A. M. \⌒i to 11 A. M. ⌒i to 2 P. M. overcast to 6 P. M. \⌒i afterwards. Rain at 11½ A. M., from 3 to 6 P. M. & at 10½ P. M.
5	...	0.12	S. by E.	0.6	Clear to 4 A. M. Stratoni to 4 P. M. ⌒i afterwards. Rain at 8 A. M.
6	...	1.03	S. S. E.	...	Overcast to 5 P. M. Stratoni afterwards. Rain from 2 A. M. to 1 P. M.
7	134.0	0.10	S. W. & S. S. W.	0.1	Stratoni to 10 A. M. ⌒i to 5 P. M. \⌒i afterwards. Rain at 4 A. M.
8	133·0	...	S. S. W. & S. W.	...	⌒i nearly the whole day.
9	126.0	...	S. S. W, & S. W.	...	Clear to 7 A. M. ⌒i to 7 P. M., clear afterwards.
10	135.0	...	S. S. W. & S. W.	...	Clear to 6 A. M. ⌒i to 6 P. M., clear afterwards.
11	...	...	S. W. & S. E.	...	⌒i & \i to 10 A. M. Stratoni afterwards.
12	131.0	...	S. by E. & S. S. E.	0.2	Stratoni to 5 A. M. ⌒i to 3 P. M., clouds of different kinds afterwards. Lightning at 7 & 8 P. M. Slight rain at 6 P. M.
13	129.5	0.89	S. S. E. & S. E.	4.0	Clear to 6 A. M., ⌒i to 2 P. M., overcast to 5 P. M., clouds of different kinds afterwards. High wind at 2¾ P. M. Lightning to W. at 7 P. M. Rain from 2½ to 4 P. M.
14	125.0	2.05	N. E. & W. by N.	6.9	\i to 5 A. M. ⌒i afterwards. High wind & rain at 2½ & 10½ P. M. Lightning to E at 10 P. M. Thunder at 10½ P. M.
15	...	0.54	E. N. E. & N. E.	0.4	Overcast nearly the whole day. Lightning to W from midnight to 2 A. M. Thunder at 1 A. M. Rain from 3 to 8 A. M. and at 3, 4 and 8 P. M.

Solar Radiation, Weather, &c.—*(Continued.)*

Date.	Max. Solar radiation.	Rain Guage 1 ft. 2 in. above Ground.	Prevailing direction of the Wind.	Max. Pressure of Wind.	General aspect of the Sky.
	o	Inches		lb	
16	...	0.84	N. E, E. & E. by S.	1.0	Overcast nearly the whole day. Rain at 6 & 8 A. M. & from 10½ A. M. to 4 P. M. & at 7 P. M.
17	...	0.36	S. E. &E. S. E.	0.2	Stratoni to 11 A. M., overcast afterwards. Rain at 5, 6 & 12 A. M. & at 11 P. M.
18	...	0.52	S. E. & S. S. E.	1.1	Overcast to 4 P. M., clouds of different kinds afterwards. Thunder at 10½ A. M. Lightning to S at 8 P.M. Rain at midnight, 3 & 11 A. M. & at 1, 2½ & 7 P. M.
19	...	0.70	S. W. & S. by E.	...	Overcast to 10 A. M., stratoni to 6 P. M. ╲_i afterwards. Rain at midnight & 3½ A. M.
20	...	0.91	W. S. W. & S.	3.1	⌒i & ╲i to 8 A. M., stratoni to noon., overcast to 6 P. M., ╲_i afterwards. High wind, thunder & Lightning at 3 P. M. Rain from 2 to 6 P. M.
21	...	1.79	W.N.W.&W. byN.	1.6	Overcast.Rain after intervals.
22	...	1.29	W. &W. S. W.	1.2	Overcast to 11 A. M. ╲⌒i to 6 P. M., clear to 8 P. M., overcast afterwards. Rain from 2 to 8 A. M. & from 9 to 11 P. M.
23	...	0.11	S. W., S. & S. S. E.	...	Overcast to 6 A. M. ╲⌒i to 11 A. M. ╲i & ⌒i afterwards. Lightning to W at 11 P. M. Rain at 2 & 3 A. M.
24	...	...	S. S. E, & S. E.	...	Clear to 2 A. M. ⌒i to 4 P. M., clear afterwards. Slight rain at 10½ A. M.
25	...	...	S.& S. W.	...	Cear to 4 A. M. ╲⌒i to 7 A. M. ⌒i to 5 P. M., clear afterwards. Slight rain at 1 P. M.
26	134.0	...	S. W. & W. S. W.	...	Clear to 7 A. M. ⌒i to 6 A. M., clear afterwards.
27	130.5	0.05	S. S. W. & S. S. E.	1.0	Clear to 6 A. M. ⌒i to 5 P.M., overcast afterwards Thunder at 4½ P. M. & from 7 to 9 P. M. Lightning at 7 P. M. Light rain at 4½ P. M.
28	132.0	...	S. S. E. &E.N. E.	...	╲_i to 4 A. M, ╲⌒i to 10 A. M. ⌒i to 1 P. M. ╲_i to 4 P. M. overcast afterwards. Slight rain at 5½ & 9 P. M.
29	...	0.07	N. E. & E. S.E.	1.0	Clear to 5 A. M ╲⌒i to 9 A.M. overcast to 7 P. M. ╲i afterwards. Lightning to S from 8 to 11 P.M. Rain at 7½ & 10 A.M.
30	...	0.73	E. N. E. & E.	1.0	Clear to 5 A.M., overcast to 8 P. M., clear afterwards. Rain at 8 A. M. & from 11 A. M. to 4 P. M.

╲i Cirri, —i Strati, ⌒i Cumuli, ╲_i Cirro-strati, ⌒-i Cumulo strati, ╲⌒ Nimbi, ╲⌒i Cirro cumuli.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of September 1867.

MONTHLY RESULTS.

	Inches.
Mean height of the Barometer for the month...	29.645
Max. height of the Barometer occurred at 11 A. M. on the 29th ...	29.848
Min. height of the Barometer occurred at 4 P.M. on the 16th ...	29.343
Extreme range of the Barometer during the month	0.505
Mean of the daily Max. Pressures	29.708
Ditto ditto Min. ditto	29.582
Mean daily range of the Barometer during the month	0.126

	o
Mean Dry Bulb Thermometer for the month	83.1
Max. Temperature occurred at 2 & 3 P. M. on the 1st & 12th... ...	92.5
Min. Temperature occurred at 6 & 7 A. M. on the 22nd	76.0
Extreme range of the Temperature during the month	16.5
Mean of the daily Max. Temperature	88.1
Ditto ditto Min. ditto, ...	79.7
Mean daily range of the Temperature during the month... ...	8.4

Mean Wet Bulb Thermometer for the month	80.3
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer	2.8
Computed Mean Dew-point for the month	78.3
Mean Dry Bulb Thermometer above computed mean Dew-point ...	4.8

	Inches.
Mean Elastic force of Vapour for the month	0.949

	Troy grain.
Mean Weight of Vapour for the month	10.18
Additional Weight of Vapour required for complete saturation ...	1.68
Mean degree of humidity for the month, complete saturation being unity	0.86

	Inches.
Rained 25 days,—Max. fall of rain during 24 hours	2.05
Total amount of rain during the month	13.70
Total amount of rain indicated by the Gauge attached to the anemometer during the month	12.41
Prevailing direction of the Wind... ... S. W. & S. S. E.	

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of Sept. 1867.

MONTHLY RESULTS.

Tables shewing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour, when any particular wind was blowing, it rained.

No. of days

Hour.	N.	Rain on.	N. by E.	Rain on.	N. N. E.	Rain on.	N. E.	Rain on.	E. N. E.	Rain on.	E. by N.	Rain on.	E.	Rain on.	E. by S.	Rain on.	E. S. E.	Rain on.	S. E.	Rain on.	S. S. E.	Rain on.	S. by E.	Rain on.
Mid night									2				3				1		2		6		2	1
1	1						1		2		2		2						1		4		2	
2							3		1		2		2								4	1	3	
3							3		2				2				2		1		1		3	
4							3		2				2				2		2				3	1
5							4	2	3		1		1				1	1	2				2	
6							4	1	4	1	1				1				2		2	1	2	
7							3	1	3		2		2				1		2		3	1	2	
8					1	1	1	1	3				2	1	1		3		3	1	3	1		
9							1		4				3	1			2		4	1	2	1		
10									1		1		4	1			7	1	3	1			1	
11							1		1	1			3	1			5		1		4	2	4	2
Noon.									3				2		1		2	1	4	2	3	2	3	
1					1		3		2		1		1	1			3		2		4	1	2	2
2	1				1		5						1				4	2	2		2		2	1
3							1	1	3	2			4	2	1		1		2		5	3	2	
4							1		2	1			1		1	1	2		5	3	3	2		
5							1	1	3	1	1	1	3				2		2		1		2	1
6							1		1				6	1			2		1		4	1	2	
7							1		1				1		2	1	2		3		4		3	
8							1	1					2		2				3		7		3	
9							1		1		1		1		1				3		7	1	2	
10									1		1		1		2				3		6		3	
11									2				2		1				4	1	6	1	2	1

Hour.	S.	Rain on.	S. by W.	Rain on.	S. S. W.	Rain on.	S. W.	Rain on.	W. S. W.	Rain on.	W. by S.	Rain on.	W.	Rain on.	W. by N.	Rain on.	W. N. W.	Rain on.	N. W.	Rain on.	N. N. W.	Rain on.	N. by W.	Rain on.
Mid night	4		1		3		3		1						1									
1	4		1		3		4	1	1	1			1											
2	4		1		4		3	1	1	1									1	1				
3	4				5	1	3	1	2	2									1	1				
4	5	1			4		3		2	2											1	1		
5	3		1		5	1	4		1				1	1										
6	2		1		4		4		1				1	1			1	1						
7	2				4		3		2				1	1										
8	2	1	1		1		6		1				1	1					1					
9	1		1		4		2		3		1		1						1					
10					4		3		3				1	1	1		1							
11					3		3		2						1		1		1	1				
Noon.	1		1		1		5				1						2		1	1				
1			1		1		4	1	1		1				1		2	1						
2			4		2		1				2						2		1	1				
3			1		3		3		1				1				1		1					
4	2		1		3		5		1						1		1				1			
5	3		1		2		5		2	1					1		1	1						
6	2				1		6	1	2	1					2									
7	2	1			1		7		1						2	1								
8	2				1		6		1						1		1	1						
9	3		1		1		4		1						2		1	1						
10	1		2		3		4	1	1						2									
11	3		1		3		3	1	1						1									

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of October 1867.

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the sea level, 18.11 feet.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer during the day.			Mean Dry Bulb Thermometer.	Range of the Temperature during the day.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	29.818	29.879	29.767	0.112	81.5	87.8	78.0	9.8
2	.850	.911	.799	.112	83.0	86.5	79.2	10.3
3	.879	.941	.821	.120	84.0	89.5	80.2	9.3
4	.874	.942	.793	.149	83.4	88.5	77.3	11.2
5	.861	.924	.809	.115	82.8	88.0	78.0	10.0
6	.852	.912	.794	.118	83.9	89.4	80.6	8.8
7	.852	.913	.796	.117	83.4	88.8	78.5	10.3
8	.852	.906	.802	.104	83.8	90.0	79.0	11.0
9	.876	.950	.789	.161	83.9	89.3	79.7	9.6
10	.874	.947	.799	.148	84.2	89.5	79.5	10.0
11	.847	.895	.802	.093	82.8	90.0	78.5	11.5
12	.825	.872	.755	.117	83.3	89.5	78.8	10.7
13	.859	.929	.811	.118	82.9	89.0	78.5	10.5
14	.890	.953	.841	.112	83.4	88.7	79.2	9.5
15	.911	.972	.851	.121	83.1	88.8	77.9	10.9
16	.916	30.008	.836	.172	81.2	87.0	76.2	10.8
17	.875	29.944	.817	.127	81.5	88.5	75.0	13.5
18	.862	.902	.803	.099	81.1	87.0	78.0	9.0
19	.908	.956	.870	.086	77.1	79.5	75.4	4.1
20	.934	.999	.886	.113	78.4	84.6	75.7	8.9
21	.880	.957	.800	.157	80.8	86.7	76.0	10.7
22	.844	.897	.767	.130	80.9	85.5	78.0	7.5
23	.880	.959	.816	.143	82.8	88.4	78.5	9.9
24	.936	.994	.870	.124	81.3	86.0	77.0	9.0
25	.939	30.005	.887	.118	79.3	83.6	77.0	6.6
26	.909	29.977	.842	.135	79.7	85.0	76.5	8.5
27	.914	.981	.865	.116	79.4	85.0	74.5	10.5
28	.912	.982	.865	.117	78.5	85.4	72.5	12.9
29	.916	.979	.875	.104	76.4	84.5	69.5	15.0
30	.895	.945	.848	.097	76.9	83.5	69.5	14.0
31	.836	.881	.779	.102	73.1	74.7	70.6	4.1

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived, from the hourly observations, made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of October 1867.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	79.7	1.8	78.4	3.1	0.952	10.25	1.06	0.91
2	80.6	2.4	78.9	4.1	.967	.39	.43	.88
3	81.1	2.9	79.1	4.9	.973	.42	.75	.86
4	79.7	3.7	77.1	6.3	.913	9.80	2.16	.82
5	79.5	3.3	77.2	5.6	.916	.83	1.92	.84
6	79.9	4.0	77.1	6.8	.913	.78	2.35	.81
7	79.4	4.0	76.6	6.8	.899	.63	.33	.81
8	78.2	5.6	74.3	9.5	.835	8.94	3.16	.74
9	77.7	6.2	73.4	10.5	.811	.67	.46	.72
10	78.3	5.9	74.2	10.0	.832	.91	.33	.73
11	77.9	4.9	74.5	8.3	.840	9.03	2.72	.77
12	78.3	5.0	74.8	8.5	.849	.09	.84	.76
13	78.3	4.6	75.1	7.8	.857	.19	.60	.78
14	77.9	5.5	74.0	9.4	.827	8.88	3.08	.74
15	76.4	6.7	71.7	11.4	.768	.24	.62	.70
16	74.4	6.8	69.6	11.6	.717	7.71	.50	.69
17	74.8	6.7	70.1	11.4	.729	.85	.46	.69
18	77.8	3.3	75.5	5.6	.868	9.35	1.82	.84
19	76.2	0.9	75.6	1.5	.871	.44	0.48	.95
20	76.4	2.0	75.0	3.4	.854	.25	1.06	.90
21	77.4	3.4	75.0	5.8	.854	.20	.87	.83
22	78.2	2.7	76.3	4.6	.890	.59	.51	.86
23	78.3	4.5	75.1	7.7	.857	.19	2.56	.78
24	77.5	3.8	74.8	6.5	.849	.13	.11	.81
25	77.2	2.1	75.7	3.6	.873	.43	1.16	.89
26	76.2	3.5	73.7	6.0	.819	8.85	.87	.83
27	74.3	5.1	70.7	8.7	.744	.03	2.59	.76
28	71.5	7.0	66.6	11.9	.651	7.04	3.31	.68
29	69.2	7.2	64.2	12.2	.601	6.53	.19	.67
30	69.4	7.5	64.1	12.8	.599	.50	.36	.66
31	71.7	1.4	70.6	2.5	.741	8.10	0.69	.92

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of October 1867.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer for each hour during the month.			Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Mid-night.	29.883	29.949	29.813	0.136	78.9	82.6	73.0	9.6
1	.873	.940	.795	.145	78.5	82.2	72.5	9.7
2	.865	.935	.790	.145	78.1	82.0	72.4	9.6
3	.858	.934	.783	.151	77.9	81.6	71.3	10.3
4	.857	.929	.802	.127	77.6	81.5	70.5	11.0
5	.872	.938	.815	.123	77.4	81.3	70.0	11.3
6	.889	.951	.821	.130	77.2	81.0	69.5	11.5
7	.905	.974	.840	.134	78.1	81.5	70.6	10.9
8	.924	.998	.855	.143	80.6	84.0	74.0	10.0
9	.937	30.008	.862	.146	82.6	86.8	74.7	12.1
10	.939	.003	.860	.143	83.9	87.2	74.5	12.7
11	.921	29.981	.842	.139	85.1	88.0	74.4	13.6
Noon.	.899	.965	.833	.132	85.3	89·4	73.4	16.0
1	.871	.937	.808	.129	85.3	90.0	73.0	17.0
2	.847	.912	.776	.136	85.4	89.5	73.0	16.5
3	.830	.892	.755	.137	85.6	90.0	73.0	17.0
4	.828	.887	.767	.120	84.9	89.6	72.4	17.2
5	.832	.901	.773	.128	84.2	89.0	72.2	16.8
6	.847	.921	.782	.139	82.3	86.6	71.6	15.0
7	.863	.919	.793	.126	81.3	85.0	71.0	14.0
8	.882	.939	.811	.128	80.6	84.5	70.8	13.7
9	.896	.950	.841	.109	79.9	84.0	71.0	13.0
10	.903	.959	.843	.116	79.4	83.5	71.0	12.5
11	.896	.955	.845	.110	79.0	82.8	70.6	12.2

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of October 1867.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
Midnight.	76.6	2.3	75.0	3.9	0.854	9.24	1.23	0.88
1	76.4	2.1	74.9	3.6	.851	.21	.14	.89
2	76.2	1.9	74.9	3.2	.851	.22	.00	.90
3	76.0	1.9	74.7	3.2	.846	.17	0.99	.90
4	75.9	1.7	74.7	2.9	.746	.17	.90	.91
5	75.7	1.7	74.5	2.9	.840	.12	.89	.91
6	75.7	1.5	74.6	2.6	.843	.14	.81	.92
7	76.4	1.7	75.2	2.9	.860	.31	.91	.91
8	77.2	3.4	74.8	5.8	.849	.15	1.86	.83
9	77.6	5.0	74.1	8.5	.830	8.91	2.77	.76
10	77.6	6.3	73.2	10.7	.806	.63	3.50	.71
11	77.8	7.3	72.7	12.4	.792	.47	4.10	.67
Noon.	77.6	7.7	72.2	13.1	.781	.33	.31	.66
1	77.4	7.9	71.9	13.4	.773	.26	.38	.65
2	77.4	8.0	71.8	13.6	.771	.21	.47	.65
3	77.5	8.1	71.8	13.8	.771	.21	.55	.64
4	77.4	7.5	72.1	12.8	.778	.31	.18	.67
5	77.4	6.8	72.6	11.6	.790	.45	3.79	.69
6	77.3	5.0	73.8	8.5	.822	.82	2.76	.76
7	77.1	4.2	74.2	7.1	.832	.96	.28	.80
8	77.0	3.6	74.5	6.1	.840	9.07	1.94	.82
9	76.8	3.1	74.6	5.3	.843	.11	.67	.85
10	76.7	2.7	74.8	4.6	.849	.17	.45	.86
11	76.5	2.5	74.7	4.3	.846	.16	.34	.87

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of October 1867.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage 1 ft. 2 in. above Ground.	Prevailing direction of the Wind.	Max. Pressure of Wind.	General aspect of the Sky.
	o	Inches		lb	
1	...	0.81	S. by E. & variable.	0.2	⌒i to noon. Overcast to 3 P. M. Clouds of different kinds afterwards. Rain at 1 & 2 P. M.
2	127.0	...	S. by E. & S.	...	Clear to 5 A. M. \⌒i to 11 A. M. ⌒i to 8 P. M. Clear afterwards. Thunder at $2\frac{1}{2}$ P. M. Slight rain at 5 P. M.
3	131.0	...	S. & S. S. W.	...	Clear to 7 A. M. ⌒i to 7 P. M. Overcast afterwards. Lightning from 8 to 10 P. M.
4	124.0	...	S. S.W. & variable.	3.7	_i to 5 A. M. \⌒i to 1 P. M. Clouds of different kinds afterwards. High wind at 9 P. M. Lightning from 7 to 9P.M. Slight rain at 9 P. M.
5	...	...	S. W. & S. S. W.	...	Clear to 4 A. M. \⌒i to noon. ⌒i afterwards. Lightning at 8 & 11 P. M. Thunder & slight rain at $2\frac{1}{2}$ P. M.
6	130.8	...	S. S. W. & S. W.	...	Clear to 5 A. M. ⌒i to 5 P. M. Clouds of different kinds afterwards.
7	132.6	...	W. S. W, & S.S. E.	...	_i & \i to 8 A. M. ⌒i afterwards.
8	128.4	...	N. W. & W. N. W.	...	Clear to 11 A. M. ⌒i to 4 P. M. Clear afterwards.
9	128.0	...	N. W. & N. N. W.	...	Clear to 6 A. M. \⌒i to 3 P. M. ⌒i to 8 P. M. Clear afterwards.
10	125.0	...	N. E. & E. N. E.	...	Clear to 9 A. M. ⌒i to 5 P. M. Clear afterwards.
11	...	...	S.	...	Clear to 8. A. M. ⌒i afterwards.
12	128.5	...	Variable.	...	_i & \⌒i to 9 A. M. ⌒i to 1 P. M. \⌒i to 7 P.M. ⌒i afterwards.
13	129.8	...	N. N. W.	...	\i to 8 A. M. ⌒i to 4 P. M. Clouds of different kinds afterwards.
14	127.4	...	N. E. & E. N. E.	...	Clear to 2 A. M. \⌒i to 6 A. M. ⌒i to 5 P. M. Clear afterwards.
15	126.0	...	E. N. E. & N. E.	...	Clear to 10 A. M. ⌒i to 3 P. M. \i afterwards.
16	125.5	...	E. N. E.	...	Clear nearly the whole day. Slightly foggy at 10 & 11 P. M.
17	120.0	...	N. N. E.	...	Clear to 10 A. M. \i to 6 P. M. Clear afterwards.
18	...	0.11	E. N. E.	...	_i to 7 A. M. ⌒i to 11 A. M. Overcast afterwards. Light rain at noon & 1 P. M. & from 9 to 11 P. M.

Solar Radiation, Weather, &c.—(*Continued.*)

Date.	Max. Solar radiation.	Rain Guage 1 ft. 2 in. above Ground.	Prevailing direction of the Wind.	Max. Pressure of Wind.	General aspect of the Sky.
	o	Inches		lb	
19	...	2.43	N. E.	1.0	Overcast. Thunder at 2½ P. M. Rain from midnight to 5 A. M. & from 10 A. M. to 6 P. M.
20	119.4	2.06	E. & variable.	0.6	Overcast to 8 A. M. \⌒i & ⌒i to 1 P. M. Overcast afterwards. Rain at midnight, 2 & 4½ A. M., 2 P. M., & from 4 to 9 P. M.
21	126.5	...	W.N.W.&W.S.W.	...	\⌒_i & \⌒i to 3 A. M. Overcast to 6 A. M. \⌒i to 1 P. M. ⌒i to 5 P. M., clear afterwards.
22	131.7	...	W. S. W.& variable	...	\⌒i to 6 A. M. ⌒-i to 1 P. M. \⌒i to 6 P. M., clear afterwards. Slight rain at noon.
23	129.5	...	S. W. & E.S. E.	...	⌒-i to 4 P.M., clear afterwards.
24	129.0	...	N.N. E. & variable.	2.0	Clear to 5 A. M. ⌒-i to 7 P. M., clear afterwards.
25	...	0.73	N. E. & N. N. E.	...	Clear to 6 A. M. ⌒i to 10 A.M. Overcast to 2 P. M. Clouds of different kinds to 8 P. M., clear afterwards. Thunder at 12½ A. M. Rain at 10 A.M. & from noon to 2 P. M.
26	124.0	...	N. by W.& variable	...	Clear to 4 A. M.\⌒i to 9 A. M. ⌒i to 5 P. M.Clear afterwards. Slightly foggy from 9 to 11 P.M.
27	125.0	...	N. by W. & N byE.	...	Clear to 11 A. M. ⌒i to 8 P.M. Clear afterwards. Foggy from midnight to 4 A. M.
28	125.2	...	N. E. & N. N. E.	...	Clear to 1 A. M. _i to 4 A. M. Clear to 10 A. M. _i to 6 P. M. Clear afterwards.
29	125.4	...	N.E. & N.	...	Clear to 5 A. M. \i to 5 P. M. Clear afterwards.
30	123.2	...	N. N. E. & N. E.	...	Clear to 5 A. M. \i to 3 P. M. \⌒i & _i afterwards.
31	...	2.31	E. N. E. & N. E.	1.3	\⌒_i to 2 A. M. Overcast afterwards. Rain from 3 A. M. to 11 P. M.

\ i Cirri, — i Strati, ⌒i Cumuli, _i Cirro-strati, ⌒-i Cumulo strati, \⌒ Nimbi, \⌒i Cirro cumuli.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of October 1867.

Monthly Results.

	Inches.
Mean height of the Barometer for the month...	29.880
Max. height of the Barometer occurred at 9 A. M. on the 16th ...	30.008
Min. height of the Barometer occurred at 3 P.M. on the 12th ...	29.755
Extreme range of the Barometer during the month	0.253
Mean of the daily Max. Pressures	29.942
Ditto ditto Min. ditto	29.821
Mean daily range of the Barometer during the month	0.121

	o
Mean Dry Bulb Thermometer for the month	81.2
Max. Temperature occurred at 1 & 3 P. M. on the 8th & 11th... ...	90.0
Min. Temperature occurred at 6 A. M. on the 29th & 30th	69.5
Extreme range of the Temperature during the month	20.5
Mean of the daily Max. Temperature	86.8
Ditto ditto Min. ditto, ...	76.9
Mean daily range of the Temperature during the month... ...	9.9

Mean Wet Bulb Thermometer for the month	76.9
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer	4.3
Computed Mean Dew-point for the month	73.9
Mean Dry Bulb Thermometer above computed mean Dew-point ...	7.3
	Inches.
Mean Elastic force of Vapour for the month	0.824

	Troy grain.
Mean Weight of Vapour for the month	8.88
Additional Weight of Vapour required for complete saturation ...	2.33
Mean degree of humidity for the month, complete saturation being unity	0.79

	Inches.
Rained 10 days,—Max. fall of rain during 24 hours	2.43
Total amount of rain during the month	8.45
Total amount of rain indicated by the Gauge attached to the anemometer during the month	8.01
Prevailing direction of the Wind... ... N. E. & E. N. E.	

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of Oct. 1867.

MONTHLY RESULTS.

Tables shewing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour, when any particular wind was blowing, it rained.

Hour.	N.	Rain on.	N. by E.	Rain on.	N. N. E.	Rain on.	N. E.	Rain on.	E. N. E.	Rain on.	E. by N.	Rain on.	E.	Rain on.	E. by S.	Rain on.	E. S. E.	Rain on.	S. E.	Rain on.	S. S. E.	Rain on.	S. by E.	Rain on.	S.	Rain on.	S. by W.	Rain on.	S. S. W.	Rain on.	S. W.	Rain on.	W. S. W.	Rain on.	W. by S.	Rain on.	W.	Rain on.	W. by N.	Rain on.	W. N. W.	Rain on.	N. W.	Rain on.	N. N. W.	Rain on.	N. by W.	Rain on.
																					No. of days																											
Mid night			1		4		2	1	4	1							4				1		1		2				3		2		1								1		1		1		1	
1			1		3				5				1				3				1		1		2				3		2		1								1		2	1	1		1	
2					3	1	2		4	1					1		2		1		2		1		2				3		3		1								1		1		1		1	
3	1				2	1	3		3								3		1		2		1		2				2		2		1								1		2	1	1		1	
4					1	1	5	1	4				1		1		1		1		2		1		2				2		2		1								1		1		1		1	
5					4	1	5	1	3		1		1	1			1		1		1		1		3				1		3		1								1		1				1	
6	2				5		5	1	3		1		1						1		1		1		3						3		2				1				1						1	
7			1		5		5	1	4				2						2		1		2		1				1		2		2								1				1		1	
8					5		6	1	4		1		1				1		1		1		1						1		3		2				1						1		1		1	
9	1		1		5		7	1	4				2						1				1		1		1				2		3				1						1					
10	2				2		3		10	3			1						1						1		1		1		2		2		1						1		3					
11	1				2		8	1	3	1			3				1		1						1		1		2		1		2				1		1		1		2					
Noon.	1						6	1	3		1				1	1			3	1	1								2		3	1	2				1				2		3	1			1	
1	4	2					5		1										2	2	1	1			2						2		1		1		3				1		5		2		1	
2	3						3		1				2	1					2						1	1	1	1	2	1	4				2		1				2		2		3		2	1
3	5		1				4		1	1	2		1				1				2	1			2				2	1			3				2		1				2		2			
4	2				2		4		2						1	1	2				1	1			1				3		1		3	1	1								3		5			
5	4				1		4	1	2	1							1		1		2	1			1		1		2	1	2		2		1								2		4		1	
6			2		1		8	1	1	1					1								1		2	1	1		2		2		2								1		2		2		1	
7	1		2		1		7		1	1			1		1				1				1		1				3		2		3	1									1		2		1	
8			2		2		5		4	1							1		1				1		2				3		1		2								1	1	1		2		1	
9			2		2		5	1	3	1			1		1				1				1		1		1		2		1		2								1	1	2	1	2		1	
10	1		1		2		4		5	2			2						1				1		2				2		2		1								1		1		2		1	
11	1		1		3		2		5	2					1		1				1		1		2		1		2		2		1								1		2		1		1	

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of November 1867.

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the sea level, 18.11 feet.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer during the day.			Mean Dry Bulb Thermometer.	Range of the Temperature during the day.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	29.728	29.870	29.220	0.650	70.1	71.7	68.0	3.7
2	.561	.923	28.544	1.379	73.2	79.5	69.5	10.0
3	.975	30.039	29.894	0.145	77.5	82.5	71.4	11.1
4	30.017	.084	.983	.101	78.1	83.4	73.0	10.4
5	.007	.087	.947	.140	76.5	82.0	72.0	10.0
6	29.980	.056	.928	.128	74.8	80.7	69.6	11.1
7	30.012	.083	.964	.119	73.9	80.2	67.5	12.7
8	.041	.105	.986	.119	74.0	79.8	68.0	11.8
9	.046	.091	.980	.111	75.4	81.4	71.0	10.4
10	.011	.063	.951	.112	74.7	76.0	72.5	3.5
11	29.939	.004	.868	.136	75.5	81.0	72.0	9.0
12	.925	29.978	.881	.097	74.4	77.4	71.8	5.6
13	.993	30.053	.931	.122	74.8	78.8	71.0	7.8
14	.999	.072	.933	.139	76.3	81.9	72.5	9.4
15	.932	29.990	.856	.134	75.0	80.3	70.0	10.3
16	.931	.981	.879	.102	72.8	79.0	68.0	11.0
17	.987	30.055	.942	.113	73.3	81.6	66.4	15.2
18	30.063	.125	30.018	.107	75.0	82.2	68.5	13.7
19	.087	.153	.043	.110	75.4	82.0	69.5	12.5
20	.067	.124	.021	.103	74.3	80.5	68.7	11.8
21	.064	.124	.004	.120	74.6	82.0	69.0	13.0
22	.085	.142	.031	.111	74.3	81.4	68.0	13.4
23	.148	.216	.104	.112	74.7	83.0	67.4	15.6
24	.158	.231	.100	.131	73.9	81.4	68.2	13.2
25	.111	.187	.048	.139	72.9	80.0	67.0	13.0
26	.111	.175	.064	.111	72.1	79.5	65.5	14.0
27	.151	.228	.102	.126	72.4	79.8	66.0	13.8
28	.139	.217	.083	.134	71.9	78.4	66.0	12.4
29	.133	.205	.072	.133	71.0	79.2	64.5	14.7
30	.138	.215	.082	.133	69.9	76.7	63.5	13.2

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived, from the hourly observations, made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of November 1867.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	69.2	0.9	68.5	1.6	0.692	7.62	0.41	0.95
2	70.7	2.5	68.7	4.5	.697	.61	1.21	.86
3	73.3	4.2	70.4	7.1	.736	.99	2.05	.80
4	73.5	4.6	70.3	7.8	.734	.95	.27	.78
5	70.8	5.7	66.8	9.7	.665	.11	.64	.73
6	68.3	6.5	63.7	11.1	.591	6.45	.81	.70
7	66.8	7.1	61.8	12.1	.555	.06	.95	.67
8	68.6	5.4	64.8	9.2	.613	.71	.33	.74
9	72.0	3.4	69.6	5.8	.717	7.81	1·62	.83
10	73.5	1.2	72.7	2.0	.792	8.65	0.58	.94
11	73.0	2.5	71.2	4.3	.756	.23	1.23	.87
12	72.5	1.9	71.2	3.2	.756	.25	0.90	.90
13	72.8	2.0	71.4	3.4	.761	.30	.96	.90
14	73.6	2.7	71.7	4.6	.768	.35	1.34	.86
15	70.3	4.7	67.0	8.0	.659	7.18	2.13	.77
16	66.8	6.0	62.0	10.8	.559	6.11	.60	.70
17	67.1	6.2	62.1	11.2	.561	.13	.71	.69
18	69.1	5.9	65.0	10.0	.617	.73	.58	.72
19	69.3	6.1	65.0	10.4	.617	.73	.70	.71
20	68.1	6.2	63.8	10.5	.593	.46	.66	.71
21	68.8	5.8	64.7	9.9	.611	.66	.54	.72
22	68.3	6.0	64.1	10.2	.599	.54	.58	.72
23	68.0	6.7	63.3	11.4	.584	.37	.86	.69
24	68.0	5.9	63.9	10.0	.595	.50	.51	.72
25	66.5	6.4	61.4	11.5	.548	5.99	.74	.69
26	64.8	7.3	59.0	13.1	.506	.54	.99	.65
27	65.1	7.3	59.3	13.1	.511	.59	3.01	.65
28	64.9	7.0	59.3	12.6	.511	.59	2.89	.66
29	64.4	6.6	59.1	11.9	.508	.57	.68	.68
30	62.2	7.7	56.0	13.9	.458	.03	.95	.63

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of November 1867.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer for each hour during the month.			Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Mid-night.	30.002	30.176	28.954	1.222	71.6	78.8	67.2	11.6
1	29.985	.163	.693	.470	71.2	78.0	66.4	11.6
2	.971	.149	.544	.605	70.7	77.5	65.6	11.9
3	.963	.139	.554	.585	70.2	76.0	65.5	10.5
4	.974	.146	.892	.254	69.6	74.8	65.2	9.6
5	30.006	.157	29.429	0.728	69.3	74.8	64.8	10.0
6	.022	.171	.588	.583	69.1	74.6	63.9	10.7
7	.044	.191	.666	.525	69.4	73.8	63.5	10.3
8	.069	.216	.724	.492	72.2	76.0	66.8	9.2
9	.086	.229	.762	.467	74.6	78.5	69.6	8.9
10	.087	.231	.788	.443	76.5	79.5	70.4	9.1
11	.068	.208	.788	.420	77.9	81.5	70.5	11.0
Noon.	.042	.176	.786	.390	78.7	82.5	70.5	12.0
1	.012	.148	.755	.393	79.3	82.7	71.4	11.3
2	29.990	.123	.722	.401	79.7	83.4	71.7	11.7
3	.979	.111	.706	.405	79.6	82.5	71.5	11.0
4	.978	.106	.690	.416	78.5	81.8	71.4	10.4
5	.989	.117	.708	.409	77.5	81.5	71.0	10.5
6	30.002	.136	.669	.467	75.8	81.0	71.0	10.0
7	.018	.160	.625	.535	74.7	81.0	70.5	10.5
8	.033	.171	.595	.576	73.8	80.5	69.5	11.0
9	.041	.189	.538	.651	73.1	80.2	68.5	11.7
10	.036	.199	.424	.775	72.5	80.0	67.0	13.0
11	.029	.186	.220	.966	72.1	79.5	66.5	13.0

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of November 1867.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
Midnight.	68.7	2.9	66.4	5.2	0.646	7.10	1.30	0.85
1	68.4	2.8	66.2	5.0	.642	.05	.25	.85
2	68.0	2.7	65.8	4.9	.634	6.97	.21	.85
3	67.6	2.6	65.5	4.7	.628	.91	.14	.86
4	67.2	2.4	65.3	4.3	.623	.87	.03	.87
5	67.0	2.3	65.2	4.1	.621	.85	0.98	.88
6	67.0	2.1	65.3	3.8	.623	.87	.91	.88
7	67.0	2.4	65.1	4.3	.619	.83	1.03	.87
8	68.5	3.7	65.5	6.7	.628	.88	.67	.81
9	69.2	5.4	65.4	9.2	.626	.82	2.38	.74
10	69.9	6.6	65.3	11.2	.623	.78	.97	.70
11	70.2	7.7	64.8	13.1	.613	.65	3.51	.66
Noon.	70.1	8.6	64.1	14.6	.599	.47	.94	.62
1	70.2	9.1	63.8	15.5	.593	.40	4.19	.60
2	70.2	9.5	63.5	16.2	.588	.34	.38	.59
3	69.9	9.7	63.1	16.5	.580	.25	.44	.59
4	69.6	8.9	63.4	15.1	.586	.33	.02	.61
5	70.0	7.5	64.7	12.8	.611	.62	3.42	.66
6	70.2	5.6	66.3	9.5	.644	7.01	2.53	.74
7	70.0	4.7	66.7	8.0	.653	.11	.12	.77
8	69.7	4.1	66.8	7.0	.655	.16	1.82	.80
9	69.4	3.7	66.4	6.7	.646	.07	.72	.80
10	69.2	3.3	66.6	5.9	.651	.12	.51	.83
11	68.8	3.3	66.2	5.9	.642	.03	.50	.82

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of November 1867.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage 1 ft. 2 in. above Ground.	Prevailing direction of the Wind.	Max. Pressure of Wind.	General aspect of the Sky.
	o	Inches		lb	
1	...	1.12	E. N. E. & N. N. E.	...	Overcast. High wind from 2 to 7 A. M. Gale from 6 to 11 P. M. Rain at 2, 3, 7, 8, 11 & noon & from 5 to 11 P. M.
2	...	*2.74	vane broken	...	Overcast to 1 P. M., \i to 8 P. M., clear afterwards. Heavy driving rain from midnight to 4 A. M. Drizzled from 5 to 10 A. M. Foggy at 7 & 8 P. M. A cyclone passed over Calcutta.
3	124.0	...		...	Clear to 1 A. M., _i to 5 A. M., \i to 4 P. M., clear afterwards. Slightly foggy at 4 & 5 A. M.
4	120.5	...		...	Clear to 7 A. M., \i to 6 P. M., clear afterwards. Foggy from 1 to 5 A. M. & from 7 to 11 P. M.
5	120.0	...		...	Clear. Foggy from midnight to 3 A. M.
6	120.5	...	N.	...	Clear.
7	120.0	...	N. & N. W.	...	Clear. Slightly foggy from 7 to 11 P. M.
8	119.0	...	N.	...	Clear to 5 A. M., \i to 6 P. M., clear to 9 P. M., \i afterwards. Slightly foggy from midnight to 2 A. M.
9	...	...	N. & E.	...	\i to 2 A.M., stratoni to noon, clouds of different kinds to 7 P. M., stratoni afterwards.
10	...	0.90	E.	...	Stratoni to 5 A. M., overcast afterwards. Rain fron 6 A. M. to 9 P. M.
11	...	...	E.	...	Overcast to 7 A. M., \i afterwards. Light rain at 5 & 6 A. M.
12	...	0.09	N. & N. N. E.	...	\i to 5 A. M., overcast to 4 P. M., \i afterwards. Slight rain from 11 A.M. to 1 P.M. & at 4 P.M.
13	...	...	N. & N. by E.	...	Scuds from N. to 4 A. M., \i to 7 P. M., clear afterwards. Light rain at 2½ P. M.
14	...	...	N. & N. N. W.	...	Overcast to 10 A. M., ⌒i afterwards.
15	121.0	...	N. N. W. & N. W.	...	Clear to 1 A. M., ⌒i to 7 P. M., clear afterwards. Foggy at 1 & 2 A. M.
16	110.0	...	Variable.	...	\i to 4 A.M., clear afterwards. Slightly foggy at 7 & 8 P. M.
17	116.2	...	S. S. W. & W. S. W	...	Clear.

*By Anemometer gauge.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of November 1867.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage 1 ft. 2 in. above Ground.	Prevailing direction of the Wind.	Max. Pressure of Wind.	General aspect of the Sky.
	o	Inches		lb	
18	118.6	...	S.	...	Clear to 11 A. M., ⌒i to 3 P.M., ⌒\i afterwards.
19	...	...	S. S. E. & E.	...	Clear to 7 A. M., ⌒i to 7 P.M., clear afterwards.
20	120.0	...	N. N. E. & N. E.	...	\—i to 2 A.M., clear to 10 A.M., ⌒i to 5 P. M., clear afterwards.
21	123.0	...	N	...	Clear to 10 A. M., ⌒i to 5 P. M., clear afterwards.
22	122.0	...	N. & N. E.	...	Clear to 7 A. M., \i to 10 A.M., ⌒i to 5 P. M., clear afterwards. Foggy from 8 to 10 P. M.
23	116.0	...	N.	...	Clear to noon, ⌒i to 6 P. M., \i afterwards. Foggy from 4 to 7 A. M. & from 8 to 11 P. M.
24	117.0	...	N. E.	...	Clear to 5 A. M., \i & ⌒i to 6 P. M., clear afterwards.
25	116.2	...	N. & N. N. E.	...	Clear to 11 A.M., ⌒i to 5 P.M., clear afterwards.
26	...	...	N. E. &. N N. W.	...	Clear to 8 A. M., \i &⌒i to 5 P. M., clear afterwards.
27	117.5	...	N. & N. N. E.	...	Clear to 6 A. M., \i to 10 A. M, ⌒i to 6 P. M. clear afterwards.
28	115.5	...	N. & N. N. W.	...	Clear to 6 A.M., \i to 10 A. M. Stratoni to 1 P. M., \i & ⌒i to 5 P. M., clear afterwards.
29	114.0	...	variable	...	Clear to 5 A. M., \i to 6 P. M., clear afterwards. Slightly foggy from 8 to 11 P. M.
30	111.0	...	N.	...	Clear to 5 A. M., \i to 5 P. M., clear afterwards. Slightly foggy at midnight & from 5 to 7 A.M.

\i Cirri, —i Strati, ⌒i Cumuli, \—i Cirro-strati, ⌒—i Cumulo strati, \⌒—i Nimbi, \⌒i Cirro cumuli.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of November 1867.

MONTHLY RESULTS.

	Inches.
Mean height of the Barometer for the month...	30.018
Max. height of the Barometer occurred at 10 A. M. on the 24th ...	30.231
Min. height of the Barometer occurred at 2 A. M. on the 2nd ...	28.544
Extreme range of the Barometer during the month	1.687
Mean of the daily Max. Pressures	30.096
Ditto ditto Min. ditto	29.915
Mean daily range of the Barometer during the month	0.181

	o
Mean Dry Bulb Thermometer for the month	74.1
Max. Temperature occurred at 2 P. M. on the 4th	83.4
Min. Temperature occurred at 7 A. M. on the 30th	63.5
Extreme range of the Temperature during the month	19.9
Mean of the daily Max. Temperature	80.1
Ditto ditto Min. ditto, ...	68.9
Mean daily range of the Temperature during the month... ...	11.2

Mean Wet Bulb Thermometer for the month	69.0
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer	5.1
Computed Mean Dew-point for the month	65.4
Mean Dry Bulb Thermometer above computed mean Dew-point ...	8.7
	Inches.
Mean Elastic force of Vapour for the month	0.626

	Troy grain.
Mean Weight of Vapour for the month	6.82
Additional Weight of Vapour required for complete saturation ...	2.25
Mean degree of humidity for the month, complete saturation being unity	0.75

	Inches.
Rained 6 days,—Max. fall of rain during 24 hours	2.74
Total amount of rain during the month	4.85
Total amount of rain indicated by the Gauge attached to the anemometer during the month	3.68
Prevailing direction of the Wind... ...	N. & N. N. E.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of Nov. 1867.

MONTHLY RESULTS.

Tables shewing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour, when any particular wind was blowing, it rained.

No. of days

Hour.	N.	Rain on.	N. by E.	Rain on.	N. N. E.	Rain on.	N. E.	Rain on.	E. N. E.	Rain on.	E. by N.	Rain on.	E.	Rain on.	E. by S.	Rain on.	E. S. E.	Rain on.	S. E.	Rain on.
Mid night	5						1	1	1											
1	5								1											
2	3						2		1				1							
3	4						1		1	1			1							
4	5		1						1											
5	9		1						1				1							
6	11		1		3	1			2											
7	9		1		4		4		1	1										
8	12		1		4		3	1	1										1	
9	9		3		2		3		2				1	1	1				1	
10	9		1		3		10						1	1						
11	7		5		2		5		1	1			1						2	1
Noon.	6		3	1	5	2	4		1				1							
1	7		4	1	4	1	1		1				1						1	
2	6		1		5	1	2						2							
3	9		1	1	3		3						2	1						
4	9		2	1			1						3				1	1		
5	8				5	1	2						2	1						
6	7				1	1	2						2	1						
7	4				1								2	1						
8	3				1	1							2	1						
9	3				1	1							2	1						
10	4				1	1							1							
11	4				1	1							1							

Hour.	S. S. E.	Rain on.	S. by E.	Rain on.	S.	Rain on.	S. by W.	Rain on.	S. S. W.	Rain on.	S. W.	Rain on.	W. S. W.	Rain on.	W. by S.	Rain on.	W.	Rain on.	W. by N.	Rain on.	W. N. W.	Rain on.	N. W.	Rain on.	N. N. W.	Rain on.	N. by W.	Rain on.
Mid night	1				1																							
1	1				1																							
2																							1					
3																							1					
4	1																						1					
5																												
6	2								1														4		1		1	
7	1		1						1														1		3			
8							1		1												1				2			
9																	1		1						3			
10					1												1						1					
11					1										1										2			
Noon.	1								1														2		2			
1					1								1								1		2		3			
2					1				1		1										1		3		4			
3			1						1												1		4		2			
4							1						1						1				3		3		3	
5			1		1								1				1						4				1	
6					1								1				1						2		3			
7																									3			
8																											1	
9																											1	
10					1																							
11											1																	

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of December 1867.

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the sea level, 18.11 feet.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer during the day.			Mean Dry Bulb Thermometer.	Range of the Temperature during the day.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	30.125	30.201	30.071	0.130	69.4	76.5	63.6	12.9
2	.092	.163	.024	.139	70.9	78.2	64.0	14.2
3	.100	.173	.039	.134	71.0	77.5	65.2	12.3
4	.120	.193	.066	.127	71.5	78.2	65.0	13.2
5	.101	.189	.046	.143	70.0	77.6	63.4	14.2
6	.047	.115	29.987	.128	68.9	77.0	61.5	15.5
7	.021	.088	.961	.127	68.9	77.1	63.0	14.1
8	.048	.125	30.003	.122	67.0	75.0	60.5	14.5
9	.058	.124	.001	.123	66.5	76.0	58.5	17.5
10	.083	.173	.029	.144	66.4	74.2	59.0	15.2
11	.068	.163	.013	.150	64.7	72.5	57.5	15.0
12	.056	.131	.005	.126	65.3	74.8	58.0	16.8
13	.075	.165	.014	.151	67.3	75.5	59.8	15.7
14	.062	.139	.010	.129	66.7	73.2	61.5	11.7
15	.057	.110	29.997	.113	67.7	75.0	61.0	14.0
16	.102	.180	30.046	.134	67.4	74.6	60.0	14.6
17	.108	.169	.057	.112	69.1	78.2	62.0	16.2
18	.093	.173	.022	.151	68.7	76.5	61.5	15.0
19	.082	.148	.022	.126	68.3	77.0	60.5	16.5
20	.057	.126	29.992	.134	67.7	75.8	60.2	15.6
21	.042	.109	.986	.123	67.0	75.4	60.0	15.4
22	.057	.138	.998	.140	66.8	76.7	59.2	17.5
23	.099	.177	30.046	.131	66.9	75.2	60.0	15.2
24	.110	.182	.045	.137	66.6	75.5	59.0	16.5
25	.074	.151	.032	.119	66.3	73.5	60.5	13.0
26	.058	.138	.003	.135	67.8	76.4	60.0	16.4
27	.055	.121	.011	.110	70.1	78.2	62.0	16.2
28	.082	.153	.025	.128	69.6	78.0	62.5	15.5
29	.085	.157	.025	.132	68.1	75.5	61.4	14.1
30	.096	.180	.030	.150	66.8	74.7	60.0	14.7
31	.082	.144	.017	.127	66.0	73.4	58.5	14.9

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived, from the hourly observations, made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of December 1867.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	63.1	6.3	58.1	11.3	0.491	5.41	2.45	0.69
2	65.8	5.1	61.7	9.2	.554	6.08	.15	.74
3	65.3	5.7	60.7	10.3	.536	5.88	.37	.71
4	64.5	7.0	58.9	12.6	.504	.52	.86	.66
5	63.0	7.0	57.4	12.6	.480	.27	.73	.66
6	63.0	5.9	58.3	10.6	.494	.44	.30	.70
7	61.8	7.1	56.1	12.8	.459	.06	.68	.65
8	59.6	7.4	53.7	13.3	.423	4.69	.61	.64
9	59.3	7.2	53.5	13.0	.421	.67	.52	.65
10	58.7	7.7	52.5	13.9	.407	.51	.66	.63
11	57.4	7.3	51.6	13.1	.394	.38	.42	.64
12	59.3	6.0	54.5	10.8	.435	.83	.10	.70
13	61.4	5.9	56.7	10.6	.469	5.17	.20	.70
14	61.8	4.9	57.9	8.8	.488	.39	1.84	.75
15	61.8	5.9	57.1	10.6	.475	.24	2.22	.70
16	62.4	5.0	58.4	9.0	.496	.48	1.91	.74
17	63.3	5.8	58.7	10.4	.501	.53	2.25	.71
18	63.1	5.6	58.6	10.1	.499	.51	.18	.72
19	62.6	5.7	58.0	10.3	.489	.40	.20	.71
20	61.4	6.3	56.4	11.3	.464	.12	.34	.69
21	60.1	6.9	54.6	12.4	.437	4.84	.46	.66
22	60.5	6.3	55.5	11.3	.450	.99	.27	.69
23	61.0	5.9	56.3	10.6	.462	5.11	.17	.70
24	60.2	6.4	55.1	11.5	.444	4.92	.29	.68
25	60.6	5.7	56.0	10.3	.458	5.08	.07	.71
26	61.8	6.0	57.0	10.8	.473	.22	.26	.70
27	64.4	5.7	59.8	10.3	.520	.71	.32	.71
28	63.0	6.6	57.7	11.9	.485	.33	.57	.68
29	62.1	6.0	57.3	10.8	.478	.27	.28	.70
30	60.7	6.1	55.8	11.0	.455	.04	.22	.69
31								

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of December 1867.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer for each hour during the month.			Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Mid-night.	30.080	30.134	30.024	0.110	64.6	68.3	60.5	7.8
1	.074	.125	.022	.103	64.0	68.0	59.5	8.5
2	.065	.113	.012	.101	63.4	67.2	59.0	8.2
3	.057	.101	29.999	.102	62.9	66.5	58.8	7.7
4	.053	.106	30.000	.106	62.3	66.5	58.7	7.8
5	.062	.110	.011	.099	61.8	66.4	58.2	8.2
6	.080	.134	.027	.107	61.2	65.2	57.5	7.7
7	.101	.151	.044	.107	61.0	65.5	57.5	8.0
8	.130	.176	.069	.107	65.9	69.2	60.0	9.2
9	.147	.196	.087	.109	67.2	71.8	62.5	9.3
10	.147	.201	.088	.113	70.1	74.5	65.5	9.0
11	.130	.176	.073	.103	72.5	76.3	69.3	7.0
Noon.	.097	.144	.042	.102	74.0	76·8	71.2	5.6
1	.062	.113	29.998	.115	75.1	78.2	72.0	6.2
2	.039	.085	.976	.109	75.6	78.2	71.0	7.2
3	.024	.083	.968	.115	75.7	78.2	72.0	6.2
4	.022	.071	.961	.110	74.5	77.7	71.5	6.2
5	.031	.080	.970	.110	73.3	76.3	70.5	5.8
6	.044	.097	.987	.110	71.0	74.5	67.0	7.5
7	.060	.113	30.007	.106	69.3	73.0	65.0	8.0
8	.076	.129	.025	.104	68.2	72.0	64.4	7.6
9	.086	.137	.037	.100	67.0	71.5	63.0	8.5
10	.092	.147	.042	.105	66.1	70.5	61.8	8.7
11	.087	.140	.030	.110	65.3	70.0	61.0	9.0

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of December 1867.

Hourly Means, &c. of the Observations and of the Hygrometrical elemen ts dependent thereon.—*(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
Midnight.	60.9	3.7	57.9	6.7	0.488	5.41	1.37	0.80
1	60.4	3.6	57.2	6.8	.476	.29	.36	.80
2	60.0	3.4	56.9	6.5	.472	.25	.28	.80
3	59.5	3.4	56.4	6.5	.464	.17	.26	.80
4	59.0	3.3	56.0	6.3	.458	.12	.19	.81
5	58.7	3.1	55.9	5.9	.456	.10	.11	.82
6	58.3	2.9	55.7	5.5	.453	.07	.03	.83
7	58.3	2.7	55.9	5.1	.456	.11	0.95	.84
8	61.6	4.3	58.2	7.7	.493	.46	1.60	.77
9	61.3	5.9	65.6	10.6	.467	.16	2.19	.70
10	62.5	7.6	56.4	13.7	.464	.09	.94	.63
11	63.1	9.4	55.6	16.9	.452	4.95	3.68	.57
Noon.	63.5	10.5	56.1	17.9	.459	5.01	4.03	.55
1	63.7	11.4	55.7	19.4	.453	4.94	.40	.53
2	64.1	11.5	56.0	19.6	.458	.97	.51	.52
3	63.9	11.8	55.6	20.1	.452	.92	.59	.52
4	63.7	10.8	56.1	18.4	.459	5.01	.17	.55
5	63.8	9.5	56.2	17.1	.461	.03	3.81	.57
6	64.0	7.0	58.4	12.6	.496	.43	2.82	.66
7	63.8	5.5	59.4	9.9	.513	.64	.19	.72
8	63.2	5.0	59.2	9.0	.509	.63	1.95	.74
9	62.7	4.3	59.3	7.7	.511	.65	.65	.77
10	62.0	4.1	58.7	7.4	.501	.56	.54	.78
11	61.4	3.9	58.3	7.0	.494	.48	.45	.79

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of December 1867.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage 1 ft. 2 in. above Ground.	Prevailing direction of the Wind.	Max. Pressure of Wind.	General aspect of the Sky.
	o	Inches		lb	
1	120.5	...	N. N. W. & N.	...	\i & \‿i to 6 P. M., clear afterwards.
2	116.5	...	N. & N. N. W.	...	Clear to 10 A. M., ⌒i to 5 P. M., clear afterwards.
3	114.5	...	N.	...	Chiefly clear.
4	116.0	...	N. & N. N. W.	...	Chiefly clear.
5	115.0	...	N. & N. by W.	...	Clear
6	111.5	...	N.	...	Clear. Slightly foggy at midnight & from 7 to 11 P. M.
7	115.8	...	N.	...	Clear. Foggy at midnight & 1 A. M., & from 8 to 11 P. M.
8	112.0	...	N. N. W. & N.	...	Clear. Foggy at midnight & 1 A. M., & from 8 to 10 P. M.
9	114.0	...	N. & N. N. W.	...	Clear. Slightly foggy from 8 to 11 P. M.
10	113.5	...	N. & N. by W.	...	Clear to 7 A. M., ⌒i to 10 A.M., clear afterwards. Slightly foggy at midnight. & 1 A. M.
11	113.0	...	N. by W. & W. N. W.	...	Clear to 5 A. M., thin \i to 6 P. M., clear afterwards. Foggy from 8 to 11 P. M.
12	112.4	...	N. & N. W.	...	Clear to 5 A. M., \i to 3 P. M., _i to 6 P. M., clear afterwards. Foggy from midnight to 7 A. M., & from 7 to 10 P. M.
13	...	...	N.	...	\i to 11 A. M., ⌒i & \i afterwards.
14	108.0	...	N.	...	\i & \‿i to 6 P. M., clear afterwards.
15	112.0	...	N. N. W. & N. W.	...	Scatd. ⌒i to 6 A. M., clear to 11 A. M., ⌒i to 3 P. M., clear afterwards. Foggy at 9 P. M.
16	114.0	...	N. W. & N.	...	Clear to noon, ⌒i to 5 P. M., clear afterwards.
17	113.0	...	N. & N. N.E.	...	\‿i to 2 A.M., clear to 11 A.M., ⌒i to 2 P. M., clear afterwards.
18	114.0	...	N.	...	Clear nearly the whole day.
19	113.0	...	N.	...	Clear.
20	111.0	...	N.	...	Clear.
21	111.5	...	N.	...	Clear.
22	112.5	...	N.	...	Clear. Slightly foggy at 11 P. M.
23	111.2	...	N.	...	Clear. Slightly foggy from midnight to 6 A. M., & from 8 to 11 P. M.
24	112.0	...	N.	...	Clear.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of December 1867.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Guage 1 ft. 2 in. above Ground.	Prevailing direction of the Wind.	Max. Pressure of Wind.	General aspect of the Sky.
	o	Inches		lb	
25	111.2	...	N.	...	\i to 5 A. M., \i & \⌣i to 6 P. M., clear afterwards. Light rain at 1½ P. M.
26	111.8	...	N.	...	Clear to noon, \i & \⌣i to 5 P. M., clear afterwards. Slightly foggy from 8 to 11 P. M.
27	112.0	...	N.	...	Clear. Slightly foggy at midnight & 1 A. M.
28	113.0	...	N. E.	...	Chiefly clear.
29	111.0	...	N. E.	...	Chiefly clear.
30	111.5	...	N.	...	Chiefly clear. Slightly foggy at 7 & 8 P. M.
31	...	...	N.	...	Clear to noon, ⌒i to 5 P. M., clear afterwards. Foggy from 7 to 11 P. M.

\i Cirri, —i Strati, ⌒i Cumuli, _i Cirro-strati, ⌒_i Cumulo strati, \⌒_i Nimbi, \⌒i Cirro cumuli.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of December 1867.

MONTHLY RESULTS.

	Inches.
Mean height of the Barometer for the month...	30.077
Max. height of the Barometer occurred at 10 A. M. on the 1st ...	30.201
Min. height of the Barometer occurred at 4 P. M. on the 7th ...	29.961
Extreme range of the Barometer during the month	0.240
Mean of the daily Max. Pressures	30.152
Ditto ditto Min. ditto	30.020
Mean daily range of the Barometer during the month	0.132

	o
Mean Dry Bulb Thermometer for the month	67.9
Max. Temperature occurred at 2 P. M. on the 2nd, 4th, 17th & 27th	78.2
Min. Temperature occurred at 6 & 7 A. M. on the 11th	57.5
Extreme range of the Temperature during the month	20.7
Mean of the daily Max. Temperature	75.9
Ditto ditto Min. ditto, ...	60.9
Mean daily range of the Temperature during the month... ...	15.0

Mean Wet Bulb Thermometer for the month	61.7
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer	6.2
Computed Mean Dew-point for the month	56.7
Mean Dry Bulb Thermometer above computed mean Dew-point ...	11.2
	Inches.
Mean Elastic force of Vapour for the month	0.469

	Troy grain.
Mean Weight of Vapour for the month	5.17
Additional Weight of Vapour required for complete saturation ...	2.34
Mean degree of humidity for the month, complete saturation being unity	0.69

	Inches.
Drizzled 1 day,—Max. fall of rain during 24 hours	Nil
Total amount of rain during the month	Nil
Total amount of rain indicated by the Gauge attached to the anemometer during the month	Nil
Prevailing direction of the Wind... ...	N. & N. N. W.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of Dec. 1867.

MONTHLY RESULTS.

Tables shewing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour, when any particular wind was blowing, it rained.

Hour.	N.	Rain on.	N. by E.	Rain on.	N. N. E.	Rain on.	N. E.	Rain on.	E. N. E.	Rain on.	E. by N.	Rain on.
Mid night	4											
1	7											
2	6											
3	5											
4	4		1									
5	5		1									
6	18		1		1							
7	16						1					
8	16		1		1		3					
9	15		1		1		3					
10	12		1		5		1					
11	17		2		1		2					
Noon.	13		2		2		5					
1	16		2		2		2					
2	14		1		1		2		1			
3	15		1		2		1					
4	23				2		1					
5	20				2		1					
6	16						3					
7	8											
8	6											
9	4											
10	4											
11	4											

Hour.	E.	Rain on.	E. by S.	Rain on.	E. S. E.	Rain on.	S. E.	Rain on.	S. S. E.	Rain on.	S. by E.	Rain on.	S.	Rain on.	S. by W.	Rain on.	S. S. W.	Rain on.	S. W.	Rain on.
Mid night									No. of days											
1																				
2																				
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				
11																				
Noon.																				
1																				
2																				
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				
11																				

Hour.	W. S. W.	Rain on.	W. by S.	Rain on.	W.	Rain on.	W. by N.	Rain on.	W. N. W.	Rain on.	N. W.	Rain on.	N. N. W.	Rain on.	N. by W.	Rain on.
Mid night											1		1			
1																
2															1	
3															1	
4															1	
5															1	
6									1		5		4			
7											5		8		1	
8									1		4		3		2	
9									1		4		5		1	
10											3		6		3	
11									1		3		5			
Noon.					1				1		3		3		1	
1									1		3		3		2	
2											3	1	8		1	
3							1				3		5		3	
4											2				3	
5											2		3		3	
6											2		2		3	
7											1		1		2	
8									1				1			
9									1				1			
10											1					
11											1		1			