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ACADEMY OF NATURAL SCIENCES

OF

PHILADELPHIA.

Presented by Dr. T. B. WILSON.——18

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GLEANINGS

IN

SCIENCE.

JANUARY TO DECEMBER,

1831.

VOL. III.

The Gleaners spread around, and here and there,
SPIKE AFTER SPIKE, their *scanty* harvest pick.

THOMSON.

In the knowledge of bodies we must be content to *glean* what we can from particular experiments; since we cannot, from a discovery of their real essences, grasp at a time whole sheaves, and in bundles comprehend the nature and properties of whole species together.

LOCKE.

CALCUTTA:

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1831.

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TO

GEORGE SWINTON, ESQ.

BENGAL CIVIL SERVICE,

Chief Secretary to Government,

&c. &c. &c.

IN TESTIMONY OF

HIS WELL KNOWN EXERTIONS

FOR

THE EXTENSION OF SCIENCE GENERALLY,

AS IN ACKNOWLEDGMENT OF

THE INTEREST WHICH HE HAS UNIFORMLY SHEWN
IN FAVOR OF THE PRESENT WORK,

THIS THIRD VOLUME

OF

GLEANINGS IN SCIENCE

IS

Inscribed,

BY HIS OBEDIENT SERVANT,

THE EDITOR.

CALCUTTA,
January, 1832.

PREFACE.

The present volume was intended to have been dismissed with less ceremony than the two preceding, had not circumstances required it to be the last. This being the case, the Editor cannot allow himself to part from his Subscribers and Contributors, without expressing to them the grateful sense he entertains of their unvarying support. To the kind assistance afforded by the latter, he is sensible the work owes whatever merit it may be found to possess; while to the former it owes its very existence, since it is by them that the expence of publication has been defrayed. Feeling, therefore, as he does how much the success of his experiment is attributable to the kind feelings of these his supporters, it is with unfeigned regret he finds himself (being no longer able to carry on his duties as Editor) compelled to announce that the present or third volume is to be the last of the Gleanings in Science.

But though the Gleanings will expire, and the present Editor's duties will cease with the present volume, each will have a successor far more worthy of public support. The gentleman, who kindly undertook the completion of the present volume, has announced his intention, assisted by his brother secretary, to commence with the present year the publication of a periodical work to be entitled The Journal of the Asiatic Society. This work, it is hoped, may receive support from the subscribers to the Gleanings, as the terms and period of publication will be the same with those of that work; but it will have several advantages besides that of the superior Editorial ability which the conductors of it are known to possess. It is intended, for instance, to include in it such papers from the archives of the Society as, though sufficiently interesting, are not yet quite suited to the character of their quarto volume of Transactions. It is not meant, that the selection of these papers should be confined to any particular subject; literary and antiquarian papers being considered equally eligible with those purely scientific. This course alone will afford great interest and variety to the proposed work, and when to this advantage is added a larger type and wider limits, a work is announced, which it is not doubted, will throw its predecessor deep into the shade, and will make good its title to increased public support.

It will be generally admitted that a work such as that announced, has been long called for, and that it will supply a desideratum in our Indian literature. The regular Transactions of the Asiatic Society appear in too bulky and expensive a shape to afford sufficient information to the European world of the state of Indian science, or to supply excitement to the labourers in the vineyard here. No one, who desires to draw the immediate attention of the literary or scientific world to the result of his enquiries or meditations, will choose as the vehicle of publication a volume which does not appear oftener than once in five or six years, while its bulk and price* are such as to restrict its purchase almost entirely to the possessors of large libraries. But the proposed work will be free from both these objections. Appearing regularly once a month, and at a price which is within the means of all, it will no doubt do much to foster the increasing taste of the public for useful enquiries, while under the proposed management there is little fear of its proving equally effective in raising the character of Indian science.

If in this particular point of view, the work, of which the termination is now announced, appear defective, it must be recollected that the present Editor's means were less, while his difficulties were greater, than those of the projectors of the new Journal; and above all, that his was a first attempt in a country where all first attempts are almost sure to fail. The proposed work will follow one which may be said in some measure to have succeeded,—it commands the exertions of a learned Society, and it is to be conducted by two gentlemen, whose names alone are warrants of success. But although it be sufficiently evident that the new work must aspire to higher pretensions than the present one, the Editor owes it to himself, as well as to his correspondents, to state that his views, in originally projecting the Gleanings, were such as to induce him to seek for and prefer elementary communications;—and this so much so, that on a review of the whole work he is rather disposed to regret that such papers have not been more numerous, than to undervalue the work as being less recondite than might have been expected. It has always appeared to him that a great mistake is made, when science is assumed to be something so very abstruse as to be beyond the comprehension of the common reader. To him it has always appeared that this character of difficulty, which has attached to science, is attributable to

* It is curious to observe the preference so generally given to the quarto form of publication by the members of our learned societies. Assuming that their purpose is to disseminate useful information, nothing can be more preposterous. It is obvious, that for one purchaser of a bulky sprawling quarto in which " a river of type meanders through a meadow of margin," there will be half a dozen of a commodious octavo, and this without the very important advantage of a reduction of price amounting to one-half.

our writers; for it is not to be denied that we have fewer good writers on scientific subjects than on any other in the whole range of human knowledge. That it is more in the *manner* than in the *matter* that the general repugnance to scientific pursuits is owing, appears in the uncommon success of those excellent works, Mrs. Marcet's Conversations on Chemistry and Dr. Arnott's work on Natural Philosophy. No one complains of not understanding these works; they are level (to use a hacknied phrase) to the meanest capacity: yet they treat of subjects that heretofore had a mysterious terror for the general reader. But that the obscurity and difficulty of science is almost always nothing else than the obscurity and difficulty of the writer, is a truth that is more readily acknowledged by the self-taught, who every day find themselves obstructed by difficulties which oral instruction, or even a different work, may suggest to them the solution of.

Entertaining views such as these, the Editor conceived that a periodical work afforded peculiar facilities for treating scientific subjects in a less repulsive form than is adopted in more formal works, and in particular might afford to the student advantages which are otherwise only to be found in oral instruction. In such a work, questions may be proposed and answered, by which the learner's doubts may be solved, or obscurities illustrated. Even the different views which different people are found to take of the same subject, may be highly useful to the beginner, as it is indeed often the readiest means of removing difficulties which had appeared insuperable. It was in fact thought that a monthly journal, such as the Gleanings, might be made instrumental in recommending scientific enquiries to the general reader, chiefly by supplying that elementary information so difficult to be found at the moment, and yet, for want of which, subjects of the highest interest are found to be unintelligible to the unlearned.

That the Editor's success has been at all commensurate with his expectations, he does not mean to assert: on the contrary he knows, that it has been a very general complaint, that the work was not sufficiently elementary to effect the object here indicated. This would probably have corrected itself in time, although it must have always depended more on the contributors than on the Editor. In the mean time, though he is glad to see the promised appearance of a superior Journal, he is disposed to think that a work such as he has above marked the character of, would prove very generally popular, and would receive perhaps more encouragement than the GLEANINGS ever obtained, or even than the new Journal can reasonably look forward to enjoy, at least in India.

J. D. H.

CORRIGENDA.

In Volume II.

[Not noticed in the list published with that volume.]

Art. V. page 349, *dele* 'so likewise are the suborbital sinuses' *and substitute* 'suborbital sinuses, none?'

Also, in the specific character, *remove the brackets and query from the word* 'sublyrated.'—[*By the Author.*]

Page 360, line 9, from bottom, *for* 'Pentacrinus' *read* 'Pentacrinites.'
376, line 15, ditto, *for* 'maren' *read* 'mán.'
377, line 15, ditto, *for* 'oxydiging' *read* 'oxydizing.'
,, line 23, ditto, *for* '18¼' *read* '18½.'
383 line 17, from top, *for* 'demileur' *read* 'demêleur.'
,, line 29 and 31, ditto, *for* 'stribe' *read* 'strike.'
385 line 17, ditto, *for* 'Killogrammas' *read* 'Kilogrammes.'
,, line 27, ditto, *after* 'above' *insert* 'is.'
386 line 18, ditto, *for* 'anthrocite' *read* 'anthracite.'
,, line 22, ditto, *for* 'Palam' *read* 'Palamú.'

In Volume III.

Page 60, line 16, from top, *for* 'custards' *read* 'bustards.'
93, line 3, from bottom, *for* 'geologists' *read* 'geodests.'
121, line 22, from top, *for* 'cooled down to 25°' *read* 'cooled down 25 degrees.'
129, line 8, *dele* 'or volcanic.'
,, line 9, *dele* 'and which is there composed of small cinders, fragments of augite, &c. covered by a coating of burnt clay.'
130, line 9, *for* 'shews it to have had' *read* 'seems to be of.'
,, line 21, *for* 'bringing with it' *read* 'and deposited.'
,, line 21, *for* 'clay' *read* 'oxide.'
131, line 27, *for* 'has been' *read* 'are appearances here of.'
,, line 30, *for* 'of a' *read* 'resembling a.'
,, line 35, *for* 'Hunada' *read* 'Nunada.'
,, line 37, *for* 'veins' *read* 'ruins.'
,, line 41, *for* 'rents' *read* 'vents.'
132, line 4, *for* 'are of' *read* 'are partly of.'
,, line 5, *dele* 'in so far as they may be ranked under the general names of Calamites and Equiseta.'
,, line 21, *for* 'joints' *read* 'beds.'
133, line 16, *for* 'outline' *read* 'outlier.'
,, line 20, *for* 'hornblende' *read* 'hornblende predominates.'
Note, line 2, *for* 'Basacan' *read* 'Baracan.'
Page 134, line 19, *dele* 'a,' and *for* 'ridge of gneiss' *read* 'ridges.'
,, line 50, *for* 'Dungudhy' *read* 'Dungoadhy.'
135, line 15, *for* 'lifted by' *read* 'imbedded in.'
,, line 32, *for* 'Tutki' *read* 'Tulki.'
136, line 26, *for* 'the loose' *read* 'the layers of loose.'
193, line 30, *for* 'J. Finnis, Esq.' *read* 'Lt. J. Finnis, Asst. Ex. Off. 14th div.'
264, line of means for 2 h. 40 m., *for* 'temp. 8.5' *read* '85.7.'
under rain-gauge 2, *for* '1.03' *read* '10.3
280, line 22, *for* 'powde' *read* 'powder.'
328, line 12, *for* 'leaving' *read* 'having.'
330, line 29, *for* 'Chinie' *read* 'Chimie.'
346, line 11, *for* 'February' *read* 'March.'
355, line 9, from bottom, *for* '43½' *read* '43.''
,, line 7, ditto, *for* '2¼' *read* '2½.'
356, line 3, *for* 'Shahrud Bostan' *read* 'Shahrúd-e-Bostam.'
,, line 8, *for* '45 and 22' *read* '48 and 24.''
,, line 18, *for* 'that number' *read* 'half that number.'
339, line 15, from bottom, *for* 'labou ' *read* 'labour.'

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The sheets of Buchanan's Statistical Account of Zillah Dinajpúr are to be separated from the several monthly numbers, and kept in reserve until the Report upon Dinajpúr be completed, which it is estimated will contain about 300 pages, and thus form a volume of itself.

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GLEANINGS

IN

SCIENCE.

No. 25.—*January*, 1831.

I.—*On the Minerals of the Rajmahal Cluster of Hills. By* Dr. F. Buchannan.

[From his unpublished MSS.]

THIS is the only part of India, where I have seen a great mass of stony matter disposed in what are called horizontal strata; nor is it every where in these hills that this position can be traced, and it is chiefly observable on their higher parts. There it may be in general traced, wherever any considerable excavations have been made, or wherever there are abrupt precipices. Such however are not common, for although the hills are steep, they are not broken by great rocks, and the stones, by which their surface is covered, are generally small detached masses. Towards the roots of the hills, again, in many places, the rocks are absolutely devoid of visible stratification.

The great mass of these hills consists of what appears to me to be the variety of trap, called whinstone, in Turton's translation of the Systema Naturæ[1] (vol. 7, page 127), although I am not clear, that it is not a compact lava (vol. 7, page 127), between which stones I know of no proper limit. It is found in detached masses on the bank of the river at Rajmahal and Sakarigali; but both there,

[1] Geology, as a science, is of recent growth, and even at the present day this department of it, the nomenclature of rocks, is little understood, and has received scarcely any attention from geologists. In the time of Linnæus this was still more the case, and, in fact, notwithstanding his fame, as a botanist, mineralogy owes Linnæus nothing. *Whinstone* is a provincial term, occasionally applied to greenstone, occasionally to basalt. Greenstone is a granitic compound of hornblende and felspar, or augite and felspar, according to the majority of geological writers. Basalt is composed almost entirely of hornblende, and the grain is generally so minute as to give it an almost compact structure. Compact lava in hand specimens often bears a great similarity to basalt; it is said by Jameson to have a less specific gravity; but this may be doubted. The presence of olivin, as an imbedded mineral, is said, where it exists, to form an empirical distinction of basalt. The more crystalline varieties of this rock are less liable to be mistaken. It would be very interesting to identify all the rocks here spoken of, which might be easily done if any gentleman, having occasion to visit that part of the country, would take the trouble to forward specimens to the Secretary of the Physical Class Asiatic Society. Such specimens, if as large as a cake of Windsor soap, would be of a convenient size; they should have a fresh fracture on, at least *one side*, and they might be put up in country paper, with a label, stating where obtained, with any other information in the collector's power to communicate.—ED. GL.

and in most other places, no appearance of stratification can be observed. Its horizontal disposition[2] may, however, be very clearly discerned at the iron mine, near Partapin, in the division of Fayezullahgunj, where it forms the horizontal floor and roof between which the ore is contained.

Very nearly allied to the above, is what is called hornblende in mass, which differs chiefly in being much softer, although it still retains a great degree of toughness, and resists the action of the air much longer. It takes a tolerable polish, although inferior to that of marble, with which, however, it is often confounded. On account of the ease with which it is wrought, and of its durability, this stone is in great request among the natives. At Paingti it is found in rounded masses, immersed in a soft substance, evidently consisting of the less durable parts of a rock of the same nature now gone to decay. In some places this rotten mass has lost all traces of its origin, and has become a deep red soil, in which masses of the hornblende are found imbedded. Masses of several feet in diameter, and quite sound, might be procured; but the natives content themselves with smaller ones, which they cut into the stones on which they grind the materials for making curry, and many other substances. This stone, some say, should be called Tiliya; but others allege, that its proper name is Sangkhara. On the hill named Taruya, near Paingti, has been a quarry of this stone, from which great quantities have been taken, it is said, during the Mogul government. The place is conveniently situated, and very fine masses might be produced for building, no part of the rock having as yet decayed.

The two stones hitherto described, whin and hornblende, were by Wallerius classed together, and called hornstone, (Lapis corneus) and both the arrangement and nomenclature seem excellent, as both stones possess great toughness without being very hard, and as their colour resembles that of a black horn. Modern mineralogists, however, in the progress of their science, which seems, both in arrangement and description, to be retrograde[3], have applied the name hornstone to other minerals which have little or no resemblance to horn, and which are flint in the mass or rock. At Sakarigali, close by the edge of the water, in winter, is a curious horizontal layer of this stone, not above a foot wide, but exceedingly difficult to break. It is filled with the exuviæ of a ferm. It is divided by fissures into rhomboidal masses, from 6 to 12 inches in diameter.

A substance, which naturalists include among the clays, but called *khari* by the natives, is very generally diffused through these hills, and several quarries of it have been, and still are wrought. When perfect it is a substance somewhat like chalk, but is not calcareous. Women in many parts eat it, when breeding, as in Bengal they eat baked clay; and some of it for this purpose is exported to Murshidabád. Boys, when taught to write, rub it with water into a white liquid, with which they form letters on a black board. Finally, native painters and gilders cover with this liquid the wooden work on which they are about to operate. The best *khari* is white, and although little harder than chalk, seems to be formed of siliceous stones in a state

[2] The horizontal disposition of trappean rocks is often a deception, as may be seen in Macculloch's Western Isles. The question is, Are the Rajmahal rocks trappean, (i. e. overlying,) or do they belong to the primary class. The present paper presents few particulars on which to found even an opinion. From the general alledged absence of stratification, and the spheroidical structure noticed, we incline to consider them the former.

We recommend the question to the notice of those who may have it in their power to throw light on the subject.—ED. GL.

[3] A remark, as true as it is severe, if we exclude Mohs work, which, of course, being only recently published, was not known to Dr. B.—ED. GL.

of change. Among these hills I have found no specimens of the flinty hornstone, yet I think it probable, that formerly much has existed, for every where there abounds a kind of imperfect *khari*, which to sight has every external appearence of the real kind, but is vastly too hard for use, and in fact is in an intermediate state between the proper *khari* and flinty hornstone. Farther, in a piece of this imperfect *khari*, which I found on the road between Sripur and Majhuya, are evident traces of vegetable impressions, which serve to connect its origin with that of the hornstone of Sakarigali above mentioned. Still farther, in some pieces of imperfect *khari*, I can trace the gradations from that stone to a kind of granular quartzose concrete, very common in these hills. Although the best *khari* is white, yet much of a proper softness, as well as of the hard and improper kind consists of various parallel layers of different colours, sometimes plane, at others very curiously waved : the colours are white, red, and dirty yellow : I shall now mention the quarries of the proper *khari* that I saw, and of some of which I only heard.

On a hill, called Khari-pahár, the farthest south on the range, which I am now describing, is by far the best quarry that I have seen. It is covered by a horizontal stratum of stone about three feet thick, under which it extends to an unknown depth ; but in their operations the people have not exceeded 6 or 7 feet. It is disposed in vertical plates from one to three inches thick, and separated by an ochraceous matter, among which I observed traces of mosses. The plates run north and south, and are of various shades of white, but the whitest and softest alone are selected for market, and freed from the ferruginous matter. The *khari* seems to be what naturalists call a porcelain clay, and of a very fine quality, and perhaps, as ballast, might be sent with advantage to Europe. This quarry has been long wrought, and although situated on a hill belonging to the southern tribe of mountaineers, and cultivated by them, has been considered as the property of the Vírbhúm Rájas, and on the sale of their estate went, as a separate lot, to Lála Gamhau, who pays for it 29 Rs. a year. He sometimes has wrought it on his own account, and sometimes has let it to a manager. Whoever works it, gives to the hill people who quarry, $2\frac{1}{2}$ seers of rice for each ox-load of three maunds, and this he sells at Murshidabád for about $1\frac{1}{2}$ Rupee. He annually digs about 1,000 maunds ($58\frac{10}{14}$ Sa. wt. a seer) each weighing rather more than 60 pounds.

About 3 miles farther north, on a hill called Porgainge, is another quarry of *khari*, which I did not see. When I was in the vicinity, in December, 1810, it had been only lately discovered, and wrought for about 6 months, during which 500 maunds had been procured.

At Mansa Chandi, a small hill near Phutkiprú, was a mine of *khari*, which had been dug from a kind of sloping gallery running through a curious argillaceous stone, that will be afterwards mentioned ; but the deity of the hill, about 40 years ago, was supposed to have taken offence at the people's prying into her secrets, and the work was stopt.

On the hill, called Gadai-Tunggi, at no great distance from the above, and belonging to the northern tribe of mountaineers, is a fine quarry, now wrought. The hill forms the N. E. corner of the range overlooking Rájmahal, and consists mostly of whin ; but the surface in some places is covered with slaggy fragments, that appear to me to have undergone the action of fire. The quarry is only covered by red earth from 18 to 24 feet thick. Through this earth the workmen dig a sloping passage, open above, and perhaps 4 feet wide, until they reach the *khari*, when they dig a gallery into this substance, and take out as much as is wanted. Every year this must be repeated ; as in the rainy season the water fills up the passage, and brings down the roof ; a merchant hires the hill people for the work, and, on account of the risk, gives them 4 annas a day. The *khari* here is softer, and more unctuous[4] than at Khari-pahar, and being mostly in layers of different colours, is chiefly used as a medicine. In fact, it is what naturalists call Bole, or perhaps Lemnian clay; for in water it does not fall to powder. On one piece I saw somewhat like the appearance of a bivalve shell, but, if such, it was so much decayed, as to render its nature uncertain.

The last quarry that I shall mention is on the hill called Modiram, which is a little south from Kahalgao, and forms the north-western extremity of the range which I am now describing. This quarry is a porcelain clay, being of a less unctuous quality than the last; but on being put into water, it falls instantly to powder. It is not, however, so pure as that of Khari-pahar, being less white; but its colour is an uniform pale ash, nor is it intermixed with ferruginous matter between the layers; and being close to the river, its price at Calcutta might be a trifle. It has been wrought in 2 places, pretty high up the hill. The stratum in each has been from 3 to 4 feet thick, perfectly horizontal, and extending into the hill for an unknown length. The roof and floor in both are imperfect harsh *khari*. The natives dug into the lower quarry, without leaving pillars to support the roof, until that fell. About 3 years ago they went to the upper quarry now wrought, and have made a large excavation, perhaps 20 feet each way, and they will continue to enlarge it until the roof falls, when they will look for some other place. The leaving pillars to support the roof, is a mystery far beyond their present attainments in the art of mining, and when mentioned, was received with numerous frivolous objections.

Very nearly allied to the above *khari*, and frequently indeed forming alternate layers in the same mass of the more imperfect kinds, is the stony substance called by the natives *geru*, which differs only from reddle in being harder. It has not been found in large masses, and is in general so much intermixed with matters of another colour to which it firmly adheres, it is never sought after in quarries. Small fragments that are found scattered in the beds of torrents, and which, in the progress of decay, have been separated from the other matters with which they were united, are sometimes collected near Khari-pahar, and used as a paint, for which they seem well fitted.

I have already said, that some of these *kharis* probably owe their origin to sandstones, and of these there are in this district a great many. Some are horizontal; and of these some seem to be composed of the debris of siliceous rocks united together, partly without any visible intermediate cement, as on the ascent to Khari-pahar, and partly by a cementing matter, in which little masses of quartz are thickly interspersed, as the stratum which covers the quarry of *khari* on the same hill; others again seem to be the mere sand of the river, united by some unknown process of nature, as at low water mark under the hill at Paingti. In other sand stones, however, there is no appearance of stratification, horizontal or vertical;

[4] The term *khari*, we believe, is indiscriminately applied by the natives to any white powdery substance; thus they term chalk and indurated talc, *khari*. What the substances mentioned by Dr. Buchannan are, it is not easy to say. The unctuousness of the present variety, and its not falling to powder in water, would seem to point to indurated talc or potstone. As to the terms bole and lemnian clay, we need not remind our readers that they are vague and indeterminate, being mere local deposits, and in reality, mixtures of several substances. Brick, earth, or sand, would be equally definite.

The meagre kind may be a decomposing felspar, more or less pure. If so, it is well entitled to the name of *porcelain clay*.—Ed. Gl.

and such seem to me to be granitic rocks in a state of decay[5]. The various stages may be traced at Patharghâta, under the temple of Baleswar; and the most complete specimen may be observed on the Parpahar, which is a few miles above Rajmahal.

Sandstones, in many parts of the world, form the best material for building; but in this district, so far as can be judged from what appears on the surface, they are of little or no use. The only one, that seems to have been wrought, is on the face of the hill above Patharghât, where the edge of a horizontal stratum of concrete siliceous stone has been smoothed, and carved with numerous figures, probably of considerable antiquity. The stone is certainly very ill fitted for sculpture; but seems to resist the weather, and probably would answer well in building. A stone of a similar nature, but much more perfect, is found on the summit of Kangreswarikatok, which I take to be the crater of an extinguished volcano; but its situation is too distant from water carriage to admit of its being used.

Besides the granites and vertical strata in a state of decay, I must mention, that under the northern and southern extremities of this range, at Patharghâta and Kharipahar, there is large grained grey granite, with black micaceous or shorlaceous spots. At Patharghâta the rock is washed by the Ganges, and fine masses might, no doubt, be procured. In the very southern extremity of the division, on the Duyarka river, is a fine rock of solid granitel[6], consisting of black shorl, with many small specks of white quartz. It may be doubted, however, whether any of these primitive rocks form a part of this eastern range, as they are found just on its extremities, and may belong to adjacent mineral structures.

I here observed several breccias[7], with an argillaceous cement, containing rounded nodules of different kinds. One of these was in the bottom of the cavity in Kangreswarikatok, a place which I take to have been the crater of a volcano. Another was on the hills between Phutkipur and Mansa Chandi, which consists chiefly of what appears evidently to me to be a slaggy matter, that has undergone the action of fire; but, before I proceed to treat farther on such slags, I must observe, that south from Mansa Chandi, at Jajpur, on the borders of Virbhum and Murshedabad, there is a hill, which consists chiefly of a clay readily cut with a knife, but which on exposure to air becomes somewhat hard, and is evidently of the same nature with the brickstones of Malabar, which I have described in my account of Mysore. It is, however, vastly inferior in quality. This clay has a very strong resemblance to the slaggy stone of Mansa Chandi; and some parts of it, that have hardened into stone, are scarcely distinguishable, except by wanting the slaggy appearance. They must, however, be considered as a kind of breccia, as they contain ferruginous nodules in an argillaceous cement.

To return to the slaggy matter, which I consider as having undergone the action of volcanic fire, I cannot say that I saw it any where, very decidedly, forming great masses like currents of lava, but on a great many places I found it in detached blocks lying on the surface; such as on Pir-pahar, near Rajmahal, on Chaundi-pahar, on the road between Sripur and Majhuya, and on different parts of Kangreswarikatok, which I consider as the old crater. On Mansa Chandi and Gadai Tunggi, I am inclined to think, that the masses were united into solid rocks; but, without

[5] This seems rather an unwarrantable extension of the term sandstone, judging by the present practice of geologists; but at the time Dr. B. wrote, terms were used very vaguely, and with wide significations. Even at the present day this fault has not been entirely corrected.—Ed. Gl.

[6] Granitel is a term now nearly obsolete, applied by the older geologists to a mixture of hornblende and felspar, or hornblende and quartz. Ed. Gl.

[7] Modern geologists confine the term *breccia* to a rock formed of angular fragments. If the pieces are rounded they use the term *conglomerate*.—Ed. Gl.

digging, that could not be ascertained. On the edge of what I took to be the crater of Kangreswarikatok, I found a stone, which appeared to me to be volcanic sand conglutinated; and the resemblance between this stone and the siliceous concrete that is often incumbent on the *khari*, is very strong. This, together with the circumstance of the vein of *khari* contained in the slag of Mansa Chandi, seem to imply an extension of the operations of fire over the whole of this mineral division of the district.

I have said, that Kangreswarikatok, on the western extremity of this range, towards Parsanda, appears to me to have been the crater of a volcano[8]. It is a conical hill, about 300 feet in perpendicular height, and very steep on all sides. On reaching the summit, you find that it consists of a great cavity, surrounded by a thin ledge, and descending to very near the level of the plain. The ledge now is of unequal heights, having in some places given way, especially towards the east, where a gap, about 30 yards wide at the bottom, gives access from the outer plain with very little ascent, and allows the water from the cavity to escape. Towards the summit, the inner surface of the ledge consists of abrupt rocks, but the bottom is filled with the debris of the portions of the ledge that have fallen. Much slaggy matter is to be found, both on the outside of the hill, and in the bottom of the cavity.

I have not observed any other place that appeared to me to have any resemblance to a crater; but many such may exist, as I could examine only a very inconsiderable number of the hills, and as it was by the mere chance of having been detained by a rainy day, and being idle, that I visited Kangreswarikatok.

I was informed by Isfundiyar Khan, a fine young man, assistant to the Suzawul, who manages the hill tribes, that about five years ago he heard of a smoke that issued from a hill named Chapar Bhita, about seven coss S. E. from Karariya. He visited the place, which was not hollow, and consisted, as usual, of earth mixed with a great many fragments of stone. In the day it was not luminous; but that a thin smoke issued continually from a space about 8 or 10 cubits in diameter. He heard, that in the night it was luminous; but he did not see it in that state. On throwing wood upon the hot place, in a few minutes it took fire. These appearances continued for about three years, and then stopt. When I heard this account, I had long passed Karariya, otherwise I should have certainly attempted to visit the spot, although the distance was represented as 12 or 14 miles, and the road impracticable for any sort of conveyance.

In this range of hills I saw no traces of pyrites, coal, nor other inflammable substance. I have, however, been informed, that at Motijharna, on the hills near Sakarigali, there is a stratum of coal; but this information I also received long after I had been in the vicinity, and from a person, on the accuracy of whose accounts I had several opportunities of knowing that no reliance could be placed.

Besides the slaggy detached masses that are scattered over the surface of this mineral range, there are two other classes of sporadic bodies, that are very common, not on the higher hills, so far as I saw, but at their roots, or on very low hills, or very often on the plains that are interposed.

The first of these sporadic masses, that I shall mention, are siliceous, and are usually found scattered over surfaces, intermingled with fragments of whin slag and imperfect *khari*, and I suspect owe their origin to these bodies under a fusing heat. I found them at the bottom of Gadai-Tunggi, and Chaundi, near the iron mine of Partapur, but above all on the road from Sripur to Majhna, for almost the whole of its extent, which is about 14 miles, just in the centre of the northern part of this mineral range. Many transitions or intermediate states, between the three

[8] It would be very desirable to have a more particular description of this place.—Ed. Gl.

substances, to which I have above alluded, and the more perfect siliceous nodules may, I think, be observed. When perfect, they are more or less diaphanous, or even transparent; and many of them are crystallized. Some of their substances are uniform, others are in various coloured layers, but in general without the smallest interruption of continuity. These layers are sometimes parallel, sometimes concentric, and several nodules with concentric layers are often included in one mass. Many of the masses are covered with stellated pits, as if they had formerly been corals; but the crystallized internal structure of some that are thus pitted on the surface, seems to prove, that the appearance is not owing to the impression of animal exuviæ. The crystals are very various. In general they are clusters covering the surface; but in others they are confined between parallel plates; while in others they shoot from the inner surface of a smooth cylinder, and fill its cavity; finally, in others they form through the substance of the nodule very curious angular cavities.

The other kind of sporadic masses, scattered on the surface of this mineral tract, is calcareous, and consists of nodules called *ghangal.* In some places, these nodules are small, lie on the surface, so as to cover it entirely, and prevent vegetation. In others they are imbedded at some depth in a thick red soil, through which they are scattered at various depths. Their surface is white, and very irregular, and their shape is very various, often branching out like corals. They are exceedingly hard, and within of a compact structure, and are entirely similar to the calcareous nodules found in the south of India, which I have described in my account of Mysore. In the interior of the district they are generally found on the surface; but towards the banks of the Ganges are most usually immersed in the earth, and in both are used for making lime; but it is of an inferior quality, and is not white, nor fit for the outside plaster with which walls are encrusted; but answers well enough for mortar to connect the bricks. On the hills of Paingti and Sakarigali considerable quantities are burned.

This calcareous matter seems to me to be a kind of *tufa*[9], and to have been once in a soft state; on these detached nodules, indeed, no impressions can be traced; and there is strong reason to think, that they are now forming, as it is alleged by the workmen, that the same earth, from which they have been taken, after a lapse of some years, ts found to contain new ones. But farther, the very same calcareous substance, of which these nodules consists, is found in very large solid masses, in which it seems to have flowed over the surface of the stony matter, and to have involved many detached portions, or to have lodged on the surface of a rock, into the crevices and pores of which it has penetrated, so that the two masses cohere. The external surface of such masses is as unequal as that of the nodules, and resembles that of some corals.

At Paingti two very distinct kinds of this tufa in mass may be traced. One exactly resembles the stone of Manihari, described in my account of Puraniya, and which, when I wrote that, I considered as a porphyry changed into calcareous matter; and in fact it so exactly resembles the argillaceous breccia found in the hills south west from Phutkipur, that I have very little doubt of its having been once of a similar nature. In this are involved many masses of the hornblende in mass, which I have mentioned as constituting the greater part of the hills near Paingti. The masses of hornblende are of very various sizes, from that of an apple to that of the head, and have been rounded by the progress to decay, before involved in the calcareous mass. The other kind of solid calcareous mass found at Paingti consists of the common *tufa,* involving pebbles of various natures, but mostly of the *geru* or indurated reddle, that I have formerly mentioned.

[9] Evidently what in other parts of the country is called *cancar.* See our 1st. vol. p. 305 *et seq.*—Ed. Gl.

At Patharghát again the same calcareous substance has flowed over a stratum of the red concrete sandy matter, mentioned as found there, and entering its crevices, has united with it into one mass.

This calcareous matter at Paingti has also formed a very different substance from the above mentioned *tufa*, or at least has in decay suffered a great change of appearance, forming a friable granular substance; but it retains traces to show, that it has formerly resembled that which I suppose to have changed from the argillaceous breccia. This is a very considerable mass, into which the cave under the old Mudursah, described in the topography, has been dug.

In this portion of the district the quantity of metallic matter, in the form of ore, is not very considerable, and it is iron alone that has been discovered. The richest mines of Vírbhúm are close adjacent to its S. E. side, and probably are connected with it in mineral affinity, for mines were formerly wrought at Virkati in Sultangunj, and at Kalidaspur, in Ambar, both on the eastern side of this division; but these have been abandoned, and are now entirely choked, so as to be inaccessible. The former were situated in a stratum strongly resembling the indurated clay of Jaypur, abovementioned; and at Jaypur I found plates of iron ore, forming a mass contiguous to that clay, and separated from each other by argillaceous matter, strongly impregnated with iron. They are not attracted by the magnet, have a somewhat conchoidal fracture, very fine compact grain, no lustre, a very dark reddish brown colour, and red streak.

The finest iron mine, however, in the district, is on the hill named Ramkol, a little south from Partapur, which I have already had frequently occasion to mention; but this also has been abandoned, the people in that vicinity having been totally abandoned to sloth. The mine is a horizontal stratum some way up the hill, running to an unknown extent between two solid masses of whin or trap, which compose the hill. The stratum of ore was said to have been about 7 feet perpendicular thickness; but, having been wrought exactly in the same manner as the quarry of *khari* on Modiram, the roof has fallen, and the exact dimensions cannot be ascertained. The whin immediately adjacent to the ore is decayed, or, as the natives not unaptly say, is dead, which rendered the precaution of pillars still more necessary. The ore is of two natures. In the upper part of the stratum it is softer, is called *laliya*, and is attracted by the magnet; in the under part it is harder, is called *kariya*, and is not attracted. This is said to be the best ore, although it would appear to be specifically lighter, and should therefore contain least metal. Both are black with a common lustre, and contain small grains and dots, which to me give an appearance of its having undergone fusion. This is probably the only mine in the district, which Europeans would consider worth working.

In this part of the district, as well as in the third of its mineral divisions, there is a very common appearance, which I think may possibly arise from ferruginous vapours issuing from the earth. In certain places all the fragments of stone and pebbles that are lying on the surface of the earth, are covered with a kind of brownish enamel, quite thin and superficial. The stones thus covered are of all different kinds, nor does any one in the same space seem to escape, while similar stones, at a little distance, are in no manner affected.

In September 1810 at Masdhari Pahar, about 10 coss east from Kalikapur, in the territory of the northern tribe of mountaineers, a considerable space of the surface of the hill, said to have been about 40 yards each way, sunk downwards, leaving a cavity 10 or 12 cubits deep. The cavity at first was filled with water, but soon dried. The soil was a red clay, mixed with many fragments of stone. The intermediate country was so inaccessible, that I could not find means to visit this curiosity.

II.—*Observations on the Cause of the Spouting of Overflowing Wells or Artesian Fountains.*

According to some philosophers, the theory of the spouting waters of Artesian springs has been referred, sometimes to that of *jets d'eau*, and sometimes to that of syphons; a bored well being, as they say, only the second branch of a large syphon, of which the first branch is the subterranean course, between impermeable strata, followed by the compressed waters coming from a higher country than that in which the bored well has been formed.

According to others, such a well can only be considered as a tube, which shows the pressure of water upon an earthy or stony stratum, at which the bored well terminates.

Mr. Dickson, of New Brunswick, after showing that, by means of bored wells, water may be procured in any place whatever, and that it will rise to the surface of the earth, independently of all gravitating pressure, says, that masses of water, precipitated into the abysses of the interior of the earth, are thrown out to its surface by an innate expansive force, through the action of the central fire; and again admits, as a second cause for the ascent of water, the effect of capillarity,—forgetting that, if this action could bring subterranean waters to the surface, it yet could not make them spring beyond it.

According to M. Azais, the springing of the water of bored wells seems to be unamenable to any common law, and can only be accounted for by the universal principle of expansion: "For," says he, "every body which contains in its central parts an expansive focus, surrounded by envelopes of greater or less thickness or condensation, is a body in *a state of resilience*, that is, in a state of continued effort against the resistance of these envelopes. It incessantly labours to drive them outwards, to break and dissolve them; and not being able to do this, it at least exercises its expansive action upon the internal substances, agitates them, divides them, attenuates them, and projects them as much as it is possible for it through the pores of the external envelopes. This action of *resilience* and *transpiration* is in nature the first and essential *vital action*." After distinguishing three kinds of transpiration, viz. 1*st*. the *vital transpiration*, which emanates from the central regions of our planet, and projects outwards by radiation the subtile fluids, such as *caloric*, the *magnetic fluid*, *electricity*, &c.; 2*dly*, the *middle transpiration*, which emanates from the intermediate regions, and projects, under a vague and semi-impetuous form, the various gases of which the mass of the atmosphere is composed; and, 3*dly*, the *weak* or *indolent transpiration*, which emanates from the layers nearest the envelope, a *soft transudation* like *sweat*, and under an *aqueous* form, M. Azais says, that, like the blood, which, through the impulsion of the central focus, is continually making an effort to exhale, by supplying our habitual transpiration, and which springs out the moment the lancet has burst the envelope which retained it, the central water springs out under the borer in obedience to the universal principle of expansion[1].

[1] On this subject, M. Azais, after observing that in the globe, taken as a whole, each of the three modes of transpiration always preserving the same measure, there always emanate from it the same quantities of subtile fluid, gases and water; whence it follows, that, wherever the aqueous transpiration is precipitated, by the aid of a bored well or a bleeding, a local intensity is given to it, by which there is drawn off a more or less extensive mass of the aqueous transpiration, which in ordinary cases, makes its way slowly, with difficulty, and under a very divided form by the pores

In his *Recueil Industriel Manufacturier*, M. Moleon has inserted an article on the Essay published at New Brunswick by Dickson, which had been communicated to him by one of his London correspondents. This correspondent says, that, without profoundly examining the question, he ventures to assert, that, in his opinion, the waters which spring from a depth of 400 or 500 feet (of which there are examples in England, in parts at a great distance from any hills of a similar height), are not the product of infiltrations from above, which feed small springs and wells, but that these wonderful and inexhaustible jets are projected by great subterranean arteries, which are acted upon by great reservoirs of air which the earth contains, and which are often met with in boring. The author of this article rests his opinion, 1*st*, on the disengagement of hydrogen gas which took place during a boring in America [2]; 2*dly*, on the vacuities which are often met with in forming wells; and, 3*dly*, on the circumstance, that the quantity of spouting water is not diminished, when several wells have been bored quite close to each other, which induces him to think that the pressure of the air must there be the cause of motion.

The workings of mines and quarries have shown, that, in certain kinds of ground, the waters spread out into veins, stripes, brooks, and even sometimes torrents, running through the cracks, fissures, and natural perforations of the interior of the rocky strata [3]; while, in other kinds of ground, they form sheets or expanses of various extent, in beds of sand, earth or permeable stones,—and the moment the upper stratum is perforated, they rise and spring out with greater or less rapidity, until they have attained the level from which they come.

of the envelope. Thus there is substituted a small, but rapid and continued torrent for a vague and confused fumigation, occupying much more time and space. Now, it is extremely probable that this fumigation through the pores of the envelope is the principal food of plants, the large trees especially; the magnificent forests, which no external drought can wither, have, without doubt, the mouths of their roots open towards the aqueous transpiration, which ascends towards them from the interior of the earth. This vital source of vegetation would be cut off, or at least greatly diminished, were too many vertical fountains opened in their neighbourhood, and in the ground which bears them.—*Unpublished Memoir on Artesian Wells, by M. Azais.*

2 This boring was made at the bottom of a dry well, in the brewery of Messrs. Bord and Collok, at Albany. This well was in depth.................. 30 feet

The sound passed through gravel and clay, ...	11
Black slate,...	41
At this depth of 82 feet, water was found; but as it was not abundant, the boring was continued.	
Black slate, ...	168
	250
At the depth of 250 feet there was a plentiful disengagement of hydrogen gas in the black slate, ...	32
	282

At the depth of 282 feet the water sprung up to the height of four feet above the surface of the ground.

3 The quarries of Paris, and, in general, all large quarries present frequent examples of vestiges of subterranean brooks or currents now dry, which must formerly have traversed the limestone mass at different heights, by means of the fissures and tortuous cavities which intersect it in all directions.

Such is the basis of our theory of the spouting of subterranean waters : it is merely the result of what we daily see in the workings of mines. It is the application of the theory of *jets d'eau* and syphons. It is, in fine, so simple, and so natural, that it is hardly possible to offer one more satisfactory.

The thermal waters which rise to the surface from the interior of primitive formations, owe their springing to the disengagement of compressed gases, which react upon the surface of these waters in the same manner as vapour acts upon the water in the Eolypile.

The springing of cold mineral gaseous waters may be assimilated to that of the compression fountain.

The circumstances of springs which flow out upon the declivities of hills, nearly at a constant height in stratified countries, and particularly in those composed of alternate layers of sand and clay, establish and characterize that disposition of water which we have said to be in sheets, and whose origin is due either to subterranean effusions coming from higher countries, or to infiltrations of snow and rain water arrested by these claybeds.

This sheet of water has been likened, by Professor Hachette [4], to a layer of ice of a similar form to a layer of clay, sand, or chalk. If the water is considered as occurring there between two curved surfaces, such as two sections or basins of different diameters, whose upper edges are in a plane, or irregularly indented, or partly closed, the liquidity of the water is the cause of the pressure which the tube of the bored well measures ; but if, in place of a sheet of fluid water, there be supposed a layer of ice, the pressure would resist, and would not be indicated by the tube, and it would be changed in its power of cohesion.

Whatever be the manner in which water spreads under ground, in descending from higher to lower grounds, whether in sheets or in veins, stripes or torrents, when it happens to meet with an issue of any kind in the ground, it insinuates itself into it, and rises to a height corresponding to the level of its point of departure, or rather to a height which balances the pressure which the water exercises against the walls of the canal which contain it [5]. Hence arise the spouting fountains or natural *jets-d'eau*, which occur in secondary formations.

Whence it follows, that, to obtain a spouting fountain, we must, 1st, Try, according to the nature of the ground, at a greater or less depth, to reach a flow of water coming from higher basins, and passing along, in the bosom of the earth, between compact and impermeable rocks ; 2dly, Afford this water, by means of a well artificially bored, the possibility of rising to a height proportional to that of the level from which it comes ; and, 3dly, Prevent, by tubes inserted into the bored well, the spreading of the ascending water in the surrounding sand, or in the cracks and fissures of the rocks traversed by the bore.

From this it will be seen, that spouting springs may be obtained by means of boring, in almost every country that presents in its interior subterranean sheets of water, between the alternating and continuous beds of permeable and inpermeable deposits, extending to the country or mountains which contain the reservoirs of these water-sheets, and whose bases or slopes are covered by these beds.

But it is essential to repeat here, that we must not expect to find wells of this description everywhere, as has been thoughtlessly asserted ; for, on the one hand, the nature of the ground sometimes absolutely prevents it, as in granite districts ; and, on the other hand, it is possible that a perforation, made even at a very small

[4] M. Hachette, *Considerations sur l'Ecoulement des Liquides.*

[5] Memoir by M. Barrois, on Bored Wells : *Societé des Sciences de Lille*, 1825.

distance from a bored well affording water, may not yield any, should the latter, for example, be fed by a subterranean current, in place of being supplied by a sheet of water, or should the perforation be made upon the extremity of a basin with inclined strata resting upon a formation of a different nature.

We shall not here enter upon any details respecting the art of boring Artesian wells, such not being our object. M. Garnier's *Manuel du fontenier-sondeur* contains all that can be desired on the subject.

Taking a general view of what we have said, we deduce the following consequences, which we believe to have been sufficiently demonstrated.

There exist great subterranean sheets of water at various depths. These sheets are more commonly met with in the plane of superposition of strata of different formations. They, however, frequently occur at various heights in the great masses, such as those of clay, chalk, and even marine limestone containing cerithia, when these masses are entire, and of great thickness.

According to the slope, the undulations, or the declivity which are presented by the plane of superposition of the permeable deposits in which the waters flow between impermeable strata, these great sheets of water are met with at all depths; but it is impossible to lay down any constant rule with respect to them.

In order that these waters be capable of ascending, it is necessary that the formations among which they occur be entire, in the state in which they were originally deposited, and that they be not intersected by large vallies, or deep ravines, in which the waters would find a free and easy exit.

It would be in vain to search for springs in deposites which, at no great distance from the place of boring, are intersected by vallies, or when the formations are internally cracked, filled with tortuous separations, and greatly disturbed, whether by the contraction attending the desiccation of the mass, or by internal shocks, swellings or earthquakes; or, lastly, when these neptunian formations, such as plastic clay, chalk, oolite and shell-limestone, are raised up, and present precipices at the surface, as is the case, for example, with the plastic clay at Issy, Vauvres, Auteuil and Passy, and with the chalk at Meudon, Sevres, Auteuil, Bongial, &c.

In these different localities, we need not expect success in boring for springs, unless by penetrating deeply into the mass of the chalk, in search of the sheets of water in its lower part, or even by traversing it entirely, in order to come upon those in the clays, oolites, and shell-limestones; or lastly, unless by penetrating deeply into the latter, when they happen to be raised to the surface, and present cliffs, or are intersected by valleys of greater or less depth.

On this subject it is necessary to observe, 1st, That if in a country composed of elevated plains, such as those of Champagne, Normandy, Picardy and Beauce, or any other of the same nature, or of similar formation, in place of boring to the necessary depths for reaching the different water-sheets which are commonly the most abundant, and, at the same time, those which rise highest, the boring is stopped at higher levels less distant from the surface, it is more than probable that, in that case, the ascending waters would stop more or less *beneath* the surface of the ground, according to the depth of the borings.

Then also, so far from considering the operations as having failed, because in this case the water does not rise above the surface, we are of opinion that, according to the localities and the nature of the ground, steps might be taken to remedy the deficiency.

Thus, for example, when the water of a boring only rises to within a certain number of yards from the surface, but in sufficient quantity, it might be conducted from the point to which it reaches, by a small gallery, into some neighbouring well, or into one dug on purpose, and there might thus be produced a kind of artificial fall, which might be employed to make the water ascend to the surface of the ground, and even beyond it, by employing for this purpose either a hydraulic engine, *(belier hydraulique,)* which would always give a third of the volume of water; or a wheel, which might be placed at the point of the fall, and which, working a pump, suitably placed, might raise the third, or perhaps even the half of the volume of water; or, in short, any other hydraulic machine of the kind. But these means would be practicable, only in so far as the wells into which the waters should be precipitated, might not allow them to run off into a strata of permeable deposites.

In concluding these considerations, and the consequences which we have deduced from them, we shall mention the circumstances which it is necessary to examine and appreciate before resolving upon boring a well.

1st, It is necessary to examine the physical constitution, or the nature of the ground, and the disposition of the surface of the country, with reference to the mountains which overlook it, the valleys by which it is intersected, and the springs which rise in these valleys. The latter it is particularly necessary to examine, before deciding upon boring a well, as many of them are real natural wells.

2dly, It is of importance to select a fit person for boring, the art not being merely mechanical, and such as can be practised by any borer [6].

Lastly, Besides attending to these circumstances, it is necessary to be possessed of perseverance and courage, which will lead us to disregard the delays and difficulties often unavoidably connected with the operations of boring.

HERICART DE THURY.

[6] A borer who has no experience may entirely fail in the operation confided to him; and such an occurrence may suffice to prejudice a whole country against bored wells, if it be the first time that they have been tried in it. Too frequently the borers are nothing but common labourers, who follow a blind routine, and are apt to be discouraged, when, in a different country, they do not see the sound bringing up the kinds of earth and stone to which they have been accustomed. The levels of water, and the manner of determining their rise, are often unknown to them. Sometimes by their haste to sink the tubes, they prevent the sheets of water from ascending to the surface; and they are frequently discouraged, because they do not find, succeeding each other, the formations in which they have been accustomed to see water springing. Lastly, some of them having no knowledge of the art, have been seen exposing their workmen, without any precaution, in the bottom of deep wells, where they run the greatest risk when they approach impermeable beds covering the sheets of compressed water. These waters sometimes coming from distant and very elevated reservoirs, often rise at the very moment of boring, in such quantity and with such impetuosity, that the workmen scarcely have time to ascend to the surface, and have even perished before they were able to give any signal of distress. Frequently the irruption of the compressed waters is accompanied with a disengagement of air, which escapes with such noise and impetuosity, that the workmen are thrown over, and others have compared the effect of this disengagement of air to a violent blow upon the body or arms. It is this disengagement of air which has led some persons to think that the ascent or springing of the water of bored wells is owing to the pressure of the atmospheric air in great subterranean cavities. If this cause be admitted for the rising of water at the very moment when the impermeable stratum is perforated, it remains to be examined, why the air once disengaged, the water continues to spring, although it no longer undergoes pressure from the air.

III.—*On the* Chíru; the Kemas *of Ancient Authors.*

[From Major Hamilton Smith's Supplement to the order Ruminantia.]

In our last number we published an account of the *Chíru*, by a gentleman who has had the advantage of drawing up his description from an acquaintance with the animal itself, whom he kept for some time in a state of confinement. This account will, doubtless, prove an acceptable present to the naturalists of Europe, and we derive much satisfaction from seeing our work selected by the author, as the medium of communicating his interesting observations to the public. It appears that a more perfect description had been formerly transmitted to the Asiatic Society, through Dr. Clarke Abel, the then Secretary to the Physical Class; but this description, it now appears, by some mischance, is not forthcoming. The paper in our last number will, therefore, be the more valuable, in as much as the naturalists of Europe appear hitherto to have had no certain or full account of the animal. The following extract, from Major Hamilton Smith's Supplement to the Order Ruminantia, in Griffith's translation of Cuvier's *Regne Animal*, will show the quantum of information which the latest and best work on Natural History can furnish on the subject of the *Chíru*. As the work in question is not very common, we doubt not our readers will be pleased to see it. If the *Chíru* be really the same as the *Kemas* of Ælian, the circumstance will add another to the many proofs we have already, of the very extensive knowledge which the ancients had of Natural History.

The *Chiru*. (*A. Kemas ?*) The *Kemas* of Ælian is only characterized by horns, with the points turned forwards, a hide very thickly set with hair, and a white tail. Naturalists, viewing the direction of the points of the horns as a decisive criterion of groups, have mostly placed this species among the Reduncæ, and considered it an African species, without adverting to the fact, that the quantity of hair, and the colour of the tail, removed it from any known animal of this genus, belonging to that quarter of the globe, or even from those of Asia hitherto described. No ruminant of a low latitude, or residing beneath high mountains, is furnished with a superabundant coat of hair; and thus we are led to look for the *Kemas* of Ælian among those remote from the tropics, or whose habitat is confined to elevated regions, and to consider it as still undescribed in the catalogues of nomenclators. Assuming the foregoing data, a late discovery in the mountains of Central Asia shews us an antelope in which the indications of Ælian are obvious; we mean the *Chiru* or Unicorn of the Bhotias. From the accounts which we have received, and the inspection of the horns by a friend, we are enabled to present a notice of this animal sufficiently distinct to establish it as a species, the probable *Kemas* of Ælian, and to indicate its presumed affinity with the orygine group, at least until subsequent observation shall have confirmed or invalidated the opinion.

The materials from which the notice is collected, consist in the description of the skin of a male to which the horns were attached, but mutilated and distorted from the want of skill or of means in the natives who procured it, and also in several horns sent from Catmandu to Calcutta. From these it appears, that the total length of the animal approaches to six feet, and the height, at the shoulders, is more than three feet. The horns are from twenty-one to twenty-six inches long, black, slender, annulated with rings, most prominent towards the front, and extending three-fourths up the horn, the rest smooth and pointed; they are seated on the crest of the frontals, parallel to the plane of the face, close at base, divergent; their general direction between straight and lyrate, and the tips turned forward the head is ten inches long, seemingly without lachrymary sinus, and without a moist muzzle ; the ears are short ; the neck, compared with the body, very long, if at least this seeming disproportion be not the result of overstretching that part ; the fore-legs and withers are lower than the croup ; the tail is eight inches long, and shaped as in the Axis ; the hair of the animal is rough and very thick, but not quite so hard or long as in the Musk, with much of the same quill-like character : it conceals a fleece of fine soft wool, set very close, and pressed against the skin : the colour of the face and legs is dark, nearly black ; the neck, back, and sides, blue-gray slate colour, turning to rufous on the back ; the belly, inside of the thighs and tail, are whitish ; the distinctive characters of the female are unknown.

We have here another instance of wool on the skin of an antilopine species ; a character not only perfectly consistent, but of necessity, when the animal resides in high latitudes, or on high mountains : thus a similar cause produces a similar effect upon the *A. Lanigera* of North America, the *Chiru* of Central Asia, and, indeed, on the *Chamois* of Europe. This wool is so abundant, that in the notice sent from Catmandu[1], it is described as perfectly similar to that of the Wild sheep of Bhót. It is probable that the residence of this animal in the same regions, and sometimes in company with the Thibetan Musk, led the Arabian and Byzantine writers to consider it as the musk-bearing animal ; and this error was the more likely to occur, as they might have known the Mongolian *Dzeren (A. Gutturosa)*, who is actually provided with a pouch. Of all the antilopine animals, the *Chiru* is the one which corresponds best with Ælian's *Kemas*[2] ; and if we consider, that although the species is described at present as found in Bután, the mountain ruminants are more likely than those of the plain to spread along the ramifications of central ridges as far as they can find a congenial climate, there is no reason to deny its former and probably present existence, even in the Caucasian range, and to have come within the inquiries of Ælian, during the military expeditions of his time (that is of Alexander Severus) into the mountains of Armenia[3]. The species might still have remained unnoticed in the elevated wildernesses of Central Asia, if the people of the country had not asserted it to be the Unicorn, and since the specimen is produced, insisted that it is often found with only one horn. No doubt all the *Oryges* are liable to break one of their horns, when we consider their length, small diameter, and the vigour and courageous disposition of the animals ; and we may infer, that the reports of *Monocerotes* so ancient, so general, and so permanent, depend solely upon these accidents ; and that the unicorn *Chiru* of Bhót is, in all likelihood, the unicorn of the ancient Persians.

According to the accounts of the natives, this species resides in the most inaccessible pine tracts of Chandang, north-west of Digurchu, in the Himalaya mountains, on the verge of the snow, and evinces great activity and vigilance. They

[1] A MS. extract, for which I am obliged to J. E. Gray, Esq., of the British Museum.

[2] Although the word *Kemas*, Κεμας, appears a genuine Greek term for a young ruminant, the derivation seems rather far-fetched, and it is, possibly, in common with other Greek terms, derived from the more ancient oriental root *Kem*, which, with its mutations, signifying summit, crest, &c., extends over the old world. There is a curious connexion between the ancient names of the great ranges of mountains and of ruminants. Thus Taurus, and Taurus a bull ; Himalaya, Hemala a ram, the Teutonic Hamel ; Imaus, and Hæmus and Kemas ; Caucasus, and Ghau-cas or Oxridge ; Coomri, and Komri, a doubtful Hybrid of Central Africa, &c.

[3] Ælian's description of its swimming and residence in woods, is more appropriate to Asiatic than African locality.

associate sometimes with the musk, and with the *nervati*, or wild sheep of Bhót. Mr. Hodgson, assistant resident of the East India Company at Catmandu, first produced the documents for a description of the animal ; there were, however, already some accounts of it transmitted in a letter from Captain Smith, who commanded a party stationed in the eastern parts of Nepál. In the Calcutta *Oriental Miscellany*, are the dimensions of the skin, before noticed, and communicated, we believe, by Mr. Hodgson. Total length of the animal five feet eight inches ; of the head ten inches ; of the ears four inches and a half ; of the body four feet two inches ; length of the neck one foot nine inches ; of the fore-leg one foot eight inches ; of the hind-leg one foot eight inches and a half ; of the tail eight inches ; circumference of the head one foot eight inches and a half.

It appears, from the information of friends, that the term spiral horns, which was at first assigned to it, refers to the annuli, which are obsolete, excepting in front ; and from the figure shewn us, we are inclined to consider a horn in the collection of Mr. Parkinson, attached to a part of the frontal, and formerly belonging to the Leverian Museum, as of this species. It is about twenty-seven inches long, measured upon the curves ; black, slender, very slightly lyrated, parallel with the face, bending outwards towards the middle, and the tips turned forwards ; marked with twenty-one annuli, most prominent in front, striated between, and with about five inches of the summit smooth. It is seated on the crest of the frontals, and may have been the horn which induced Mr. Pennant to describe his cinereous Antelope, or *Eleotragus* of Schreber, as having the points turned forward. We had placed it in the group of *Oryx*, with the surmise that this referred to *Kemas* in our original catalogue. There is, however, a slight difference, the present having a small lateral bend, which we hear does not exist in that of the *Chiru*. If, therefore, it does not belong to the Bhót species, it is a fragment of one as yet undescribed.

IV.—*Examination of the Water of several Hot Springs on the Arracan Coast : from specimens preserved in the Museum of the Asiatic Society.* By J. Prinsep, *Esq. F. R. S., Sec. Ph. Cl. As. Soc.*

[Read at Meeting of the Physical Class Asiatic Society, 27th Oct. 1830.]

No. 1. Bottle labelled " From the hot water fountain in Tavoy, 1825."

The specific gravity of this specimen was 1001,7 at 86°,6.

Tested with acetate of silver it yielded no muriatic precipitate, but acquired a brown shade, indicative of the presence of a little sulphuretted hydrogen.

Nitrate of barytes and oxalate of ammonia, gave copious deposits, shewing the principal ingredient to be sulphate of lime.

No. 2. " From the Lankyen hot well in Tavoy," 2 bottles. Sulphureous smell, specific gravity 1002,3 and 1002,4, very slight traces of muriates.

On boiling down 1000 grs. of this water, pearly spicular crystals of sulphate of lime were deposited, which weighed, on collection, 2,0 grs. to which 0,4 of earthy uncrystalline sediment must be added : this salt, therefore, forms the principal and almost sole ingredient of the Tavoy hot springs.

No. 3. " From the Sienlee hot fountain in Martaban."

The first bottle had a specific gravity of 1000,8 at 86°,6.

The second also 1000,8.

They both afforded slight traces of sulphuric acid and of lime, and none of muriates.

No. 4. "From the petrifying rivulet at Mergui."

The specific gravity, at the same temperature, was 1000,7.

Traces of sulphuric acid and lime.

The low specific gravity of the two last specimens rendered it uninteresting to examine them more in detail : indeed, the prevailing salt in all of them seems the same; namely, sulphate of lime ; and they correspond in quality with the water from the hot spring on the Athan river, in the Tennasserim province, of which Mr. Piddington has given an elaborate analysis. The present specimens had been so long in bottle, that it was useless to examine their gaseous contents. I would beg to remark on Mr. Piddington's analysis, that the sulphate of lime being considerably soluble in water, the proportion of that salt may probably have been greater, including most of what has been set down as sulphate of magnesia : the same remark applies to the separation of the carbonate of lime.

While on the subject of hot springs, I take the opportunity of recording some observations made in the year 1827, upon specimens sent to me from other parts of India.

No. 5. From the hot wells in the Mahadeo hills, near Hoshungabad, called by the natives of the place "Unhonee Sumonee." The bottles were filled on the spot by Doctor Spilsbury, who accompanied them with the following remarks:—

"The wells are resorted to by the natives, seemingly rather as places of worship than for any medicinal purposes; although some afflicted with itch and other cutaneous disorders, were observed among the bathers : I could not learn that the water of either of the wells was used for drinking.

The heat of the eastern well is hardly low enough to admit the hand. A lamp held over the western well was immediately extinguished, proving a constant disengagement of carbonic acid gas."

Both of these specimens had a smell of sulphur ; they emitted bubbles of carbonic acid when boiled; their specific gravity was very nearly that of rain water ; and the salts present (all in minute quantity) were sulphuretted, muriated, and carbonated alkalies.

No. 6. From a hot spring at Sonee, on the banks of the Sutlej, in the Himmalaya mountains.

The temperature, noted by Mr. E. Ravenshaw, was 136°.

The specific gravity was 1004, 95, at 88°. Far.

The absence of lime, sulphuric acid, and iron, was proved by their respective tests. Nitrate of silver produced a copious precipitate, slightly blackened ; and acetate of lead, a brown flocculent deposit.

1000 grs. concentrated, were tested in vain for nitric acid, by sulphuric acid and gold leaf. The solution yielded 6 grains of common salt, adulterated with a little alkaline sulphuret. Decomposed by nitrate of silver it yielded 14,8 grs. of muriate of silver, equivalent to the above 6,0 of muriate of soda.

No. 7. Water from a well at Banda, supposed, by the natives, to be superior for the dying of *kurwa* cloth, in giving the lac dye a brighter red colour.

The specific gravity was found to be 1001,1, at 88°.

One of the bottles had a strong smell of sulphuretted hydrogen, when first opened : the other had none.

The proper tests proved the absence of { Sulphuric acid. Lime, (a trace.) Nitric acid.

1000 grains, evaporated to concentration, deposited an earthy crust, which, with the solution itself, effervesced with acetic acid : yielded a slight orange precipitate with muriate of platina: had a mixed, bitter and saline taste: curdled with nitrate of silver.

The principal ingredients of this water were, therefore, muriate of soda and magnesia, and carbonates of lime and potash, all in small quantities.

The peculiarity of the well consists in its having a dividing partition across it, not reaching deep into the water; the natives assert that the water, on one side, is detrimental; and on the other, coming from a different spring, beneficial for the process of dying: and they pay for the privilege of drawing the latter.

The above cursory chemical examination was performed upon both specimens, side by side, with the same results, and the only difference observable, was in the sulphurous smell of one of the bottles. It is possible, that the sulphuretted hydrogen may come in bubbles into the well on one side, and be prevented, by the partition, from extending to the other side its influence, which would, doubtless, be more or less injurious to the dye. The good quality of the water may be attributable to the carbonated alkali, which may heighten the red colour of lac in solution; but in the absence of more local information, these suppositions are altogether gratuitous.

V.—*On the Method of making Ice at Hooghly.*

In a recent excursion up the river, I stopped at Hooghly, for the purpose of visiting the Ice Fields. The principle of the process has been well explained by the late Dr. Wells, in a little work published in London, many years ago; being merely an advantageous application of the radiation of heat from the surface of non-conducting bodies, during a clear night, when there are no clouds to intercept or reciprocate that radiation. It had been very generally supposed, that the congelation was accelerated, if not created by evaporation; because it was observed, that the natives always used porous vessels. Many persons are still of that opinion; while others attribute the success of the manufacture at Hooghly, to an imaginary existence of saltpetre in the soil; and others, again, to the dryness of the soil, and to the spot being higher than the general level of the country, a fact very questionable, except as regards the river banks nearer to Calcutta. Mr. Scott, in a letter to Mr. Swinton, which was published in Brewster's Journal, in 1828, has shewn, from experiments of his own, that the porosity of the vessels is a detriment instead of an advantage, and that ice may be procured even under a coating of oil: and with respect to soil and locality, it would seem that Hooghly has no advantage over the immediate environs of Calcutta, except in being farther from the sea. There is no spot, on this side of Benares, on which frost even appears naturally in any shape; but every large town, from Calcutta upwards, is supplied with ice, made in the same manner as at Hooghly, the facility of obtaining and preserving it being greater as we advance into the interior. The Nuwaub of Moorshedabad was in the habit of sending ice, by way of *nuzzur*, to the Governor General, in the month of May, after it had ceased to be procurable in the bazar here.

In the Philosophical Transactions for 1775, there is an abridged account of the Indian method of Ice-making "at Allahabad, Motejíl, and Calcutta," from a paper presented by Sir Robert Barker, describing the plan pursued by an ice-maker retained by him for the supply of his own table. As that description is probably unknown to many readers of the *Gleanings*, who have never seen the process, and the Ice beds at Hooghly are somewhat differently arranged, the following notes may, perhaps, be deemed worthy of a place in your interesting periodical.

About a mile from the river, and nearly twice as far from the new *Ghát*, you suddenly quit the dense border of trees which cluster among the native houses, and arrive upon an open plain which, in the rainy season, is covered with paddy cultivation. At a short distance from the opening, on either side of the road, are the first ice fields: the rest are all situated within a few hundred yards. The beds I examined were on the left, or east side: they occupied about half the space between the road and a thick range of high trees, which intercepted the beams of the rising sun; they consisted of four rectangular excavations, two feet deep, and 115 feet long, by 25 feet wide, parallel to the road on the shorter side. One of them, which was empty, appeared to have been recently cut; the other three were filled with straw, which is put in very dry, to the depth of eighteen inches. Two of these were covered with little circular round bottomed earthen pans, of 9 inches diameter, an inch and three-eighths deep, and a quarter of an inch thick: I give the dimensions of one I measured as that of the whole, there being very little difference of size: they were just such as are commonly used in the bazar, for musters of grain. The pans were all placed touching each other, in rows of 150 by 32, so as to cover as much of the beds as possible; but as the wind had been southerly the evening before, (on the 16th January,) no ice was expected, although the sky was cloudless, and they had consequently been suffered to remain without water. In one or two pans, however, which accidentally contained a little, there was a slight crust of ice at 7 A. M. of the 17th, and I found the temperature of the dry pans only 35, tried by a very small thermometer left some minutes in one of them, while that of the air, four or five feet above them, was 52. The pans belonging to the third bed were standing on end, resting against each other in a row on each side, ready for use. When laid out upon the straw, they are fed with water, by a small earthen vessel, tied at the end of a bamboo, about 14 feet long, by which the most distant pans may be reached without stepping upon the bed; and on each side is a row of about 20 large *gamlahs*, fixed in the ground, and kept full of water; a span of 6 or 7 feet is left between the beds for the people to pass freely, and to allow room for the *gamlahs*, &c.

The collection of the ice from each bed, of 4,800 pans, occupies ten men for two hours, beginning at daylight. Every pan is lifted, and its entire contents are quickly scooped out with a small iron trowel, shaped like a sickle, into a wide mouthed gumlah, which is occasionally emptied into a mat basket, whereby the water is drained off, and the ice is carried to the first reservoir. This consists of a hole in the earth, from 3½ to 4 feet deep, and 4 or 5 feet in diameter, lined with dry whisps of straw, and matted within and above the straw. In a very cold night 10 maunds have been collected from one bed of 4800 pans—say from a surface of water of about 2000 square feet, but sometimes the quantity does not exceed half a maund. The selling price on the spot is 12 Rupees per maund. The best freezing month is December, and the next best is January: November is more productive than February, which has seldom more than three or four collecting nights; but both these months yield very little. Perhaps a season may reckon 50 freezing nights in the whole.

The ice preserves, or ice houses, are on the same principle as the reservoir above described, but larger. It is daily brought from the several works to the principal dealer, a native who has four large reservoirs on the right of the road, opposite to the works I have described. Three of them were 12 to 15 feet in diameter, and 10 feet deep, including 3 feet of raised earth, and contained between six and seven hundred maunds of ice altogether. The fourth was of much larger dimensions, and had alone contained 1200 maunds last year, but it was now empty. In one of the first three, which was not full, I examined the state of the ice: it had been beaten down, and was become a solid mass of 6 feet thick, not touching the matted circle, and loosely covered with whisps of straw. When filled, these ice houses are thickly thatched over, and the Ice is taken out by a little matted door, and sent down by water to Calcutta, in quantities proportioned to the demand, every day, while it lasts, which is usually till the latter end of April. There is no store kept in Calcutta beyond the daily consumption, and that in the houses of the retailers. Between the reservoirs are deep holes of two feet diameter, communicating with them, laterally, by a small hole to receive the drainage water, which is not allowed to accumulate, and is occasionally lifted out.

I was informed, by the intelligent dealer to whom the pits belong, that the demand for ice, in Calcutta, had greatly fallen off. A few years ago there was a sale for eight or nine thousand maunds, at the present price of ten to twelve Rupees; but now the market would be overstocked with three or four thousand. Many fields had consequently been abandoned, and the whole supply of last season, not reckoned an unproductive one, was only 2100 maunds. There remained but five sets of works in activity, belonging to the different parties, viz. 4 beds already described; 2 similar ditto, on the opposite side of the road; 7 ditto further on; 6 ditto ditto; and 6 ditto, about 200 yards distant, on the right of the road, the property of a medical gentleman, who has built a square brick ice house, coated with a thick mound of earth on every side, and protected from the sun above by an elevated thatch raised over it, like an umbrella. I did not visit his works; but I was told that his ice grounds were laid out like the rest, and of the same dimensions.

The luxury of ice does not exist, I believe, any where on the other side of India; although in Guzzerat frost is often seen upon the ground, and the nights are sufficiently clear and cold to produce it by the Bengal process. In many parts of the Deckan, notwithstanding the high temperature of the day in the winter months, when I was at Poonah several years ago, in the month of December, I was surprised at the intense coldness of the nights, (colder than in Calcutta;) after a hot day in which the Thermometer had risen sometimes as high as 82°, the usual range of the afternoon in that month being 76 to 80°. No dew, however, was perceptible upon the grass at sunrise, nor did it ever freeze. One night I placed my small thermometer upon a little cotton, in a hollow of the ground favourable for uninterrupted radiation to the sky: the cotton was saturated with water in the morning, and the mercury stood at 38; the temperature of the air, ascertained by passing the instrument quickly through it, being then 46. I have no doubt, therefore, that congelation might have been obtained upon the surface of large beds of straw or maize stalks, considering the great dryness of the atmosphere, which always prevails upon that elevated plain, when by such means the influence of the ground heat, communicated by the wet cotton in my experiment, should be intercepted. Mr. Scott, indeed, states, that he did not succeed in making ice when the temperature of the air exceeded 41, although Sir Humphry Davy supposes it may be obtained under a temperature of 50. The latter opinion appears to be confirmed by my observations at Hooghly, where the hygrometric state of the atmosphere is much less favourable than at Poonah.

G.

VI.—*Remarks on Dr. Paris's "Philosophy in Sport."*

To the Editor of Gleanings in Science.

SIR,

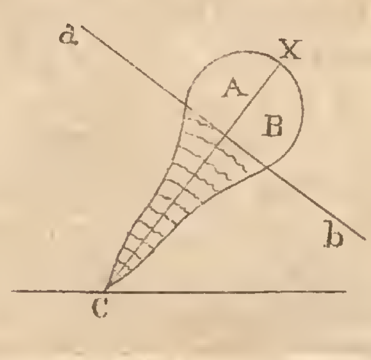
Your remarks, in the *Gleanings* just received, on the especial necessity of excluding all "chaff and rubbish" from works designed, either by cheapness or by attractive style or decoration, for the extension of useful knowledge among those classes of people to whom it has hitherto been repulsive or inaccessible, have induced me to refer to some notes from the work above named, which has been attributed to, and contains internal evidence indicating the facetious author of the Essay on Diet.

The subjects of these notes will appear trivial to some of your readers; and, but for their author's celebrity, I would not have ventured to obtrude them on your attention: they are, in external form, nothing more dignified than peg-tops and trundling hoops, though capable of yielding much euphonous controversy. Dr. Paris is responsible for all that follows between brackets.

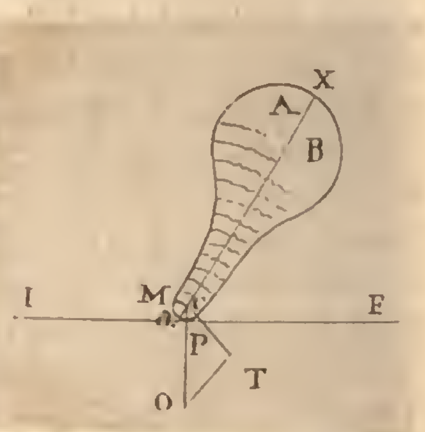
The Hoop. [Its rolling on without any disposition to fall "is owing to the centrifugal force, which gives it a motion in the direction of a tangent to the circle, and consequently overcomes the force of gravity,"—as in the instance of the glass full of water being whirled round the hand without spilling. The difficulty in making it go straight forwards is occasioned by the impossibility of giving it each time a straight forward blow, added to inequalities in the ground and hoop. Vol. I. p. 231.] The *ipsissima verba* above quoted are pure *verbiage.* The hoop moves, like any other projectile, as long as its impetus continues superior to its gravitation; the only peculiarities in its mode of progression being occasioned by its friction on the ground, and consequent rolling motion.

The Top. [Its erect position, when in rotatory motion, is "owing to the centrifugal force." "You have already learned, from the action of the sling, that a body cannot move in a circular path without making an effort to fly off in a right line from the centre; so that if a body be affixed to a string, and whirled round by the hand, it will stretch it, and in a greater degree according as the circular motion is more rapid. The top, then, being in motion, all its parts tend to recede from the axis, and with greater force the more rapidly it revolves: hence it follows that these parts are like so many powers acting in a direction perpendicular to the axis; but as they are all equal, and as they pass all round with rapidity by the rotation, the result must be, that (*a*) the top is in equilibrio on its point of support, or on the extremity of the axis on which it turns.

["It is evident that the top, in rising from an oblique to a vertical position, must have its centre of gravity raised." This was *not* occasioned by the centrifugal force: "it entirely depended upon the form of the extremity of the peg, and not upon any simple effect connected with the rotatory or centrifugal force of the top. I will first satisfy you, that were the peg to terminate in a fine point, the top never could raise itself. Let A B C be a top spinning in an oblique position, having the end of the peg on which it spins brought to a fine point. It will continue to spin in the direction in which it reaches the ground, without the least tendency to rise into a more vertical position; and it is by its rotatory or centrifugal force, that it is kept in this original position: for if we conceive the top divided into two equal parts, A and B, by the line



X C, and suppose, that at any moment during its spinning, the connection between these two parts were suddenly dissolved, then would the part A fly off with the given force in the direction *a*, and the part B with an equal force in the direction *b*; whilst, therefore, these two parts remain connected together, during the spinning of the top, these two equal and opposite forces A and B will balance each other, and the top will continue to spin on its original axis. Having now shewn that the rotatory or centrifugal force can never make the top rise from an oblique to a vertical position, I shall proceed to explain the true cause of this change; and I trust you will be satisfied that it depends upon the bluntness of the point. Let A B C be a top spinning in an oblique position, terminating in a very short point, with a hemispherical shoulder, P *a* M. It is evident, that, in this case, the top will not spin upon *a*, the end of the true axis X *a*, but upon P, a point in the circle P M, to which the floor I F is a tangent. Instead, therefore, of revolving upon a fixed and stationary point, the top will roll round upon the small circle P M, on its blunt point, with very considerable friction, the force



of which may be represented by a line O P at right angles to the floor I F, and to the spherical end of the peg of the top: now it is the action of this force, by its pressure on one side of the blunt point of the top, which causes it to rise in a vertical direction (*b*). Produce the line O P till it meets the axis C; from the point C draw the line C T perpendicular to the axis *a* X, and T O parallel to it; and then, by a resolution of forces, the line T C will represent that part of the friction which presses at right angles to the axis, so as gradually to raise it in a vertical position; in which operation the circle P M gradually diminishes by the approach of the point P to *a* as the axis becomes more perpendicular, and vanishes when the point P coincides with the point *a*, that is to say, when the top has arrived at its vertical position where it will continue to *sleep* without much friction or any other disturbing force, until its rotatory motion fails, and its side is brought to the earth by the force of gravity. I. 266].

[" The gyration," or circular excursion " of the top, depends upon exactly the same principles as the precession of the equinoxes;]—vol. i. p 273, [viz., an unequal attractive force exerted upon the revolving mass. In the one case, this is known to arise from the action of the sun and moon on the excess of matter about the equatorial regions of the earth; in the other from the parts of the top being unequally affected by gravity, while it is spinning in an inclined or oblique position (*c*.). To those philosophers who have condescended to read the present work, if there be any such, and are thereby inclined to pursue the investigation of a subject which has hitherto excited far too little attention, we beg to submit the following remarks:

" If a top could be made to revolve on a point without friction, and in a vacuum, in the case of its velocity being infinite, it would continue to revolve for ever, in the same position, without gyration. If the velocity were finite, it would for ever remain unchanged in position, in the event of the centre of gravity being directly over the point of rotation. In any other position (supposing its velocity very great, though not infinite) there would arise a continued uniform gyration.; the line which passes through the point of rotation, and the centre of gravity, always making the same angle with the horizon, or describing the same circle round the zenith. But in all artificial experiments, the circumstances are very remarkably changed; if indeed the centre of gravity happens to be situated perpendicularly over the point of rotation, the top will continue quite steady, or *sleeping* as it is termed, till nearly the whole of its velocity is expended. In any other position the top begins to gyrate, but reclining at all times on the outside of its physical point of gyration, the top is uniformly impelled inwards, and this (when the velocity is considerable, and the point broad) acts with a force sufficient for carrying the top towards its geniscent or *sleeping* point; but when the velocity is much diminished, this power becomes feeble, the gyrations increase in diameter, and the top ultimately falls."] vol. iii. pp. 167—9.

Notes on the above passages.

(a) You will observe the *non sequitur* which occurs here. In consequence of his dropping a link in the chain of his argument, the Author is led to the false conclusion, that a top *sleeping* upon a plane inclined to the horizon will have its axis of rotation perpendicular, not to the horizon, but to the inclined plane. *(b)* To suit his theory, the author here converts friction into impulse, powers which are wholly dissimilar. Friction, in this case, would act only by retarding the motion of the top, and causing it to gyrate as explained by Dr. Arnott (*see Gleanings, vol.* i. p. 368). It is true, that this friction may, from irregularities in the hemispherical shoulder of the top, and of the surface on which it revolves, and from the elasticity of both bodies, be accompanied by a bounding motion of the top; but this very phenomenon is fatal to Dr. Paris's theory; according to which, these bounds ought to consist in a slight depression of the lower end of the axis of rotation, and a raising of the other, this slight revolution being performed round an imaginary centre of motion, placed betweeen the tangential portion of the shoulder and the lower end of the axis of rotation. Now it is remarkable, that the actual phenomenon is the reverse of this; consisting in a raising of the lower end of the axis of rotation and depression of the upper; and for this very obvious reason, that the top's centre of inertia is placed between the shoulder, and *not* the lower end of the axis, but the upper. Dr. Paris has overlooked the position of the top's centre of inertia, and accordingly misstated the consequence of an impulse applied to the shoulder of the peg, besides making the inadmissible supposition, that friction is impulse: and his theory, like Dr. Arnott's, is disproved by the fact, that a top may *sleep* perpendicularly to the *horizon*, on a plane *inclined* to the horizon, in which situation it would, according to these authors, of necessity gyrate or *sleep* in a position perpendicular to the said *plane*. *(c)* As Dr. Paris has not favored the world with the details of the reasoning from which he traces an analogy between the precession of the equinoxes and the gyrations of a top, I can only state, that it is invisible to me, and that Dr. Arnott's explanation is quite satisfactory.

Of the last paragraph above transcribed, some conclusions are not deducible from what preceded; part is unintelligible, and altogether it has the air of a crude translation from the French. I shall quit this subject with remarking, as the explanation which I attempted in the 1st vol. of the *Gleanings*, p. 368, is probably original, and as Dr. Paris says, that the subject has been unduly neglected, that the word special, which appears there, is a misprint for spiral.

The Swing.—It struck me, on looking over the above work, that an excellent illustration of the pendulum might have been drawn from the facility with which a person standing in a swing can extend its excursions at pleasure, by swaying the upper part of his body forwards when he is at the forward limit of the oscillation, and backwards when at the backward limit; thereby forcibly carrying the *centre of oscillation* beyond the point which it would have attained, if the person had remained passive, and so extending the limits of each oscillation by the impetus thus acquired.

I have read Dr. Lardner's treatise on Mechanics, in his Cyclopædia; and, as far as I can judge, it is a correct, though, from its limits, necessarily a slight work. One mistake the Author has committed, while searching for a familiar illustration of expansion by heat,—a thing which is not easily found. At p. 22 he states, as an instance of this kind, that " in warm weather, the flesh swells, the vessels appear filled, the hand is plump, and the skin distended," apparently unaware that this distension is merely a consequence of the relaxation of the sanguiferous tubes, and the greater facility with which the blood then enters them.

These observations may appear hypercritical; but in works especially addressed to the general reader under the sanction of great names, it is reasonable to expect absolute accuracy, as far as the present state of knowledge allows; and errors of this kind, though obvious to those who have attended to the subject, are apt to cling with mischievous tenacity to the minds of those to whom it is new. The portion of the volume contributed by Captain Kater, relates to the balance and pendulum only, and, as might have been expected, is satisfactory in execution, and disproportionate in extent. The Procrustean rule of making all the volumes of nearly equal thickness is, indeed, a radical defect of this Cyclopædia; the wide subject of Mechanics, and the comparatively narrow one of the Processes of Fermentation[1] being compressed and expanded into equal bulks. It is, however, satisfactory to observe, from his letter in the *Times* of the 16th July, that the editor has abandoned the restrictions which he had originally imposed on his contributors, and allowed them "as much space as they may think desirable for their respective subjects:" in future editions, therefore, the deficiencies of some branches of the work can be remedied.

Are the meteorological and physio-geographical departments of the seventh edition of the Encyclopædia Britanica committed to the candour and modesty of the Professor who, in the Supplement, poisoned at its spring the stream of knowledge to which hundreds will apply, by substituting, for (all that is expected in such a work) a clear and impartial statement of the principal meteorological facts and opinions, his own crude notions as the sum of all that is known or thought of the matter? Any of your readers, who are possessed of these and similar publications, would render no small service to lovers of science, by occasional notices of their progress and criticisms on their contents; as it too often happens in this country, that an Encyclopædia is the only accessible source of information on subjects which unexpectedly acquire interest, and the accuracy and comprehensiveness of such a work is of proportional importance to its possessor.

D. B.

VII.—*Analytical Examination of a Mineral Water from the Athan Hills, Tenasserim Province. By* H. Piddington, *Esq.*

[Read before the Physical Class Asiatic Society.]

This water was forwarded by W. Bruce, Esq.; the bottle was thus labelled:—

"Athan river, province of Tenasserim; water from the Hot Springs, rising in the Athan hills, filled about four miles from the foot of them, in the middle of a grove of cocoa-nut trees, completely surrounded with thick jungle, and a mile and a half from the banks of the river: the water so hot the hand could not bear it."

W. BRUCE.

Examination.

1. The cork of the bottle was not a very good one, but it was well sealed; this circumstance will be subsequently alluded to.

2. The water was perfectly limpid, and evolved some minute bubbles of gas; its smell and taste were peculiar, they might be termed bituminous with a slight putridity, rather than sulphurous; the smell strongly resembled that of moist decayed cheese. The most delicate tests could not detect a trace of sulphuretted hydrogen: a slight sediment had been deposited.

[1] Ably executed by Mr. Donovan; though requiring illustration from a few wood cuts, to which the silly and expensive vignette title pages might, throughout the work, be advantageously sacrificed.

3. The water reddened litmus paper, but did not affect tincture of turmeric or of galls; this last, however, gave a very sensible precipitate when lime water was added, as in the valuable analysis of the Bath waters, by Mr. Phillips.

4. Its specific gravity at the temp. of 80°, was 1003.

Tests.—For gaseous contents.

The presence of free carbonic acid was ascertained by boiling—litmus paper; lime water; acetate of lead; soluble precipitate.

2. The absence of oxygen, by comparing the precipitate formed in a solution of proto-sulphate of iron, with rain-water, distilled water, and the mineral water; of these, the mineral water afforded, by far, the smallest quantity of oxygen to the precipitate.

3. From the want of a mercurial pneumatic apparatus, the examination for nitrogen was necessarily omitted.

4. The absence of sulphuretted hydrogen was ascertained by solution of acetate of lead; silver foil; mercury; arsenious acid; nitrate of silver.

For Saline Contents.

Bases. The presence of lime by ox. ammonia; solution of potass.
—— Ditto of magnesia by carbonate of ammonia; and phosphoric acid, after precipitate of the lime.
—— Ditto of iron by tincture of galls and lime water; no other test would show any trace of it, but this was most distinct.
—— The absence of potassa by muriate of platina added to concentrated solution.

Acids. The presence of sulphuric acid by muriate of baryta.
—— The absence of muriatic acid by nitrate of silver.
—— Ditto of nitric acid by platina foil, with muriatic acid added to the concentrated solution.
—— Ditto trace of presence of combined carbonic acid by nitrate of silver after expulsion of the free acid; giving a soluble precipitate, but in exceeding minute quantity.

The addition of acids occasioned no turbidity, hence no bituminous matter was held in solution by an alkali.

Analysis.

The quantity of carbonic acid gas was estimated, by adding a solution of acetate of lead, till no farther precipitate was afforded, and digesting the dry precipitate in dilute nitric acid, which dissolved the carbonate, and left the sulphate of lead untouched; the quantity of gas being inferred, by the equivalent scale from the carbonate of lead formed: in the absence of any, or at most very minute portions of carbonated alkalies, (incompatible in any quantity with the muriate of magnesia,) and when operating without a mercurial pneumatic apparatus, this is, perhaps, the most accurate method.

2,40 grs. of carbonate of lead were thus obtained from 8 ounces of the water, which containing 0,398, by *weight* of carbonic acid, are equal to 0,856 cubic inches of gas in 8 oz. or 1,712 to a pint—wine measure.

		Grains.
A. 8 oz. (by measure) of the water, when evaporated at a temp. of 212° afforded, of saline matter,	..	10,52
B. Of these were soluble in alcohol (of 820,) being pure muriate of magnesia, slightly coloured (with the iron ?)	..	1,50
and of the remaining,	..	9,02

C.[2]	Were soluble in warm distilled water,	..	2,04
	leaving insoluble,	..	6,98
D.	From which dilute nitric acid[3]; dissolved carb. of lime,	..	0,30
E.	Leaving the residuum sulphate of lime,	..	6,68

F. The aqueous solution (C.) weighing 2,04 grains, gave no trace of carbonates or muriates; the sulphuric acid was precipitated by acetate of baryta, and the magnesia by carbonate of ammonia and phosporic acid; the examination for alumina was inadvertently omitted.

From the foregoing products of 8 oz. a wine pint of the water may be estimated to contain

Gaseous;	carbonic acid gas,	1,712 cub. inches.
		Grains.
Saline;	muriate of magnesia,	3,00
	protoxide of iron,	trace.
	carbonate of lime,	0,60
	sulphate of lime,	13,36
	sulphate of magnesia (and alumina ?)	4,08
	Total	21,04

The Sediment was collected, by washing the bottle with distilled water; it subsided very slowly; the quantity was inconsiderable; the colour light grey; and it adhered, with great tenacity, to the glass in which it was dried.

Enclosed in a glass tube, and exposed to the heat of a lamp, finally urged a little with the blowpipe; it blackened immediately: a highly fetid and sickening odour was evolved, and a yellowish oily-looking fluid deposited on the sides of the tube, above which were distinct traces of sulphur; litmus paper, and silver foil were instantly discoloured, and water being added, gave a precipitate with acetate of baryta; the residuum was a light fibrous carbon.

Sulphur was then evidently present in the sediment, and probably petroleum; for when a minute portion of sulphur was mixed with the common petroleum of the bazar, (earth oil,) and subjected to the same process, the same phœnomena, and particularly the evolution of the fœtid gas, which, from its affecting the stomach, cannot be mistaken, were produced.

From the imperfection of the cork, it is uncertain whether the sulphur was only mechanically suspended in the water, or deposited by the decomposition of sulphuretted hydrogen, originally present in it; this is known to take place in some degree in Europe; it may, therefore, much more probably have occurred here at a much higher temperature, and with a far greater intensity of light; but it is questionable, whether it would have been so completely effected, as to leave no trace of gaseous impregnation in the water.

If more of the water can be procured, I shall be happy to avail myself of it to correct the uncertainty; for the peculiar state in which the iron exists in it, which is hitherto only known of the Bath waters, promise to render these springs one day of high importance, in a medical point of view.

9th January, 1828.

[2] Warm water would take up a certain portion of solution of lime.
[3] Acetic acid should have been used here.

VIII.—*Suggestions for the Improvement of Mineralogical Cabinets, in general, and those of the Asiatic Society, in particular. By* J. Prinsep, *Esq. F. R. S. Secy. Phys. Class As. Soc.*

Although it may seem a very simple task to arrange a cabinet of geological or mineralogical specimens in glass cases or drawers, so as to preserve them, and render them accessible to inspection, still there is room for the exercise of some little judgment, in so combining the qualities of such a receptacle, as to adapt it to a particular locality or climate, and to the class of visitors who will most frequently be invited to its inspection. Before, therefore, offering a recommendation to the Physical Class to incur the expense of making up a set of mineral cases, without which it is useless to attempt any arrangement of the numerous stores of Indian specimens now buried at random in various boxes, or scattered on the floor of their museums, I shall beg leave to submit to their consideration, the points which I assume, as desiderata, in an Indian cabinet.

1stly.—With regard to the Cabinet itself.

It should be open to inspection, and not to touch : the specimens should be as near to the eye as possible, so as to admit even of examination with a microscope, without removal from their frames :—they should receive a full body of light on them ;—and the inspector should view them without being in a constrained posture.

Now all of these ends may be attained, by arranging the minerals on shelves nearly vertical, covered by glass doors, so that the specimens shall absolutely touch the glass, and placing the cabinets, where it may be possible, standing out at right angles, and in juxtaposition to a window.

Indian apartments are, from necessity, a good deal darkened, to keep out the heat, and what little light is admitted, generally comes by reflection from the terraced ground of a veranda : this throws into complete obscurity any objects lying horizontally upon tables away from the windows, and the constrained attitude of leaning over, with straining eyes, to behold them, renders it quite a labour to undertake the inspection of a collection. The vertical cabinet, on the contrary, preserves the head erect, and offers quite a gratification to the eyesight, unalloyed by pain or fatigue. It should have a height of not more than 6 or 6½ feet—and there should be no shelves below 2 feet 9 inches from the ground : —two or three horizontal drawers below may, however, be conveniently introduced, for the purpose of holding unarranged specimens.

2ndly.—With respect to the Specimens.

It should be a maxim to convey as much information as possible, on the spot, without reference to books or catalogues :—but again, the specimens should not be half hidden by paper labels.—These objects may be attained, by merely attaching a small numbered ticket to the specimen, (for reference, where necessary,) and setting forth the name, composition, locality, and donor's name, of each mineral, upon a tablet of paper, placed upright behind it : from the vertical position, the light will fall sufficiently upon this, and it will not be liable to be rendered illegible by a coat of dust, as is very soon the fate of tickets horizontally placed.

Another maxim should be, to discard, at once, from the *selected cabinet of the museum,* all duplicates from the same locality, though presented by different donors ;—and again, to arrange the specimens according to their habitats only, and not as the separate contributions of individuals, (the donor's name being always inscribed as above stated). This will contract the geological illustration of India into a reasonable and convenient compass, and save an immense deal of labour to the curators of the museum.

A further application of system may be introduced, by classifying the geographical localities in one direction, and the mineral species at right angles thereto, on the shelves. Thus, supposing one cabinet to comprehend the Himmalayan collection, along the top shelf should appear the names of the places, from the West to the East; while on the descending shelves under them, should be arranged, successively, Granite, Gneiss, Slates, Sandstone—in the order in which they are themselves found on descending from the summits of the mountains to the plains on the South. Of course, such an arrangement could not be made perfectly to represent facts; but it would greatly assist the imagination and the memory in the pursuit of geological study.

A cabinet, capable of holding 360 specimens open to view, and as many more in the drawers, constructed on the principles above advocated, is submitted this evening for the inspection of the Physical Class.

IX.—*On the Soil in which the Cinchona thrives. By* H. Piddington, *Esq.*

[Read before the Physical Class of the Asiatic Society.]

In examining a collection of minerals from Peru, which had been sent to our worthy Vice-President, I found the following label to one of the specimens.

"No. 76. Pridra que se encruntra en las margenes de Guallaza, Cerro de Sn. Cristobal, legna y media de N à S., de altura considerable. La falda del Oeste no tiene un solo arbol de Quina y la opuesta esta cubeirta: si cria en esta clase de pridra que esta Cubeirta con ofas del mismo arbol con un espesura de ¾, 1827."

Translation.

"Rock found in the neighbourhood of Guallaza, Sierra of San Cristoval, a league and a half from N. to S. and of considerable altitude. The Western slope has not a single bark tree, (Cinchona) and the opposite side is covered with them. They grow in this sort of rock, which is covered with their leaves, to the depth of three quarters of a yard."

Looking to the probability that this valuable tree may one day become an article of culture, both in India and Australia, perhaps even in Europe, it appeared probable, that an analysis of the rock might, with propriety, occupy a space in the Society's records.

It proved to be, upon examination, a decomposing granular dolonite, the exterior of which was friable, while the interior was perfectly compact.

100 grains were found to consist of water,	2,06
Siliceous matter, with some trace of vegetable matter, (from the outside,)	0,62
Carbonate of lime,	46,00
Ditto of magnesia,	51,00
Loss,	0,32
	100,00

Remarks.

In a mineralogical point of view, it is remarkable that the proportion of carbonate of magnesia far exceeds that found in those analysed in Europe, which are published in Jameson; but it is a strictly physical fact, that the Cinchona, the most valuable medical product of the vegetable kingdom, is found to flourish on a soil so utterly destructive to every other useful product that we are acquainted with! a beautiful instance added to those which science is hourly disclosing, of the beneficent economy of the universe.

X.—*Proceedings of Societies.*

1.—Medical and Physical Society.

Saturday, 8th January.

Messrs. Stuart, Green, and Minto, were elected Members of the Society. The Meeting then proceeded to the election of Officers, when the nominations were found as follows :

H. H. Wilson, Esq. President, (permanent.)

John Tytler, Esq. Vice-President.

W. Twining, Esq. Secretary and Treasurer.

C. C. Egerton, Esq. Assistant ditto ditto.

Committee of Management—John Grant, Esq. ; Dr. George Waddell ; H. Mercer, Esq. and Dr. Stewart.

Committee of Papers—J. Grant, Esq. ; Dr. Waddell ; H. Mercer, Esq. ; Dr. Stewart ; A. Wood, Esq. and E. W. W. Raleigh, Esq.

The President stated to the Society, that a portrait of their Secretary, Dr. J. Adam, had been painted, and a monument erected to his memory, according to the vote of the Society to that effect.

The following communications were then submitted. A letter from the Secretary to the Medical Board, with a copy of Mr. Searle's work on Cholera, presented to the Society, by the Board. A treatise on Mania a Potu, presented by the Author, Dr. Carter. A letter from Dr. Hays, of Philadelphia, acknowledging the receipt of the 1st and 2d Volumes of the Society's Transactions, and presenting the 10th and 11th Nos. of the American Journal of the Medical Sciences, published since May, 1829, and in continuation of the series previously received, &c. A letter from Baboo Ram Comul Sen, (a Member of the Society,) accepting the office of Collector.

A letter was read from Dr. Royle, proposing, that the Society should undertake to collect a Cabinet of Indian Materia Medica, to contain the various articles of medicine employed by the Natives of India, with specimens of the plants from which the vegetable remedies are prepared—the mode of preparation—the names and synonimes of the articles—the parts of the country whence obtained—statement of the medical properties ascribed to them by the Natives, and any direct evidence which medical men can procure regarding the actual efficacy of the several medicines, and the result of their own experience. Mr. Royle offers above one hundred specimens of medicines in use in the Upper Provinces. It was resolved, that Mr. Royle's offer be accepted, and that in adopting his suggestion, Members of the Society, in every part of the country, be invited to afford their assistance towards completing the proposed Cabinet, &c.

Morbid preparations were placed on the table, from Dr. R. Tytler, and Dr. Mackinnon.

A letter was read from Mr. Lowther, with an account of a fish bone arrested in the œsophagus of a young man, and extracted by an incision through the integuments, at the side of the neck, where the point of the bone had protruded.

Also, a communication from Mr. Boswell, of Pinang, presented by the Medical Board, on the utility of blisters of Lunar Caustic in pulmonary consumption, and various other diseases.

A case of Hydrophobia, by Mr. Rogers, Assistant Surgeon, 1st Regiment Native Infantry, presented by the Medical Board. A case of Abscess of the Liver, presented by the Medical Board.

A paper by Mr. Twining, was then read and discussed by the meeting.

2.—Asiatic Society.

Class of Natural History and Physics.

Saturday, 15th January, 1831.

Sir Edward Ryan, President, in the Chair :

1. A letter was read from Mr. G. Swinton, accompanying a parcel of Mineral Specimens from Ava, received through Major Burney, the Resident at the Burmese Court, from Mr. C. Lane.

The minerals forwarded, comprised the following metallic ores : 1. *Iron*—magnetic, glance, pyrites, red and grey hæmatite : 2. *Lead,* the crystallized carbonate :

3. *Antimony*, the grey sulphuret in grains : 4. *Realgar*, or sulphuret of arsenic; and 5. *Manganese*, the black oxyde.

Of earthy minerals, the following : crystalized sulphate and carbonate of lime, of rocks, gneiss, granite, &c., and fossil wood, silicified. Also, a bag of spinel rubies, or octohedral corundum.

But the principal object of interest was a button of metal, supposed to be *Platina*. A paper was read by the Secretary on its analysis, which proved, beyond a doubt, the existence of the first five of the following ingredients, and rendered the presence of the remainder probable.

Platina,	25	Lead, Arsenic,	20
Gold,	5	Rhodium,	0
Iridium, Osmium,	40		
Iron,	10		100

The proportions given were, of course, only approximations, as the composition was most complicated, and the quantity devoted to analysis only ten grains. The specific gravity of the bead was 17,2. There could be no doubt, therefore, as to its being an ore of Platina; and Mr. Lane has the credit of the first discovery of this precious metal among the gold dust of the Ava mines[1].

2. A report on the progress of the Boring experiment, was communicated by Mr. Ross.

Since the last meeting, a further depth of thirty-seven feet has been attained, making a total of one hundred and forty-six feet from the surface, which is deeper than has ever before been reached in operations of the kind in India. The borer is now in yellow sand under the clays. Unfortunately, the augur has been broken, and some delay may occur before an apparatus can be constructed to lift or push it aside. The funds put at the disposal of the Committee for this object have been expended, but it was hoped that the experiment would not be permitted to rest at this stage, or indeed, at all, until final success crowns it, or insurmountable difficulties put a period to the exertions of the gentlemen in charge of the operations.

3. A paper was read by the Reverend R. Everest, on the series of Fossil Shells sent down from the Himalayan mountains, by Dr. Gerard.

Mr. Everest had been able to determine, by comparison with the English collections of Mr. Taylor and Mr. Calder, and by reference to the standard works procurable here, the following genera :

Of Bivalve Shells.
1. Producta.
2. Terebratula.
3. Pecten.
4. Modiola.
5. Arca.

Of Chambered Univales.
1. Ammonites.
2. Orthoceratites.
3. Belemnites.

Also Testudinous remains of one kind.

Four Genera remain undetermined.

The interesting conclusion to which the investigation has led was this: that "there exist, in the Himalaya range, strata, analogous to the early secondary and transition formations of Europe."

Mr. Everest, however, could not fail to notice, that hitherto no remains of the two vast marine lizards, the Icthyosaurus and Plesiosaurus, the bones of which every where else mark the presence of lias, have been met with by Indian Geologists; neither any of the vegetable remains of the same formation, which are both numerous and interesting. The thanks of the Society were voted for Mr. Everest's paper, and upon the motion of that gentleman, it was resolved, that duplicates of the fossil specimens should be sent home, addressed to Mr. Sowerby, the author of *Mineral Conchology*, and the best authority on such subjects; with a request for any further information he may be able to give, as to their similarity or identity with British species.

4. A re-analysis of the turquois was communicated by the Secretary, shewing, that it was essentially a hydrate of alumina and copper[2].

5. The Class inspected a model of a Mineralogical Cabinet, made up in consequence of the resolution passed at the last meeting, and, approving of the principles of its construction, ordered a set to be put in hand for the Museum[3].

[1] The particulars of this paper, will be given in our next number.
[2] For this paper, see our last volume, p. 375.
[3] This communication will also be found in the present number, p. 27.

XI.—*Notices of European Science.*

1.—*Captain* Kater's *Collimator.*

An instrument, under this title, has been invented by Captain Kater, which promises to be of great use to the astronomical observer. A detailed description, and account of its performance, will be found in the Philosophical Transactions.

The following short notice may give our readers some idea of it.

In observing the altitude of a celestial body, we require to know the place on our circle, either of the zenith, or the horizon. The former is given by the plummet, the latter by the spirit-level. The plummet is liable to many objections, such as agitation from any slight motion of the air; and parallax, which occasions an error when judging of its coincidence with the dot on the circle. If the distance between the wire and the plane of the circle be again diminished till it touch, there is no longer that perfect freedom required, to give the wire the vertical direction. These objections have occasioned the level to be very generally preferred; but even the latter is by no means free from objections. Thus it is a very difficult thing to grind a level so true, that whatever the expansion and contraction of the bubble, its indications will be equally correct. And any inequality of temperature, however correct it otherwise may be, must inevitably give rise to error. The position of the observer occasioning an unequal distribution of heat, will often be sufficient to disturb a delicate level, as every observer, who has used them, knows, and *a fortiori*, the application of the hand to reverse them. That both plumb line and level are liable to serious objections in practice, will be sufficiently evident to those who will advert to the practice, we believe first introduced by the present Astronomer Royal, of referring all his observations for the declinations of the fixed stars to the *polar point*, or place of the pole; which he determines independently of either plumb-line or level, by observing the place of circumpolar stars, both below and above the pole. The height of the pole, again, is determined, by observing the direct place of the star, and its reflected place, as seen in mercury or water.

The latter practice, when it can be had recourse to, is, perhaps, as good as can be desired, and certainly decidedly superior to either plumb line or level. The objection to it is, that the time lost in changing the direction of the telescope, occasions a change of altitude in the star; and that, requiring, as it does, the most perfect stillness for its successful practice, that stillness must occur at the time the observation is required, or it cannot be taken advantage of. This objection is obviated by Captain Kater's instrument, which being also founded on the same principle as the other, i. e. the perfect horizontality of the surface of a fluid at rest, has all its advantages, without its defects. By means of the collimator the horizontal point can be fixed at any time, without any reference, whatever, to the place of the stars.

To understand, clearly, the nature and value of the collimator, we shall begin by stating a fact, which may be new to some of our readers, but which they may easily verify, if they please. If two telescopes, fitted up with cross wires, be adjusted to the distinct vision of distant objects, and placed with their object ends adjacent, (no matter at what distance,) and in the same straight line; then, if we look through one of the telescopes, we shall see a magnified image of the cross wires belonging to the other; and we may, if we please, make them coincide with the wires of the telescope we are looking through, to any degree of nicety; (the reason of this will be obvious to any one acquainted with the elements of optics.) This is one of the facts on which the use of the collimator depends, the other is the following. A body, floating on the surface of a fluid, will, in similar circumstances, have the same position. By similar circumstances is meant, being placed in the same direction, and having no more sources of disturbance in the one case than in the other.

Now let us suppose a vessel, of a square form, filled with mercury, and having a float of the same size (nearly) and shape. To this float let a small telescope, with cross wires, and adjusted to distinct vision, be firmly fixed; we shall have Captain Kater's collimator. For its use: Let us suppose the whole apparatus placed to the north of our circle, and at such a convenient height, that when the telescope of the circle is pointed (by estimation) horizontally, the cross wires of the collimator will be visible; let the wires of the telescope circle be brought accurately upon those of the collimator, so as to coincide most perfectly; this is, of course, easily done by the tangent or slow motion screw of the circle; the stand of the collimator being elevated or depressed, as occasion may require. Let a reading be now made, and the collimator being tranferred to the southern side of the circle, the same operation is to be repeated. The mean of the two readings will, of course, give the inclination of the collimator, supposing it to be not perfectly horizontal; and the difference of either reading from the mean, will give the error of zero, which being applied + or — as the case may require, the place of the horizontal point is thus obtained.

It is obvious, that whatever the angle or inclination of the float, when placed to the north of the circle, it will have the same inclination when removed to the south, so that the rationale of the operation consists in measuring on the circle the inclination of a line on opposite sides, which is known in each position to be equally inclined to the horizon.

Even in his first rude trials, Captain Kater found the limit of error not to exceed 5″, and on an average to be less than 3″. But with improved instruments, and more practice, these limits have been greatly reduced. Dr. Brinkley, of Dublin, has given the apparatus a very full trial, and speaks of its performance in the highest terms. A desideratum still remained; to apply it to a zenith instrument. This difficulty has been recently surmounted by the inventor, who has published in (we believe) the last Vol. of the Philosophical Transactions, a description of his zenith collimator. We shall resume the subject in our next number, and give some idea of this paper.

2.—*All Nature Alive.*

The accounts which have been recently published, of the supposed existence of active molecules in every kind of matter, whether organic or inorganic, have involved admissions so contrary to all our usual experience, that it required, we will venture to assert, a good deal of faith, not to say, credulity, to believe them in all their extent. It is foolish to say, that because people require full evidence in an extraordinary case of this kind, " their theories anticipate the laws of nature." It is precisely because they have no theory—nothing but experience to guide them, that they doubt. If they have misunderstood the facts of that experience, or if they have judged too hastily and partially, in supposing their facts to contradict this discovery, it is not the less evident, that they are right in asking for every evidence on the subject, before they admit this conclusion, inasmuch as observers with the microscope are fully as liable to be mistaken.—Observations made with very high powers are notoriously deceptive, and with low powers the facts cannot be observed. Then if the prejudice of previous bias is on one side, there is the eagerness to make a discovery on the other, so that, all things considered, we really think the sceptics were, on this occasion, as completely justified in reason, as it now appears they are in fact.

In the March number of the Magazine of Natural History, is an article on this subject, by Mr. Bakewell. Mr. Bakewell is known favorably to the public, by his geological writings, which are distinguished for the simple, intelligible, and common-sense views they contain, in opposition to the mystified and barbarous jargon of preceding writers. Some years ago, his mineralogy was one of the few books from which any thing could be learned. The same plainness and sobriety of philosophising marks the present paper. He shows, we think, to the perfect satisfaction of even believers, that the supposed discovery of active molecules is certainly, as far as regards inorganic, and probably as regards vegetable matter, entirely illusory. The illusion he attributes chiefly to the water, which it is difficult to obtain free from Animalcule. No water should be used for these experiments, but such as has been recently boiled. When this precaution was taken, there still appeared motion, but it was referred to the agitation of the support. The late Mr. W. Nicolson observed, that it is impossible to avoid the effects of vibration in London; and this fact may be convincingly seen in a basin of mercury, the surface of which is never free from disturbance. It is evident, that if the particles of dust, which float on its surface, were brought under a powerful microscope, they would appear to have spontaneous motion. So with the particle of water. Mr. Bakewell found, that even placing his hand on the table, communicated motion to the particles. In fact, we may judge of the extent of motion required in this case, from Lewenhoek's estimate, that some of the Animalcules whose motions so much surprised him, never travelled much farther than a hair's breadth. On using, for his support, the stand of a telescope, made purposely to exclude vibration, and taking all other precautions, he found these supposed motions cease after a time, when the drop might be supposed to have attained a state of rest. He concludes, then, that we cannot, without further proof, be satisfied of the truth of these new views. But if, as he says, contrary to his expectation, they should turn out to be correct, " what new views of nature will the discovery unfold. Beds of siliceous sand, like those on our Hampstead Heath, are only waiting a further process of trituration, to be awakened into life, by the torrent that shall bear them into the ocean; and the geologist, while he contemplates the organic remains of a former world, imbedded in solid rocks, must regard the rocks themselves as the parents of future living beings."

Such as the discovery may prove to be, it was made, as Mr. B. asserts, ten years ago, by a Mr. Bywater, an optician of Liverpool, but no notice was taken of it at the time. The active molecules, in vegetable substances, have been frequently observed.

GLEANINGS
IN
SCIENCE.

No. 26.—*February*, 1831.

I.—*On the Minerals in the Rájmahal Hills.*

[Continued from p. 8.]

§ 2.—*Western range.*

In the former division, I have said, that the most predominant rock is of the nature of whin or trap, and quartz is there rather an uncommon ingredient, at least in masses of a great size; but here a large proportion is quartz, and a still greater, a kind of rude jasper or petrosilex, called hornstone by the later Mineralogists; and these two siliceous stones run so into one another, by various gradations, that it is difficult, if not impossible, to say where the one begins and the other ends.

It is, I imagine, difficult to say, that these hills are in any degree stratified, although they sometimes assume an appearance of that form. In general, the siliceous rocks are intersected by a vast number of fissures, horizontal and vertical, cutting them into masses approaching to the form of cubes and parallelopepids; and when they are exposed to the weather, in a state of decay, these masses divide into layers somewhat like those of wood, especially if the mass is exposed on an abrupt vertical surface; but if the surface exposed is horizontal and level with the earth, the layers more resemble slate. In some places the vertical fissures, extending the whole depth of a perpendicular rock, give somewhat the appearance of basaltic columns, which may be especially observed in the magnificent recess called Marak, about 15 or 16 miles southerly from Mungger; but in fact, so far as I observed, there is nothing really columnar in the district.

These hills are particularly distinguished from those of Rájmahal, by their rugged nature, vast masses of naked rock projecting every where on the surface, and forming precipices of great height and abruptness.

The form which the greater part of this siliceous stone assumes, is that which I have called rude jasper or petrosilex, the hornstone of modern writers; for although these stones are considered as different, yet in the specific characters which are given, there is, as often happens, no real difference. If we take the character of Wallerius, that petrosilex is found only in veins[1], or detached masses immersed in rocks, and that jasper forms whole rocks, then undoubtedly our rock is a jasper, but it in general departs very far from the appearance of what is usually called such. It is a rock

[1] This practice of naming rocks from their position or mode of occurrence, so baneful to any thing like correct observation, is not confined to Wallerius. Many modern geologists are equally open to censure in this respect.—Ed.

striking fire copiously with steel, with a large conchoidal fracture, forming, when broken, sharp edges like a flint, and its fracture has a rough earthy appearance, being composed of very fine grains. In most parts it is of different shades of white or ash colour: but in others it inclines to livid, and still more often to red, but it is seldom, that the redness extends over a whole rock, it is generally confined to layers alternating with others, that are parallel and white, or it is confined to spots or flakes on a white ground. Such more resemble the stones commonly called jasper; but whether it could be wrought, or take a polish, I cannot say, having been unable to procure a workman.

This jasper, or hornstone, sometimes has larger grains, so that each is very distinguishable to the naked eye, and then it approaches near some of the quartz, which becomes granular; but there are other stones, which are a kind of intermediate between the two species, where a mealy or arid quartz approaches very near to our jasper; and there are still others, which would seem to be composed of small portions of the two stones huddled together, and firmly united to form, what naturalists call an aggregate, as will be afterwards mentioned.

The quartz, in its most perfect form, consists of a substance approaching to glass, the conchoidal appearances on which, when broken, are very minute, and are known to every one to differ from the former, who has taken the pains to compare the appearance of a piece of broken glass with that of a flint. The quartz, of which also there are many rocks, is sometimes almost pellucid, like glass, sometimes red, or stained with red, just like the jasper, and sometimes livid; most of it has a fat unctuous appearance; some of it approaching to the jasper, has dry, earthy looking particles; but, when broken, wants the large convexities, that distinguish that stone. Again, other portions consist of small grains, united together, and some of these have the fat appearance, while others in the same stone are mealy, and thus form what the Mineralogists call an aggregate [2].

The quartz again is very often mixed with extraneous matter, and especially with what is called mica, which shines like gold or silver. When this is in very small quantities, thinly scattered through the body of the quartz, the rock may be considered as simple; and among the whole quartz of this division very few masses, of any size, could be found, in which a few specks of mica might not be shown; but when the stone consists of some particles of quartz and others of mica, heaped together, and closely united, these particles form what is called an aggregate, and I shall proceed to treat of these after, mentioning, that mere quartz is so full of fissures, that it does not cut for building. The fort of Gidhaur is, indeed, in a great measure, built of it, or of the rude jasper from the adjacent hill; but the masses have not been squared by the mason; the parallelopepids, as rudely formed by nature, have been employed.

To return to the aggregate stones, both what I have called granular quartz and granular jasper petrosilex, or hornstone, may be considered as an aggregate; although it is usual to confine that term to rocks, in which more than one kind of matter has been aggregated.

When the stone is compounded of glassy quartz, intermixed with mealy quartz or hornstone, which, in such cases, I do not know how to distinguish, the term will be

[2] The term Aggregate has been recently revived by Dr. Hope and Sir James Hall, but in a somewhat restricted sense. They divide all rocks into Aggregates and Crystallites. The former contain the mechanically recomposed rocks, such as greywacke, sandstone, conglomerate, &c.; the latter, the granitic rocks, and those of similar structure, see our 1st vol. p. 2. In Dr. Buchannan's use of the term, it seems to mean compound, in contradistinction to simple.—Ed.

more readily admitted. In this part of the district there are many such rocks, and they are sometimes coloured in the same manner as the jasper. In some cases the mass consists of thin alternate layers of this aggregate, and of simple fat quartz, as on the detached hill called Khejuri, a little south from Tárapúr.

I have already mentioned, that large masses of quartz, which do not contain some mica, are seldom found, but when the mica and quartz are, as it were, internally combined in minute parts placed parallel to each other, they form a stone which has been called shistose mica[3]; and on the hill Raula, a part of the transverse chain reaching to Jathaurnath, may be found stones in all the intermediate stages, from pure granular quartz to the perfect shistose mica. A little east from Rauta, near a hill caled Barai, this last substance is found, in a considerable mass, forming a small hill, called Barapahar, and is wrought for making the stones of hand mills. It is by the natives called the Dudi stone, and is divided into irregular trapezoidal flags separated from each other. 1st. By vertual fissures, which run east and west, at from 2 to 4 feet from each other. 2dly, By other vertual fissures, which cross the former at right angles generally, at greater distances; and finally, by horizontal fissures, at the distance of from 6 inches to 1 foot; but these flags are so much shattered by subordinate fissures, that solid masses, fit even for making the stone of a hand mill, cannot be every where procured. This stone cuts readily with a chisel, and does not readily tarnish in the air. It has a pale greenish hue from the mica, perhaps, approaching somewhat to the nature of chlorite. In some places it is stained red. The same kind of stone is found at Tahuyar Nagar-ghat, in the same vicinity, but is not wrought.

Where the aggregate consists of 2 distinct matters mixed together without any apparent order, it is usually called a granitel[4], and some such are found on the hill Rauta, above mentioned, especially one seemingly composed of quartz and chlorite; one composed by black very heavy schorl, or perhaps micaceous iron ore, with small spots of quartz; and finally, one composed of white quartz, with a smaller proportion of the same black matter. These latter aggregates may be perhaps considered as adventitious in this division of the minerals, as they are on the boundary of a territory abounding in such, and quite different from the general mass of which I am now treating.

The only one, which I consider as properly belonging to this mineral range, is a stone composing the small hill called the Karnuya (working place) of Laheta, 15 or 16 miles southerly from Munggcr. It has been long wrought for the stones of hand mills. The quarry is on the southern declivity of the hill, runs nearly east and west, and has been opened in different places for a considerable extent. The excavations are now pretty large. One of them, the largest that I saw, might be 200 feet long, 20 wide, and 12 deep; but so irregularly and unskilfully wrought, and so clogged with rubbish, that the proper extent of good stone is not readily determinable; and this good stone is bounded on each side by kinds, which in the eye of the Mineralogist scarcely differ; but which the workmen reject as too hard, and difficult to work. The workmen take a piece suitable for their purpose, whenever they can find it most easily; cut it into shape on the spot, and then look for another, until the whole quarry is so filled with rubbish, that no more millstones are pro-

[3] Mica slate, according to most Geologists, or Micaceous Schist, according to Macculloch. The latter term is, perhaps, preferable, inasmuch as the rock in question has scarcely ever any real resemblance to the slaty structure. The terms schist and slate afford us the means of discriminating two structures that appear, at first sight, exceedingly different.—Ed.

[4] See note, p. 5.

curable. Pioneers are then employed to clear the quarry; this is also choked with large masses, which the workmen avoid as much as possible, as being troublesome to break. Fine stones for building might, therefore, be readily procured, and it seems to be an excellent material, which cuts readily with a chisel. It is an uniform aggregate, without a tendency to shistose structure, and consists of grains of glassy quartz, united by a greenish grey substance, which has no lustre, and might be, perhaps, considered as of the nature of powdery quartz or hornstone; but its colour is against that supposition; and in many places, I think, I can trace the foliated appearance of mica. It contains some small red spots, which seem to me to have arisen from the iron of the mica, when it decayed, having collected in the form of ochre. If wanted for building, the part of the stone above the quarry, which is rejected by the workmen, as wanting fissures to facilitate its division, and by them called Korra, would be found the best, but its distance from the river is perhaps too great.

The siliceous matter of this division of minerals also has some tendency to form the kinds of clay called *c,hari*, of which there is a very considerable quarry on the hill S. W. from the hot springs of Rishikunda, but which I could not visit. It is of an uniform bluish grey colour, but becomes white, when powdered. It has a soft greasy feel; does not readily fall into powder, when put in water; nor does it adhere to the tongue. It is chiefly used for writing and painting. From the unctuous nature of its feel, this might be suspected to belong to a class of minerals, that will be soon mentioned; but on the banks of the Man, near the hot springs of Bhímbandh, I found the petrosilex in a state of decay, advancing towards the formation of such a substance; and at Amjhor Ghat, 9 or 10 miles from Mungger, I saw a red grained siliceous aggregate, evidently in part changed into a kind of *c,hari*, called there *parorimati*, which is used by pregnant women as a medicine.

But farther, a *c,hari* used in writing, is found on a hill called Geruya. It is a stratum of an unctuous substance, which cuts smooth with the knife, and although on the face of an arid hill, retains some moisture, even in March. When dried, it adheres to the tongue, and instantly, on being put into water, falls to powder. It is of a fine white colour, veined and spotted like the siliceous rocks, between which it is found. These rocks have a strong resemblance to the argillaceous breccia, mentioned in my account of the 1st division of minerals, as being found near Phutkipur, but its cement is most evidently siliceous, and it contains veins and nodules of quartz, as well as nodules of other substances. The whole has more or less of a slaggy appearance; and some of it has, in my opinion, most clearly undergone the action of fire. There is, however, nothing about the hill, that resembles a crater, and it is quite sporadic, in the midst of the 3rd mineral division, near Jamdaha, on the left bank of the Chandan. I am, however, induced to consider it as a detached portion of the 2nd class of minerals, from its resemblance to the hill named Katauna.

This hill, Katauna, is situated a little south from Thanah Mallepur, in the centre of this mineral division, although it belongs to a detached portion of the judicial district of Ramgar, which is surrounded by Bhagalpúr. There is no *c,hari* on Katauna, nor has it, so far as I saw, any appearance of a crater; but its stone is exactly of the same nature with that on Geruya.

Notwithstanding the copious warm springs, which it contains, these are the only traces of volcanic fire, that I have observed in this mineral division.

The soft matter called *c,hari*, formed of the siliceous rocks hitherto mentioned, leads me to speak of a softer class of stones, which occupies much of this mineral division, although by no means so much as in the first described portion of the district, nor did I here observe any whin; they are all of a softer nature; although many of them are abundantly tough, and difficult to break with a hammer. Commencing a little south from Mungger, and going south almost to the parallel of C,harakpúr, and then turning west to the banks of the Ciyul river, is a long uninterrupted hill. On both sides it is siliceous, and, in one place, where I crossed it, the siliceous matter is nowhere interrupted ; but in every other place which I had occasion to observe, the centre of the hill seems to consist of a much softer material.

One of the best of these stones, is a very fine grained hornblende in mass, containing small crystals of the same matter, and of a greyish black colour. There is a good quarry of it near Masumganj, where a few workmen have been long employed in cutting blocks, from whence images of Siva are finished at Mungger, and sent all over Bengal.

Very nearly allied to the above, at Amjhar-ghát, a very little south from the above mentioned quarry, I saw large rocks of a fine silky lustre, and consisting of parallel, thin layers of different shades of grey, but having nothing shistose in their texture. I found detached blocks of the same at Amrakol, S. W. some 10 or 12 miles.

At the same place I found detached masses of a stone, which differs only from the former in its layers, being of different shades of red and white. I nowhere saw the solid rock of this stone ; but it is probable, that there is such in some place of easy access ; as two of the gates at Mungger have been in a great measure faced with it, and have been ornamented with many foliages cut in relieve. It does not take a finer polish than the hornblende, and does not resist the action of the air nearly so well, but from its colours it is more beautiful, and fit for buildings. In this stone had been imbedded many small cubical masses ; but they were in such a state of decay, that I can form no conjecture concerning their nature.

By far the greater part of the stones of this class, that I saw, were, however, shistose or slaty, but none of them, at least by the native artists that I tried, could be split sufficiently thin for roofing slates. Some of them are, perhaps, argilites ; but the greater part is of shistose hornblende. The one, that is in the thinnest plates, least silky, and freest from crystallizations, and that, therefore, is the nearest an argillaceous state, has somewhat of a bluish hue ; but in general they are black, or intensely dark grey, with a silky lustre, and sometimes of a fibrous, as well as of a slaty texture ; and most of them contain small plates, I presume, of hornblende. They take an imperfect polish ; and when rubbed by a pencil of the same substance, leave a grey streak, so that they might serve for keeping accounts. In many parts, they are wrought by the natives, who form platters of them ; or make slabs, with which they lay floors. In general, the workmen content themselves with taking fragments, that have been separated from the rocks by the streams of mountain torrents ; but in some places they have taken the pains to procure a smooth surface, and split masses from it, as required. In some places adjacent to these proper strata of slate, I observed shistose matter in decay, which appeared to me as a kind of transition between the slate and the adjacent siliceous rocks ; for it was more harsh than the proper slate, and in some places showed a tendency to the conchoidal fracture. In some places these slates contain Pyrites, but not in great quantity.

Very nearly allied to these shistose rocks are others of a similar colour, and silky lustre ; but their structure is not at all slaty, and consists of a number of parallel fibres strongly conglutinated. These are what I presume some naturalists call unripe asbestus. In some places it is disposed in thin parallel layers alternating with white quartz. It is not applied to use.

At Haha, on the Man river, I observed a bed of a black talcose matter, with a silky lustre ; and, except where the river had laid it bare, enclosed on every side by siliceous rock.

Mica, which serves as a substitute for glass, in its shining appearance, is nearly allied to the above[5], and, as I have mentioned, is generally diffused through the masses of quartz. In some places I found it abundantly transparent; but the plates were too small for use. Near Ghoramara, however, I learned that there was a place called Abarak, the name which the natives give to this substance; and in passing it, some of my followers found pieces tolerably large, which, with the addition of the name, induces me to think, that the substance is procured from thence, although this was denied by the natives.

The only stones of this portion of the district, that remain to be mentioned, are the calcareous.

The detached calcareous nodules called *ghanggat*, and mentioned in the former division of minerals, are in this also very common, and need not be again described.

The calcareous matter, in mass, is of two kinds, both very different from that of the first division.

One called *leruya*, is on the border of the Ramgar district, in the channel of the Ulayi river, and is said to be a small rock; but I did not see the place, nor can I judge of the extent of calcareous matter. It is a white marble, with small crystallizations confusedly heaped together, and intermixed with a little yellowish green mica, so that it must be considered as an aggregate. It takes a polish; but whether large blocks could be procured, I do not know.

The other calcareous matter, in mass, is called *asurhar*, or giant's bones. The greatest quantity is found at a place, in the centre of the hills, called Asurni, or the Female Giant. As the lime, produced from this substance, is whiter and better than that made from the nodules, a great part has been removed. It occupied a space, on the surface of the declivity of a hill, about 40 or 50 yards in length; and from the bottom of the hill extended upwards, from ten to forty yards, and seems to have formed a crust from 2 to 3 feet thick, covered by a thin soil, filled with loose masses of stone. It has evidently been fluid, or at least gradually deposited from water, as it has involved many fragments of stone, some earthy matter, and a few univalve shells, of a species with which I am not acquainted, and cannot therefore say, whether they are a marine or land production[6]. The masses of stone that have been involved, vary from the size of the head to that of a walnut, and the *asurhar*, or calcareous tufa, does not adhere very firmly to them; so that in breaking, the mass being very hard, these nodules are generally shaken out. Near the quarry I saw no rock; but all the fragments involved, and those under the calcareous matter are of a dark coloured siliceous matter. In this place I saw appearances that, in some measure, justify the native name; for one piece of the *asurhar* contained what had very much the appearance of a flat bone, with a process projecting at one end. I also observed a curious impression, a semi-cylinder about 3 inches in diameter, and 18 inches long, not quite straight, and exposed to view, as if, by breaking the rock, the other half of the cylinder had been removed. The surface of the cavity was wrinkled with transverse folds, like the inside of an intestine, but may have possibly been the bark of a tree, although I have seen no bark with such wrinkles; I rather suppose that this has been the impression of some marine animal. The greater part of this *asurhar*, as I have said, has been burned by Mr. Christian, a Polish merchant of Mungger, who, I am told, owing to the expense of carriage, did

[5] Mica cannot be said to be nearly allied to talc, except in common parlance, in which they are always confounded together. The two minerals are chemically very different in composition, while in external characters the difference is even greater. Their occurence, in the same class of rocks, proves nothing; or else too much.—Ed.

[6] I have since found these shells in the rivers of Guya.

not find it advantageous. His overseer gave me a piece of it crystallized, which differs, in some respect, from any calcareous spar that I have seen. I myself found no crystallized matter in any of the *asurhar.* This substance is also found close adjoining to the hot sources of the Angjana river, and by the natives has been wrought to a trifling extent. It is in a stratum about a foot thick, lying on loose siliceous stones, to which it adheres, and is covered by about a foot of soil, mixed with stones. So far as I saw, it contains no animal *exuvia.*

On the stones, through which the hot water issues, both at the sources of the Angjana and at Bhimbandh, there adheres a tuaceous matter, so like this *asurhar*, that I, at first sight, concluded it to be the same ; but on trial, I found that it does not effervesce with the nitric or muriatic acids, and is probably of a siliceous nature.

I have already mentioned the pyrites found in the slate, and they seem to be ferruginous, but the quantity is very small. Among this class of minerals, the only iron mines of which I heard, are in the ridge which extends east to Jathaurnath ; and as they are on the borders of the 3d division, which abounds in similar mines, I suspect that they, in fact, belong to this division, and one description may serve for both.

II.—*Examination of a Metallic Button, supposed to be Platina, from Ava. By* J. Prinsep, *Esq. F. R. S., Sec. Ph. Cl. As. Soc.*

[Read before the Physical Class of the Asiatic Society, 15th Jan. 1831.]

The specimen was transmitted from Ava, by Mr. Charles Lane, through Major Burney, the British Resident at the Burmese Court, along with a variety of the mineral products of the Burmese empire. It was accompanied by the following notice from Mr. Lane, on the subject of its locality and extraction.

" Mixed with the gold dust, found to the northward of Ava, are a quantity of grains of metal, having every appearance of iron ; they are easily corroded, and are also affected by the magnet : by melting these grains, and keeping them in fusion, until the metal is no longer observed to scorify, the enclosed button of metal is left at the bottom of the crucible.

This metal, when mixed with gold, is found to increase its brilliancy. The King's earrings are made of a small quantity of it, mixed with pure gold ; it is very brittle, and all our attempts have hitherto failed in making it malleable."

Chemical Examination.

1. The specimen was in the shape of a bright metallic button, weighing 45 grains, of a colour similar to platina.

2. The specific gravity was found, on three trials, to be 17,2 : it did not visibly affect the magnetic needle.

3. When struck lightly with a hammer, the bead broke into several pieces, the largest of which was preserved, as a specimen, for the cabinet.

4. Another piece, weighing about 13 grains, was heated under a muffle, at a temperature of 1900°. It lost all brilliancy, and assumed a dull granular spongy texture, and a dark black colour ; without loss of weight.

Heated strongly in a forge, it fused into a hard brittle button, with tarnished surface, and bubbles of air within : the loss amounting only to one 500dth. The same bead, again heated red with borax, held by a platina spring forceps in the blowpipe flame, was compressed and soldered to the forceps. The exterior coat imparted a dull green colour to the borax, and the bead retained all its brittleness.

5. A small fragment, heated strongly on mica, before the blowpipe, gave out arsenical fumes, and corroded the support with astain of litharge; a deeply indented globule, of a rosy steel colour, remained.

Analysis.

a. 10 grains, or (for convenience of division) 100 parts of the metal, pounded fine, were digested three times in fresh doses of boiling nitro-muriatic acid. A residue of blue grains, or scales, was left, weighing 40,6. The action of the acid was still perceptible upon a further digestion.

b. The solution, of an orange colour, was evaporated nearly to dryness, and edulcorated with distilled water. A white heavy powder remained insoluble, which not proving to be muriate of silver, nor muriate of lead, was set aside for examination. (A) It weighed 17,2

c. To the clear neutral orange solution, was added a warm infusion of muriate of ammonia, which instantly produced a deposition of minute shining orange grains of the triple salt of platina, weighing, when dried, 51,5 equivalent to platina, 22,5

This was heated in a forge, and converted into bright metallic platina; but from the crucible being partly fused, it adhered, and could not be separated for direct weighment.

d. Green sulphate of iron was next poured in, to separate the gold, which was dried, and found to weigh 3,4

The solution, tested with muriate of tin, still shewed the presence of platina, and perhaps palladium in small quantity; but from the colour of the acid solutions, it is evident there could not be much of the latter metal.

The iridium and osmium having been separated from another assay of 10 grains, it is necessary, first, to describe the treatment which this had undergone.

e. 100 parts of the ore were cupellated in an assay furnace, with twice their weight of silver, and a tenfold dose of lead.

No union seemed to have taken place between the compounds and the silver; neither was the latter marked with reticular crystallization on the surface, as is the case with platina alloy in general. A spongy, black crust covered the bead, and the cupel under it was stained of the same colour; the appearance of the bone-ash did not indicate the presence of antimony, nor of iron, in any large proportion. The bead (exclusive of the silver) had acquired an excess of weight equal to 4½ per cent.

f. Boiling nitric acid took up the silver and other matter (probably the components of the white precipitate A, before described, and a little platina and palladium?) the whole matter dissolved, weighing 31,3

After precipitation of the silver, by muriatic acid, iron wire was immersed, to throw down what remained, but the excess of acid was so great, as to confound the result, by the large admixture of oxyde and other impurities of the iron. The white precipitate was, however, plainly observable, giving an opake and pasty form to the greenish black deposite.

g. The residual black-blue powder, weighing 73,2, was treated as before, with boiling nitro-muriatic acid, which took up the gold and platina, leaving still untouched, of black powder, 53,4. The portion dissolved being, therefore, 19,8.

h. The black powder of *g* was digested with soda, in a silver crucible, at a red heat, and washed out with water.

j. This alkaline solution was of a bright orange colour: being left by accident in contact with the silver crucible all night, it communicated to the latter a dark grey tinge, which is one of the characteristic properties of osmium. Muriatic acid changed the orange to the dark brown colour of iridium, precipitating the osmium, which, however, adhered to the filter in a shining black film, and could not be collected.

k. The black powder, left untouched by the soda, was boiled in nitro-muriatic acid, which dissolved all but 8,3 parts (D), (for one or more repetitions of the process are necessary to effect the solution of the whole.) The solution was bright orange at first, but became darker under concentration, until it was of a dense brown. Tested with green sulphate of iron, it became nearly colourless, which is a distinguishing mark of iridium.

During concentration, some pearly flat acicular crystals were deposited (as had also been marked in the solution *b*). These were found to be soluble in boiling water, and were, therefore, washed off, and set aside for further scrutiny, (B.)

l. The clear decanted acid solution, evaporated to dryness, yielded dark brown muriate of iridium, 29,3; which further heated to 1900° ? Far. was reduced into the characteristic bluish black sponge of iridium, weighing 13,5 } 17,7
to which must be added a proportion (say half) of the residual 8,3 4,2 }
A portion of this sponge, ignited in the apex of the blowpipe flame, was, with difficulty, made to assume a metallic, light grey lustre, iridium being much more refractory in this respect than platina itself.

The dark brown colour of the neutralized solution *f*, which also gave a dark brown precipitate with ammonia, shews that some iridium might remain therein; still, the deficiency upon the original black powder *g* (53,4) could only be accounted for, by a large portion of the oxyd of osmium having been dissipated.

The solution *j* was not affected by muriate of ammonia, nor by sulphate of iron: by muriate of tin, it became colourless; prussiate of ammonia turned it green. It did not exhibit any trace of lead. Until an opportunity offers, of further analysis, it will be safe to look upon the whole of *g* as iridium and osmium.

Examination of A.

m. The white precipitate, 17,2, obtained in the first process, was submitted to the following tests before the blowpipe.

1. Alone, at a red heat, it was unaltered, and did not lose weight.

2. Gradually raised the flame, acquired a faint grey tinge, and the matter dissipated without fusion, leaving a refractory alloy on the platina wire.

3. With borax, it formed an opake dirty green enamel, with occasional specks of black.

4. On charcoal it dissipated in fumes, having an odour resembling that of arsenic, and leaving globules of a steel coloured metal behind: a slight yellow tinge, like that of litharge, spread around.

5. Heated on a support of mica (the most convenient for minute examinations), it gave out fumes of arsenic: the yellow oxyde of lead then penetrated, and fused with the mica:—finally, a round globule of infusible metal remained, imbedded apparently in scoria of iron.

6. Heated low red, with charcoal powder, in a test tube, it did not yield a metallic ring of arsenic;—apparently, requiring a higher heat than the tube would bear for its decomposition.

7. It was quite insoluble in water, and very slightly soluble in strong nitro-muriatic acid. Ammonia separated it thence in a flocculent, white form.

I am at a loss to pronounce, with accuracy, upon the nature of the above substance, from the minute quantity submitted to trial. Arseniate of lead alone would have been more fusible;—and no mention is made in Mr. Lane's notice, of the admixture of either of these metals in melting the ore, and they are not otherwise commonly found in combination with platina. It seems rather to be a mixture of the arseniates of lead, iron and platina; but it is strange, that arsenic should be able to resist the heat of a forge in a close crucible, without sublimation. From my own experiments, however, I am aware of the difficulty of separating *lead* from platina, by heat: for an alloy of 8,0 gold, and 2,0 platina, cupelled with 50,0 lead, retained 1,0 of the latter, without diminution, under the most violent forge heat. The same, in a degree, may be the case with arsenic, and the fusibility of the bead is certainly strongly corroborative of its presence.

Examination of B.

n. The long flat crystals separated from solution *k*, being dissolved in water, and set aside, produced a deposition of a number of minute, rose coloured crystals, of irregular form, with waxy lustre. They were readily fusible much below a red heat, spreading on talc, or on borax, and leaving a black, insoluble atom, without imparting a colour to the flux. The quantity was two small to allow a further examination. It is possible, from their colour, that they may be a salt of rhodium.

The aqueous solution, on evaporation to dryness, left a number of silvery fibrous crystals, which bore the appearance, and exhibited the properties of, muriate of lead, probably mixed with that of platina.

o. Proper means were not taken to separate rhodium, (should there be any present,) from the insoluble grains at the proper stage of the analysis. Professor Berzelius has pointed out an elegant process for this purpose, namely, to digest the suspected substance in fused super-sulphate of potash, which dissolves the rhodium, and leaves the oxyde of iridium untouched.

I submitted the black insoluble residue D (of *k*) to this process, but without success: neither could I, by the same means, discover any trace of rhodium in the spongy iridium of *t*.

Thus, in the foregoing analysis, I have established, beyond a doubt, the existence of seven, out of nine, metals, and a more accurate trial would most probably have ascertained the presence of the others. In so complicated a substance, little dependance can be placed upon the proportions of the separate ingredients furnished by an assay of 10 grains. I think, however, the following may be fairly set down as its composition, in round numbers.

Platina,	25
Gold,	5
Iridium, } Osmium, }	40
Iron,	10
Arsenic, } Lead, }	20
Rhodium ?	
Palladium ?	
	100

The metal is undoubtedly, therefore, an alloy of platina, and we may congratulate Mr. Lane on being the first to discover the existence of that precious metal in southern Asia. It would be very satisfactory to obtain, through that gentleman's exertions, a specimen of the grains of metal, before any attempt should be made to fuse them, and in larger quantity than the present supply. Should the platina always have accompanied the gold dust of the Ava mines, and have always been thrown aside as a brittle, useless alloy; there may, possibly, be a quantity of the rejected metal procurable at a trifling cost, and this would, indeed, be a valuable acquisition for the chemist in India.

III.—*Further Observations regarding Value; and on the mode in which it is treated by Messrs.* Malthus *and* M'Culloch.

It has been intimated to me, that an impression is left on the mind, after the perusal of the preceding papers of mine, published in the *Gleanings*, of my having employed the term *value*, as being synonimous with *utility;* and I have been referred to Mr. C. Prinsep's *Essay on Money*, for arguments to show how very erroneous such a supposition is.

That this charge is not altogether tenable, I think I am justified in saying, when I refer to such passages as occur at pages 234 and 235, and in many other places; while at the same time I must admit, that in consequence of my attention not having been previously attracted, in a particular manner, to the consequences of such an admission, a laxity of expression has, in other parts, crept in, which ought not to have been permitted, and which affords some color to the accusation[1].

I am happy that my attention has been thus called to the subject, as it has been the means of placing many of the arguments in new points of view; and because it has brought me acquainted with a work, full of originality, which I had not before enjoyed the advantage of perusing[2].

I must now enter into a defence of the mode in which I employ the term *value*, as it appears that I differ in this from Mr. Prinsep, and most other writers. In Mr. Malthus's rules for the application of terms in this science, the following occurs as the first, namely, " When we employ terms which are of daily occurrence, in the common conversation of educated persons, we should define them so as to agree with the sense in which they are understood, in this most ordinary use of them. This is the best and most desirable authority for the meaning of words."

Now, if I should, in ordinary conversation, say, that water, air and sun-shine, were valuable to man, I apprehend that all hearers would fully understand what I meant thereby; and that I should be warranted in thus using the term, by the ordinary usage of all educated Englishmen. In proof of the above, when I turn to the word value, in Crabb's work on English Synonymes, which I may quote, as giving the acceptation in which English words are ordinarily used, I find it described, as " a general and indefinite term, applied to what is really good, or conceived as such, in a thing;" and by way of example, the following quotation occurs.

[1] In such passages as the following, these, and corresponding alterations ought, I now find, to be made, at page 274; for instance, I have written :—" The cause of real value, then, in the primary description of wealth, is not, let me repeat, the quantity of labour of which it may be the result, but the quantity of labour which it must command, will, in practice, be the index by which its existence is known: for food, it has been seen, might be obtained without labour, and is, in fact, in practice, obtained with much less labour than it will support and command, and yet it is possessed of value determined by causes quite distinct from the labour bestowed in its production." Here, for " the cause of real value in the primary description of wealth, is not the quantity of labour of which it is the result," I would say " of *labour alone:*" and for the following passages, " and yet, it is possessed of value determined by causes quite distinct from the labour bestowed on its production," I would substitute, " determined by other causes, besides the labour, &c." And many similar limitations will, doubtless, elsewhere be necessary.

[2] *Essay on Money*, by C. Prinsep, Esq. London.

"Life has no value as an end, but means
An end deplorable, a means divine[3]."

Now, if we deny the existence of such value, as is here understood, we, it appears to me, arrogate to ourselves a right of altering the English language; a right which we cannot be justified in assuming, unless indeed a case of urgent necessity be made out; unless it be shewn, that the employment in Political Economy of this general and indefinite term, be altogether incompatible with the clear explanation of those branches of the science, which are in connexion with value. But I see no necessity for our assuming to ourselves this license, to alter the English language; on the contrary, I conceive that it is of the greatest importance clearly to understand wherein this general, and indefinite kind of value, differs from the more peculiar and specific descriptions which are included under it, as subspecies; I therefore take some pains to trace, first, the generic kind of value to its source; and then the specific differences which distinguish the various descriptions of value one from another.

To the necessity alone, under which man labours, for continually employing certain classes of bodies, I conceive that the indefinite value must be traced, which, in ordinary conversation, we attribute, not only to the items which constitute our wealth, but to all other useful bodies whatever. This, then, is tracing this description of value to utility alone as its source; and so far I admit the justice of the observation, that I do make utility and value synonimous. But when I come to that which I may term the technical value of political economists, that which peculiarly exists in items of wealth alone, then it becomes necessary to point out what considerations are essential to its creation. Accordingly, I devote the last paragraph of page 234, and nearly the whole of the next page, to this subject; and I shew, that to the existence of the kind of value which exclusively belongs to wealth, and which I have denominated the appreciable description of value, it is necessary, not only that the bodies possessing it should be necessary to man's existence—that they should possess inherent utility; but also that they should be the result of certain sacrifices to which man voluntarily submits in their acquisition; and that these sacrifices should be of such a nature, that all men must be agreed in opinion regarding them. Now what, I ask, is this, but saying, in other words, than those Mr. Prinsep has used, that the value inhering in items of wealth has its origin in their utility to man, and in the difficulty which attends their attainment; the necessity under which man labours for making exertions, in order that they may come into his possession, being the same thing, of course, in my treatise, as the difficulty of attainment of that writer.

I, to be sure, say, that it is only to the creation of appreciable value that these two ingredients (to use Mr. Prinsep's term) are necessary; and that to the creation of the ordinary and indefinite value which occurs in conversation, utility alone is sufficient. But Mr. Prinsep appears to me to monopolize the term *value*, as altogether the property of political economists, and as properly having no existence in other kinds of discourse, while I admit that the term is of general application; that the value peculiarly connected with political economy is of a specific character; and that what distinguishes it from the indefinite kind, is its being appreciable in its nature.

[3] We submit to our ingenious contributor, whether poets, who have a chartered license in the use, and whose very beauties often depend upon a bold abuse, of words; can, with safety, be referred to as authority for the meaning of a word used in a philosophical discussion.—Ed.

It would appear, then, that Mr. Prinsep uses "value" precisely as I employ the term "appreciable value"; and that we both trace its existence to utility, coupled with difficulty of attainment: and I am anxious that our accordance in this particular should be known, for I believe we are opposed to most of the leading writers on the subject, who, when they argue consistently, support the contrary opinion; namely, that labour, or difficulty of attainment alone, is the sole source of value.

We are opposed to most writers in another important particular, to which I am glad to have it in my power to call attention; namely, that however they are necessitated occasionally to admit the positive nature of the value inhering in wealth, their principal arguments do really hinge on the denial, (neglect, would, perhaps, be a better term,) of the existence of any but value of relative character. All that is peculiar to Mr. Ricardo's system has been shewn to rest on this latter assumption, coupled, as it most unaccountably is, with the admission, that positive value has existence.

On this latter subject I have some further observations to offer; mean time, I would bring to notice some considerations, which go to prove the necessity for distinguishing between the indefinite value of ordinary discourse, and the appreciable value appertaining to wealth, if we would fully comprehend all the bearings of value upon wealth. Thus, when we come strictly to consider the nature of the value inhering in the primary description of wealth, it will be evident, as some considerable portion of that value originates solely in the utility of the products, and not in the difficulty of obtaining them; so a corresponding portion of the value, enjoyed by that description of wealth, must be of the general and indefinite character. Suppose, for instance, the case given at page 274, where food, being obtainable without any agricultural labour whatever, is still found to become possessed of value of the appreciable kind. *Quoad*, the landowners who, in that case, obtain the food for nothing, it is clear that it could not possess appreciable value; for, in as far as they are concerned, it is circumstanced precisely like air, or water: to their apprehensions, therefore, it could not directly be susceptible of appreciable valuation. But *quoad* all productive classes, otherwise existing in the community, it would directly possess appreciable value; because, before they could obtain it in exchange for their wrought wares, specific amounts of their labour must, in the case supposed, be set in the balance, against specific quantities of food. Here, however, although to the landowners apprehension—the food would not be possessed, in a direct manner, of appreciable value, both labour and utility being essential to the creation of such value, still *indirectly* the food would become possessed of this kind of value, even in their opinions: for as the option given them is, to bestow food upon the manufacturers as an exchange for wrought wares; to go without wrought products altogether; or personally to labour in the production of manufactures; the food at their disposal, as being convertible at will, into wrought products, through the means of barter, which wrought products are only otherwise obtainable through the instrumentality of labour, becomes, in a reflex manner, possessed of appreciable value even in the estimation of the landowners. Now, although we nowhere, in practice, find food obtainable without any labour whatever, we always find that in societies, where production has made any progress, a sufficiency for the support of the requisite labour is obtainable in return for much less labour than the operative agriculturalist actually bestows; they invariably raise more than feeds themselves, otherwise, as I have already shewn, there could be no rents, nor profits in agriculture, nor profits, or wages even, in any other branch of production.

This may appear to be refining unnecessarily, and carrying, to a needless length, the analysis of the value actually existing in certain descriptions of wealth; and perhaps no practical good may result therefrom. But as the various links in the chain of agreement under examination, appear to be strictly in connexion; and as they go to prove, that, to certain classes, the indefinite description of value does exist in some kinds of wealth, while to other classes the appreciable kind exists in the same item of wealth; I have thought the matter worthy of observation at present, as being calculated to combat the opinion, that no occasion exists for distinguishing, in political economy, between the indefinite value, proceeding from utility alone, and the specific, and appreciable value, which proceeds from utility combined with difficulty of attainment.

I must now return to the inconsistencies with which I conceive that I am justified in charging the leading writers on political economy, regarding the simultaneous existence, and non-existence, of value of a positive kind.

Having turned to the term " value," in Mr. Malthus's work *On Definitions in Political Economy*, I find him writing thus: " value has two meanings; value in use, and value in exchange: value in use is synonimous with utility; it rarely occurs in political economy, and is never implied by the word value, when used alone." To this I have the same objection to offer, which holds, as I conceive, to the monopoly of the term value which Mr. Prinsep has made.

Mr. Malthus defines the other meaning to be value in exchange; " the relation of one object to some other or others in exchange, resulting from the estimation in which each is held." Now, there is ambiguity, and consequently error, lurking under this definition; for although it is here distinctly granted, that this relation of certain objects to others in exchange, is the only kind of value which exists, besides value in use, still the existence of a distinct kind of independent, or positive value, is necessarily implied in that part of the sentence which treats of that value, in the products, which results " from the estimation in which each is held." This independent value in each, cannot be that which is relative, because it must be admitted to exist in each product, before their relations can come to be compared; it is, in fact, the relation subsisting between the moral agents, and each of the products; whereas the relative value is the relation subsisting between the two products themselves. I have conceived it to be of paramount importance, to mark the distinction which exists between these two very difficult relations; and I have traced what appear to me, many of the leading errors of Mr. Ricardo's system, to the neglect of this very palpable difference. He, it now appears, is not the only writer embarrassed by the want of attention to these differences, for here Mr. Malthus is, with one breath, found to be denying, and admitting the existence of positive value; and further on, although he has already laid down, that there is nothing but value in use, and value in exchange, he adds, " when no second object is specified, the value of a commodity naturally refers to the causes which determine the estimation in which it is held." Now the causes which determine the estimation in which a commodity is held, are neither its utility (value in use), nor its standing in this relation, or that, to another commodity (value in exchange); these causes must be something positively and independently affecting the product in question. Mr. Malthus, at page 251, has another passage in point, in which he directly admits the existence of value of a positive nature. " Two articles," he says, " are never exchanged with each other, without a previous estimation of the value of each, by a reference to the wants of mankind, and the means of production." This is, in fact, saying, that the relative values of two products could not be known, unless men possessed a previous knowledge of the positive value of each ; a proposition which is indubitably true, but which cannot be admitted as such, if this be true, that there are only two kinds of value ; value in use, and value in exchange. He adds, "this general and most important relation to the means of production, and the labour which represents these means, seems to be quite forgotten, by those who imagine that there is no relation implied, when the value of a commodity is mentioned without specific reference to some other commodity." Here, then, we have a direct admission of two distinct relations ; the relation of the value already existing in products, when these come to be compared one with another ; and the relation of products to the moral agents through whose instrumentality, either one or both of the products, have been brought into existence. This admission suffices for my present purpose ; namely, to show, that some other description of value exists, besides value in use, and value in exchange ; for Mr. Malthus would, I believe, be the very first to admit, that two such very different relations as these, ought not to be confounded, by being made to pass under one denomination ; no one being more capable of appreciating than he, the extent of error to which we render ourselves liable, when we reason so very loosely, as to pass, without being aware of it, from one of these relations to the other. Besides then, the general and indefinite kind of value which inheres in all bodies which are useful to man, there exists that value which inheres positively, and independently, in all descriptions of wealth ; and which is susceptible of specific appreciation : and there exists, besides, that value in exchange, which marks the relation of existing appreciable values in different products, when these products are so circumstanced as to be brought into comparison. The former kind of appreciable value, shewing how great a sacrifice the possession of any product involves, and consequently how wealthy, or how poor, its possessor may be ; while the latter kind merely shews, that when exchanges are on foot, so much of one kind of commodity ought, in equity, to be given for so much of some other.

Having stated, that the denial, or neglect rather, of the existence of positive value, is one of the leading characteristics of the popular works on political economy of the day, I must repeat, that I am to be understood as meaning, that this denial is necessarily involved in their arguments for the establishment of the theories they support ; not that verbal admissions to the contrary do not exist in them all. Thus, besides what has been written regarding Mr. Ricardo's work, and what has now been said of the writings of Mr. Malthus, I have to bring to notice, that Mr. M'Culloch, although supporting Mr. Ricardo's doctrines through thick and thin, has still a great many detached passages which most freely admit the inevitable existence of value of a positive and independent character. Nay, he has gone into a nice discrimination between real, and exchangeable value ; stating, that the former corresponds with the labour which a product costs the actual producer ; while the latter agrees with the quantity of labour, or the quantity of commodities produced by others, which the product will command. I do not very clearly understand the drift of this argument ; and it appears to me, that Mr. M'Culloch himself does not much more clearly know what he means thereby ; for he admits, at page 221[a], that supposing the market be not affected by monopolies, the two kinds of value must be identical. Yet he does conceive them to be different ; and his reason for thinking that they must be so, is this ; that if the exchangeable value of products were no greater than their real value, or in other words, if men only got for their wares what these wares cost them, they could never gain by exchanging them for other things. But he knows that men *do gain* in practice by exchanging products, and, therefore, he looks upon this fact, as the cause

[a] *Principles of Political Economy*, by J. R. M'Culloch, Esq.

which raises the exchangeable value of products above their real value, or actual cost. This mistaking a collateral effect for a cause, is a species of sophistry, which, I regret to say, vitiates the reasonings of many of our leading political economists; but let it pass at present. I do not here mean to enter into the question of what causes a difference between prime cost and market price; I may hereafter touch on this, as well as on many other simple matters, which appear to me to be misunderstood, and mystified. I must now return to Mr. M'Culloch's manner of treating real and relative value. Having enlisted himself under Mr. Ricardo's banners, and having become persuaded, by his means, that it is through exchangeable, and not through real value, that we are to become acquainted with the varying circumstances of the different classes in society; with their increasing, or diminishing wealth, or poverty; he, although perfectly aware how much more wealthy or more poor, certain changes in productive power may render all classes, although thus in effect, stating how much the profits and wages which support them, may thereby be altered in quantity, is found treating this as a matter of little importance, and as being scarcely worthy the attention of political economists, when contrasted with the circumstance of certain relations of the products amongst themselves, remaining unchanged at the time in question; he turns his eyes from what vitally concerns mankind, and fixes them upon what can merely be questions of investigation to the curious: in proof, I beg the reader's attention to what follows.

"It is abundantly obvious, that all commodities possessed of exchangeable, must also be possessed of real value, and *vice versâ.*" page 211.

"All" that an invariable standard of exchangeable value "would teach us, would be, that the causes which first made A" (the standard) "exchange for B," (the commodity,) "continued to affect them both to the same proportional extent; but of the nature of those causes, and the intensity of their operation, we should be left wholly in the dark." "Having ascertained that the exchangeable value of any one commodity must always be expressed by the *relation* it bears to some other commodity, or to labour; the next object that claims our attention, is the investigation of the circumstances which determine this relation, or of the regulating principle of value." "It is the quantity of labour required to produce" commodities, "that forms the single principle by which their real value is exclusively regulated and determined;" and it will be afterwards shown, that when there are no monopolies, and the supply of commodities in the market is exactly proportioned to the effectual demand, their exchangeable value is identical with their real value." "If it should be found, that the power of a commodity A, to purchase or exchange for another commodity B, were increased; and if it should also be found, that an equal increase had taken place in the quantity of labour required to produce A, while the quantity required to produce B continued the same, we should be entitled to say, that A had increased in exchangeable value, because it had increased in real value; assuming the toil and trouble of acquiring any thing to be the measure of its real value, or of the esteem in which it is held by its possessor, and consequently of the proportion in which he will exchange it for other things." "Nothing that is valuable can be obtained except by the exertion of a certain amount of labour, or of physical force. This is the *price* that man must pay for all things not spontaneously furnished by nature; and it is plainly by the magnitude of the price, and not by the magnitude of the things themselves, that real value is to be estimated."

I have given these extracts from Mr. M'Culloch's work, to show how much importance he does attach to the real value of commodities; for he here goes the length of saying, that real value must be the cause of the existence of relative value, that they must be the same in the average state of markets; he also says, that the exchangeable value of commodities would teach us nothing but that certain circumstances affecting them respectively, had undergone change, or had remained constant, but that of the nature of these circumstances we should be left wholly in the dark ; he likewise tells us that the *price* man must pay for all things, is the same as their real value.

Had I been writing to establish my own views on this subject, I could not have used more appropriate language : what then shall we say when we find this Author writing to prove, that the *price* of commodities must be determined by very different principles from the above ; that *prices* cannot rise or fall, if all commodities be equally affected by any change ; and that prices being incapacitated from rising or falling by the incidental circumstance of the relations of products amongst themselves remaining unchanged, therefore the giving of more or less real value, or higher wages, to the class of labourers, the enhancement, or reduction of the real cost of producing commodities, will affect society no further than by enriching or impoverishing the class of capitalists! He writes thus at page 297. " Suppose that the quantities of labour required for the production of every species of commodities are increased in exactly the same proportion, under such circumstances, it is quite certain that their exchangeable values, as compared with each other, would remain unaltered : a bushel of corn would not then exchange for a greater quantity of muslin or broad cloth, than it did before the increased expense of its production ; but each would have a greater real value, because each would be the produce of a greater quantity of labour. Under these circumstances *the prices* of commodities would remain stationary," (the toil and trouble of acquiring each having been increased, and the toil and trouble of acquisition being, by his own shewing, the *price* of all things whatsoever,) " while the wealth and comforts of the society would be materially diminished." All classes in that case would, I take it, have become poorer ; the labourers getting smaller wages, and the capitalists smaller profits, and this, notwithstanding the fixedness of the relations of products amongst themselves ; " but he adds," as the expense of producing all commodities is by the supposition equally increased, it would not be necessary to make any greater exertions to obtain one than another, and their relative values would be totally unaffected." Now what, I may ask, does this import to the society ? it may be a matter of investigation to the curious, to watch how the relations of commodities stand, after certain changes in the means of production have taken place ; but nothing more. What concerns the society, and the political economist, studying the causes of the increase or diminution of wealth, is the circumstance of all producers having been rendered poorer than before. But no, the writers of Mr. Ricardo's school have other affairs on hand, and that which has become important in their estimation, is not the diminishing or increasing wealth of all classes, it is the relations of products amongst themselves which they have undertaken to watch, and thus they proceed. " But if a general and equal increase of the quantities of labour required for the production of commodities, cannot alter their relation to one another, it is quite obvious that this relation cannot be affected by a general and equal increase of the wages paid for that labour. Fluctuations in the rate of real wages affect the proportion in which the produce of industry is divided between capitalists and labourers, diminishing the proportion belonging to capitalists when they rise, and increasing it when they fall. But as these changes in the distribution of commodities neither add to, nor take from the quantity of labour required to produce them, they cannot affect either their real or exchangeable value." page 298. Let us sift this to the bottom : Wages permanently rise, says Mr. M'Culloch, because, from the increase of population, and the consequent extension of cultivation over inferior soils, more toil and trouble has become necessary to grow the food of the labourer. Now this is unquestionably stating a case precisely similar to that which he has just given, where the real value of all products has been increased by increased difficulty of production. Now, however, it has pleased Mr. Ricardo, and after him Mr. M'Culloch, to call this by another name; such a rise of wages is now denominated a diminution of the proportion of the produce of industry belonging to capitalists; and as a diminution of the proportion of the produce of industry falling to the share of the capitalists sounds like a very different affair from an increase of the expense of production, it is taken for granted that it is so. Here, however, this question will naturally suggest itself to the followers of Mr. Ricardo, and it deserves particular attention; for the root lies here of the errors into which he has run. Suppose, they may say, that we should allow the real price of products, the toil and trouble of obtaining them, would be increased, either when all labour has become less productive, or when the wages of labour had risen because of the existence of a necessity for resorting to worse lands for raising the food of the population; as, in either case, the rise of real price could not be indicated through the means of any commodity whatsoever, whether silver, or gold, or corn, or muslin, therefore it could not possibly affect consumers; price is only known through the means of money or some other commodity, and money is composed of silver or gold, which are commodities. Under these circumstances how then could a rise of real price be a rise of money price? and if it cannot be a rise of money price, how can it be a rise of price at all? We may allow the question to remain unanswered for the present, for these reasons; first, because it has still to be proved that such a combination of circumstances is possible, as shall tend to the enhancement of the difficulty of obtaining all products whatsoever. If, as I have endeavoured to show, the value of primary wealth must always make a very near approach, indeed, to the highest, which men can possibly entertain for it, (an inevitable consequence of the mass of the population being always necessitated to offer their utmost labour for a sufficiency of food,) then such an event as a general rise of wages, proceeding from an enhancement of the real value of food, could never take place; the destruction of a large proportion of the population being a necessary consequence of such an enhancement. In the event of a famine, then indeed we do perceive something in practice which corresponds with these theoretical imaginings; and in this case there is no need of my telling my readers, that something more distressing, occurs to the community than a mere reduction of profits to the capitalists; the whole framework of society is then convulsed, and all productive anticipations are then frustrated. But it is temporary, and passes: its permanent continuance, and the existence of society on its former scale, are utterly incompatible. But it may be asked, whether I mean to deny that instances have occurred of food being permanently raised in price, and wages raised with them, when our own country, at the present day, may be confidently appealed to as an example? I answer, every manufacturing town is a similar example. But is it not the case that people of the neighbourhood, dealing with the town, furnish from their yearly incomes, the means of enabling the townsmen to pay the superior price of food? Does not the whole world act as its neighbourhood, to that emporium of manufactures, England? If England alone existed in the world, could rising price, and wages, then be given? I answer confidently in the negative. But I find I am anticipating the results of arguments with which my readers must be unacquainted; I cannot, therefore, expect at this time to carry them along with me. Should circumstances permit my proceeding with the investigation, and should the pages of the *Gleanings* remain open to my use, in the prosecution of so comprehensive, and so dry a subject, I shall be most happy to push the investigation to its limits. But I must adopt a different mode of proceeding from the present; for much, connected with the theory of wealth, of a far more elementary nature than the abstruse inquiries we are now engaged in, remains to be established. And being convinced, that until the more elementary parts of the science are thoroughly understood, much circumlocution, and much misapprehension, must be inevitable; I cannot hope for making converts to my opinions, unless I discuss the subject of wealth from the beginning; taking up in due course, and as my readers can go more readily along with me, the question which has here been broached. For it is not the nature of value, and its connexion with wealth, which has alone been misunderstood by the writers, who have now acquired the confidence of the public; the system of money, as propounded by them, appears also to be erroneous; the principles which regulate the application of capital to production, and which determine the evolution of profits, and their separation from wages strike me as being equally misunderstood; their theories of rent; the causes assigned by them for the gain, arising out of commercial exchange; the principles by which monopolists and competitors are guided in supplying markets; all these, as well as many other important points, are, I feel well assured, discussed by them on false principles. These are sweeping charges, which it requires much hardihood to put forth, when we consider the acknowledged talent, and the well earned celebrity of many of the writers who have devoted themselves to the prosecution of this science. But if I can succeed in establishing that even the original source of wealth and revenue is at the present moment mistaken, surprise will cease to be felt that so many errors should exist; and wonder will take its place, that on so rotten a foundation, an edifice so lofty, and of such seemly proportions, should have been raised, aye, and not only raised but kept in its erect, although I believe, I may add, tottering position, for so great a length of time. Feeling all this, I propose that the next paper shall be devoted to the settling of this all-important question, "what is the original source of wealth and revenue?" perfectly assured that until that is set at rest, all must be labour thrown away, which is bestowed upon the science of Political Economy.

IV.—*On the Errors to which the Barometer is liable. By Lieut.* R. Shortreed, *Bom. Estab.*

To the Editor of Gleanings in Science.

Sir,

From the number of persons now engaged in making meteorological observations, it may be expected that a mass of facts will be obtained, so as gradually to enlarge and fill up the boundaries of that science. It is, however, much to be regretted, that while there are so many observers there are but few good observations. Without adverting to the incompetency of some of the observers, I am of opinion, that the want of good observations, is in a great measure owing to the defects of the instruments employed. I propose, therefore, at present, to notice the principal sources of the discrepancies observable among different instruments, beginning with the barometer. To those who have paid any attention to the subject, it is scarcely necessary to mention that barometers do differ in their indications. The first and most obvious errors are, in fixing the extreme points of the scale, and the intermediate division[1];

[1] I must here except those made by Messrs. Gilbert, with glass cisterns, in which, however, when the glass becomes soiled with oxide of mercury, it becomes almost impossible to set them with any tolerable precision.

this, however, is not now so common as it was some years ago. More attention has of late, been paid to this part of the subject, by instrument makers. The correctness of division is easily ascertained, and generally, in most instruments now in use, it is sufficiently exact. But supposing the scale perfect, and the tube properly filled, a fertile source of error is the different specific gravity of the mercury employed. It is much to be desired, that philosophers would agree to use mercury of some definite density; for until this is the case, no consistency among different instruments is to be expected. I would suggest 13,6 as a very convenient density for general use. Mercury of this sort is procurable without much trouble, and it does not soil the tube. In the instruments now employed, it may be found of all sorts, from 13,2 to 13,6, and occasionally 13,65. It seldom, I believe, in ordinary instruments, exceeds the last number. It might, no doubt, by careful purification, be obtained of greater density, but would be more difficult to be procured; and though it might be used in the more expensive instruments, yet it would not be used in the common ones, which would thus not be so directly comparable with the standard ones. The particular density is of little importance compared with uniformity, and 13,6 is a number more easily remembered than one having a greater number of figures. A column of 30 inches of mercury of 13,6 will exactly balance a column of 34 feet of water. The convenience of expressing correct results in whole numbers is not to be overlooked.

The next source of discrepancy among different barometers, is difference in the diameters of the tubes. But as the amount of this is constant in the same instrument, and as the value of it is known for all diameters, it is unnecessary to say more about it. Another very common source of error, is the imperfection of the vacuum. The vacuum may be imperfect from three causes, 1st, from atmospheric air; 2d, from moisture; 3d, from the vapor of the mercury itself.

If the error arise from contained atmospheric air, the amount of it may be determined in all cases without much trouble. If it arise from contained moisture, the amount of the error may likewise be calculated in all cases; but the calculation would be very troublesome, as it would be necessary, in the first place, from comparisons at different temperatures, with a correct barometer, to ascertain the quantity of moisture in the tube, and then from the pressure of vapor at the temperature, and the capacity of the tube void of mercury, to find what pressure it would actually exert, and hence we should have the consequent depression of the mercury in the tube. A formula for this purpose might be easily given; but the best of all modes of correcting this error, is to expel the moisture, by refilling and reboiling the mercury in the tube. The depression arising from the vapor of the mercury, may appear at first to be inconsiderable. In Barometers which have stood several months in the same place, I have found it amount to .020 and upwards. As far as my observation extends, the error from this cause is nearly insensible for the first week or ten days; and at the end of about a month, it may not exceed .003 or 005, but it increases according to the time that the instrument is allowed to remain unmoved. I have no means of determining the ultimate amount which it would attain; probably it depends on the temperature as well as on the time. The remedy is very simple; we have merely to cause the mercury to ascend to the top of the tube, and the vapor will be wholly condensed. I would recommend, therefore, that in all cases where a barometer is in constant use, the mercury be caused to ascend to the top of the tube, once a week at least, and thus the error would be corrected before it became of much importance. I have examined several barometers in this respect, and have invariably found them to stand higher, by a considerable quantity, after the mercury had been made to fill the tube, than they did previously; and I have no doubt, that if the experiment be made on the barometer, by which the Calcutta Register is kept in the Surveyor General's Office, a similar result will be obtained.

The following is an investigation of the depression produced on the barometric column, by a quantity of contained air.

Let h be the height of the mercury in a perfect barometer, or the true atmospheric pressure; l the length of the barometer tube, from the surface of the basin to the top. It is required to find at what height the mercury would stand on introducing a quantity of air which, at the given pressure, would fill the tube to the depth $= n$.

Let x be the height required.

The air at the pressure h occupies a portion of the tube $= n$, but when introduced at the top of the mercury, it occupies the space $l - x$, and is then under the pressure $h - x$, hence we have $hn = (h-x)\ (l-x)$; (A) : $= x^2 - (l+h)\ x + lh$; or, $x^2 - (l+h)\ x = hn - lh$; (B) : hence, $x = \frac{l+h}{2} \pm \sqrt{\left(\frac{l+h}{2}\right)^2 - lh + hn}$,

but since by the nature of the case $x \angle h \angle l$, the substractive root is the only one which can obtain here; and hence $x = \frac{l+h}{2} - \sqrt{\left(\frac{l+h}{2}\right)^2 - lh + hn} = \frac{l+h}{2} - \sqrt{\left(\frac{l-h}{2}\right)^2 + hn}$; (C). If x be required by a series, we have $x = \frac{l+h}{2} - \frac{l-h}{2} - \frac{hn}{l-h} + \frac{h^2n^2}{(l-h)^3} - \frac{2h^3n^3}{(l-h)^5}$; or, $x = h - \frac{hn}{l-h} + \frac{h^2n^2}{(l-h)^3} - \frac{2h^3n^3}{(l-h)^5} +$ &c.; (D). In most cases the first term would be sufficiently correct, that is, $x = h - \frac{hn}{l-h}$ very nearly; (E). This result may be obtained in another way. Resuming the original equation (A) $hn = (h-x)\ (l-x)$ whence $h - x = \frac{hn}{l-x}$; (F). But when the depression is small $h = x$ very nearly, and $l - x = l - h$ very nearly, hence $h - x = \frac{hn}{l-h}$ very nearly : also $h - x = \frac{hn}{l} + \frac{hnx}{l^2} + \frac{hnx^2}{l^3} + \frac{hnx^3}{l^4} + \frac{hnx^4}{l^5} +$ &c.; (G): by actually dividing (F).

The depression is, therefore, very nearly inversely as the vacuum in the tube[2], and hence the comparative advantage of a long tube over a short one imperfectly filled :—as an example,

Suppose $l = 36,\ l = 32,\ l = 31,\ l = 30,\ l = 29,\ l = 28$; $h = 28$; $n = \frac{1}{1000}$; we have x = 27,9965, 27,993, 27,991, 27,986, 27,973, 27,947 respectively.

Suppose		we have x
$l = 36$	$h = 28$; $n = \frac{1}{1000}$	27,9965
$l = 32$		27,993
$l = 31$		27,991
$l = 30$		27,986
$l = 29$		27,973
$l = 28$		27,947

2 This is true without sensible error, when the vacuum at the top of the tube is not less than an inch in length.

From equation (A) we may find n when l, h, and x, are given, or in other words, by comparing an imperfectly filled barometer with a correct one, we may find the quantity of air contained in the tube, and hence find the error of indication in any other case $n = \frac{(h-x)\ (l-x)}{h}$; (H). If great correctness be required, the bulk of the contained air, as affected by change of temperature, must be taken into account, but it is unnecessary to enlarge on this subject, and take up the pages of your work any farther, as any person who understands the previous investigation, will have no difficulty in applying it in any particular case.

In all cases, however, it is preferable to have the tube perfectly freed from air, the surest mode of attaining which, is by boiling. But this, in the hands of an inexperienced person, is attended with great danger of cracking the tube, to avoid which, I shall here mention a very simple mode of making barometers nearly perfect, without boiling.

Rub the tube dry with some silk tied to the end of a wire, or with a piece of flannel dried and heated, and then fill it with clean mercury by a paper funnel. Then collect all the air bubbles, excepting one or two at the top, and remove them by inclining the tube. Reverse it now in a basin of mercury, and the small portion of air which was left in the tube, will rise to the top. Now apply the finger to the lower end, so as to keep it air tight, or what is better, while it is in the basin, stop the lower end tightly with a cork[3]. Bring the tube now into a horizontal position, and let the mercury run as gently as may be, to the top, and by a little care and management, the contained air, expanded by the diminution of pressure, may be brought along the tube in a large bubble, leaving the tube almost perfectly filled. When the bubble is brought to the end, the remainder of the tube may be filled with mercury, and when set up it will stand almost exactly the same as in a boiled tube.

In this way I have filled tubes which stood to the same thousandth of an inch as boiled tubes; and on some occasions I have found the mercury adhere to the top of the tube, and not fall till shaken.

It is probable that a person may not succeed the first time he tries this method. I would recommend, therefore, on first filling the tube, to pass a fine iron wire through the cork, to the top; then allow the mercury to fall, by withdrawing the cork in the basin, and then proceed as before directed, to cork the tube and bring to the horizontal position; then by gently withdrawing the wire, the whole of the air may be brought along with it to the end.

V.—*On Hydraulic Cements. By Lieutenant* W. Saunders, *Madr. Eng.*

From a series of experiments lately conducted at Chatham, under the superintendence of Colonel Pasley, of the Royal Engineers, upon the subject of water cements; it has been established, that artificial hydraulic mortar, nearly equal in quality to the Roman or Sheppey cement, may be made from very simple materials, procurable in almost every country. This discovery, followed up by an ample train of practical investigation, with various ingredients, will prove a valuable acquisition to Civil Engineers and builders in Europe, and it is likely to be of the utmost consequence in countries where the natural puzzolana, or material for making water cements, is not produced.

[3] In this case, the lower end of the tube will require to be ground smooth, and the sharp internal edge removed, in order that the cork may be properly inserted.

In Bengal, where from the low level of the ground, and the humidity of the climate, the foundations of all buildings are peculiarly exposed to damp, and in many cases, as in bridges, &c. are immersed in water immediately after construction; it would seem more urgently requisite to employ a cement which should have the property of hardening under water; and yet, as far as I can learn, this desirable quality has not yet been found in any of the mortars of the country. Although, therefore, the results of Colonel Pasley's researches have not yet been published to the world, I shall take advantage of my having been present throughout the course of his experiments, to communicate the principal facts elicited therefrom, and at the time to shew, how successful has been their application towards the formation of a hydraulic cement out of materials procurable in Calcutta, and indeed all over India.

The composition of Roman cement, which has been assumed as a model for imitation, by architects, was found by Guyton Morveau, to be as follows:—

Lime,	40,3	Carbonate of lime,	73,3
Carbonic acid,	33,0		
Protoxyd of iron,	11,3		
Silica,	9,9	Clay,	14,3
Alumina,	4,4		
Loss,	1,1		
	100,0		

A second analysis, by M. Drapier, of the Boulogne stone, which precisely resembles that of Sheppey in its properties, yielded the following composition:

	Carbonate of lime,	61,6	
	Carbonate of iron,	6,0	
Clay,	Silica,	15,0	22,8
	Alumina,	4,8	
	Oxyd of iron,	3,0	
	Water,	6,6	
	Loss,	3,0	
		100,0	

These analyses prove, that the stone called Sheppey stone, is an argillaceous limestone, with a large proportion of oxyd of iron, a substance that seems to play an important part in the mixture.

The principal difference between the natural stone, and an artificial compound of the same substances, must evidently be in the more intimate commixture of the ingredients of the former; for it is not probable that a thorough chemical combination exists between the lime and silex or alumina, since the former earth is readily separable by an acid, leaving the clay apparently in its original natural state.

The principle, then, upon which Colonel Pasley proceeded, was to make as perfect a mixture as possible of his materials, that is, an exact imitation of the natural stone before calcination; and to deal with it afterwards just in the same way as with the Roman cement.

The materials, which formed the basis of his artificial puzzolana, were carbonate of lime and clay, in the proportion of 5 parts of the former, to 2 of the latter: to these it was found necessary to add other substances in particular cases of which mention will presently be made. As success mainly depended upon the proper mixture of the materials, I will detail the precautions requisite in this preliminary operation.

The carbonate of lime being reduced to a fine powder, is mixed up intimately with the clay, adding sufficient water to render it a stiff paste, such as bricks would be made of; after this, the composition is moulded into lumps of the shape of bricks, 4 inches × 3 × 2, and set to dry. It is then calcined in a lime-kiln, until the carbonic acid is thoroughly driven off.

The composition is now to be ground up, dry, into a very fine powder; and this operation requires attention; for the same composition which will make a good and lasting cement, when well pounded, will not succeed at all, when badly ground up. In the state of powder the lime is ready for use, and may be preserved, if kept from the contact of air and water. When used, it is merely to be mixed up with water; a greater proportion of liquid being added when the cement is required to harden slowly, and less when quick setting is the object: when the quantity of water is very small, or barely enough to make a paste of the powder, a very few minutes suffice to render it quite hard.

Col. Pasley employed blue clay, taken from the bed of the Medway, in most of his experiments, and found it preferable to the brown clay, apparently from its containing protoxyd of iron, in lieu of the peroxyd of that metal, which, in all cases, proved detrimental to the cement. With the brown clay, indeed, it was found advantageous to mix about 2 per cent. of protoxyd, to make it a good alloy for the lime; and to prevent its conversion to the state of peroxyd in the kiln, a further addition of some carbonaceous matter, such as coal dust, resin, &c. was in all cases found necessary. The superiority of the blue clay may probably be owing to its containing a portion of vegetable carbon, diffused through it. The proportion of carbonaceous matter added, should form 1-15th or 1-20th of the mass.

The following are the results of the various experiments made at Chatham.

Expt.	*Blue Clay.*	*Chalk.*	*Coal Dust.*	*Cement.*
1.	27	66,3	6,7	very hard and good.
2.	27	67,1	6,9	equally good.
3.	27	65,9	7,1	not quite so good.

4. The same composition, with 1-15th of different oils and resins, also answered very well.

5. Chalk and blue clay, the latter of which had been previously washed, did not form a good cement: the composition falling to pieces under water.

6. The following substances, when added in the proportion of 1-15th of the whole mass, were found to restore to the washed clay its hydraulic property: viz. carbonate of soda, carbonate of potash, and muriate of soda.

7. Compounds of chalk and pipe clay would not answer alone; but the above mentioned saline ingredients, added before calcination, at once conferred upon these cements the property of hardening under water. The proportion, in this case, however, needed to be very small, varying from 1-50th to 1-150th, according to circumstances.

8. Magnesia had strong hydraulic qualities, becoming excessively hard of itself, when immersed in water, after calcination; but it hardened without heat, and with exceeding slowness. Should the limestone used in forming a cement be a dolomite, it was thought it might prove preferable to pure limestone for hydraulic purposes.

The foregoing memoranda serve to shew the facility with which artificial puzzolanas may be formed, by calcining together mixtures of clay, lime, and protxyde of iron, with a very small proportion of alkali, where this may not be supposed to exist already in the clay employed.

From the description of the *cancars* employed as limestones in the interior of India, I was led to suspect, that they might readily be converted into hydraulic cements. Like the Sheppey *tufa*, they are found in hard nodules, and consist of sand or clay, intimately united by calcareous cement. Such *cancars*, especially as will not slake after calcination, of which many examples are given in Mr. J. Prinsep's tables, and which contain from 60 to 70 per cent. of carbonate of lime, seemed peculiarly adapted for the purpose, as their composition would obviate the cost of pounding and mixing the ingredients before calcination.

My own experiments have hitherto been confined to the following specimens :—

1. A species of small nodular *cancar*, of a dark colour, is found in the Salt Water lake, consisting of about equal parts of lime and ferruginous clay, with probably a good deal of decomposed vegetable matter. This I found, on trial, to constitute, of itself, a very perfect puzzolana, hardening rapidly under water.

2. A mixture of one-fourth of chalk, well pounded up with the above *cancar*, also yielded a very good cement, but not quite so hard.

3. The Burdwan *cancar* contains a much larger proportion of lime, from 65 to 75 per cent. : it is, therefore, too rich, by itself, to form a good cement, but with the addition of one-fourth of blue clay, it answers perfectly well.

4. The slaked lime of Sylhet, as brought to the Calcutta market, worked up with clay, in the proportions of 2 to 1, made into balls, and kilned, answers perfectly, though it does not become quite so hard as the preceding : it seems probable, that this lime may contain a little alkali, from the wood with which it was originally burned.

The clay used in the above experiments, was dug up from a few feet under the ground; it is of a blueish colour; and seems well adapted for the purpose : it is impossible for a clay to be too plastic; and when it contains much sand, it is needless to expect a good result; perhaps, therefore, the up-country *cancars*, called red nodular, and stony, in Mr. Prinsep's list, the alloy of which is of a much more sandy nature, may not be suited for hydraulic purposes. But I am informed, that there is another species of flat *cancar*, formed at the bottom of *jhils*, which is more clayey, and may, probably, succeed well; I am told also, that the latter is generally preferred by native builders, for under-water work, either alone, or mixed up with a *surki* made of half burned lumps of clay, pounded.

I have not yet been able to procure specimens of these *cancars*, but hope in a short time to obtain them : at any rate the process I have described is so simple, that it will enable any one engaged in building to experimentalize on such materials, as may be within his reach, and to provide himself, at pleasure, with a mortar fit for any under-water masonry.

VI.—*On the Longitude of Dihli. By Major* T. Oliver, *3d Regt., Ben. Nat. Inf.*

The method of lunar transits is now generally considered to be one of the best means of determining terrestrial longitudes. Its principal advantage is the frequency of occurrence of the phenomenon on which it depends; thereby allowing a multiplication of observations to any desirable extent, so as to reduce the unavoidable errors of observation to a mean value. The chief disadvantage under which it labours, is the moon's slowness of motion, which is such, that any error in the time of observation is multiplied 24 fold in the resulting longitude. To ensure the utmost accuracy of which it is susceptible, the observations should be compared with those made under another wellknown meridian, which, as far at least as observations in Europe are concerned, are seldom accessible for years after they have been made.

We hope that those of our readers who have it in their power will comply with the request made by the writer of the following letter, to communicate any corresponding observations made in India :—

To the Editor of Gleanings in Science.

Sir,

I do myself the pleasure of sending for insertion in your valuable *Gleanings*, an abstract of some observations of lunar transits and occultations of stars, made with the view of determining the longitude of Dihli.

The lunar transits were all observed at Gúrgáon, which has been determined by survey to be 48 seconds of time, west of the *Jama Mesjid* at Dihli. The instrument is a most excellent one for its size, made to my particular order, by Dollond, of 30 inches focal length, and the power I have always used is 60, which it bears remarkably well. My chronometer is an eight-day one, by Barraud, and although not perhaps quite equal to those made now-a-days, yet as the time has always been determined by Stars culminating at no very great intervals from the Moon, I consider it may well be depended on.

I shall feel much obliged to any of your Astronomical friends who will furnish corresponding observations of any of the lunar transits, noting the time of passage of any stars not differing in declination from the Moon more than 10° or 15° : I shall then give mine also for such particular periods.

It may well be supposed, that my calculations are not free from errors ; I have, therefore, given the means of detecting them, should any person feel disposed (as I hope some one may) to recalculate the observations. The sidereal time of the passage of the Moon's limb over the meridian is all that is required ; if it be taken for granted, that I am right thus far, (and I am prepared to furnish all particulars, if called upon to do so,) I cannot perceive how the results should be otherwise than correct. Regarding the time, I have been very minute and particular, and I do not think I can have committed any error here ; but for the rest of the calculations I do confess that I have not always had quite so much patience as they require. To prevent any misconception regarding the dates where the Moon's second limb is concerned, it may be as well to say, that I use the common civil reckoning as to the day of the month : for instance, the transit of the Moon's second limb, on Dec. 17th, 1829, was observed on the morning of the 17th, before noon, therefore, on the 16th, astronomically speaking.

The occultations were observed at various places within about 50 or 60 miles from Dihli, and the results reduced to the *Jama Mesjid ;* the differences of longitude being deduced from the survey I was then conducting. The greater part of these observations having been made in camp, where I could not have the advantage of a transit instrument for determining the time, I was obliged to have recourse to equal altitudes of the Sun, and as I could not always get these on the day immediately before and after the occultation, the rate of the chronometer has sometimes been depended on rather more than could be wished. The results, however, (with only two exceptions, marked doubtful in the list, and which I should be inclined to reject, only that I think it the fairest way to give all the observations,) will, I hope, be found to agree as closely as could be expected.

It can hardly be necessary, I should suppose, to enter into any detail of the method of calculation I have adopted in my transit observations or occultations ; but should you, or any of your correspondents wish it, I shall be happy to send you a *Type du Calcul* of each sort, complete in all the details.

Lunar Transits observed at Gúrgáon.

Moon's 1st limb.			Moon's 2d limb.		
Date.	Sidereal Time of passage.	Longitude deduced.	Date.	Sidereal Time of passage.	Longitude deduced.
1828.	h. m. s.	h. m. s.	1828.	h. m. s.	h. m. s.
June 23	14 22 33,7	08 39	July 31	0 11 31,0	5 08 17
24	15 20 19,0	08 19	Aug. 30	2 33 09,0	08 05
July 20	13 59 53,8	08 21	31	3 28 08,4	08 01
25	19 03 38,9	08 19	Sept. 28	3 59 01,0	07 51
Aug. 14	12 04 30,6	08 39	29	4 54 21,0	07 54
22	19 35 49,9	08 19	30	5 48 34,8	07 34
Sept. 13	14 18 45,6	08 19	Oct. 1	6 41 24,4	07 52
17	18 07 31,2	08 24	2	7 32 44,7	07 55
1829. 19	20 10 47,7	08 16	1829. 3	8 22 38,5	07 54
June 10	11 59 36,4	08 10	Oct. 18	6 23 12,7	08 07
14	15 18 06,2	08 16	19	7 19 00,8	08 09
Aug. 7	14 33 29,0	07 49	20	8 12 20,4	08 16
8	15 24 44,0	08 12	21	9 03 18,7	07 51
Oct. 2	15 40 38,4	08 32	Nov. 16	7 50 03.5	07 58
4	17 28 16,7	08 21	17	8 43 12,7	08 07
5	18 24 54,0	08 08	18	9 33 45,9	08 21
31	17 11 22,4	08 26	19	10 22 14,2	07 57
Nov. 1	18 07 19,1	08 27	21	11 55 34,0	08 03
2	19 04 17,6	08 12	22	12 41 54,7	08 01
3	20 01 44,5	08 11	23	13 28 59,6	08 02
5	21 56 38,2	08 10	Dec. 17	10 50 22,8	07 52
29	18 46 45,3	08 27	19	12 23 26,0	08 06
30	19 44 42,2	08 22	20	13 09 54,9	08 08
Dec. 2	21 39 17,0	08 17	21	13 57 24,2	08 05
3	22 35 31,8	08 12	1830. 22	14 46 36,0	08 00
4	23 31 23,8	08 21	Mar. 17	17 09 04,3	08 11
5	0 27 26,1	08 23	19	19 00 17,7	08 02
30	22 18 56,3	08 21			
1830. 31	23 15 18,3	08 12	Mean of 2d Limb.	=	5 08 02
Jan. 30	1 46 15,7	08 14	Mean of 1st Limb.	=	5 08 18
31	2 43 14,6	08 09			
March 1	4 20 50,7	08 17	Mean of both limbs	=	5 08 10
			Dihli from Gúrgaon.	=	+ 48
Mean,		5 08 18	Longitude of Dihli.	=	5 08 58

Observed Occultations.

Date.	True Lat. of place of observn.	Long. from Dihli.	Star Occulted.	Apparent time of observation.	Longitude deduced.	Longitude of Dihli.
	° ′ ″	m. s.		h. m. s.	h. m. s.	h. m. s.
1825. April 7	28 47 40	— 0 24	Ophiuchi,..	Em. 13. 42. 05	5. 08. 22	5. 08. 45
Dec. 21	29 06 38	— 1 09	Arietis,....	Im. 12 43 05	07 45	08 46
1828. Jan. 11	29 27 00	— 1 32	α^2 Libræ, ...	Im. 17 07 35	07 25	08 57
March 2	29 33 12	— 1 23	υ Leonis, ...	Im. 7 50 12	07 18	08 41
. .. ..	....	....	Ditto, ...	Em. 9 00 12	07 44	09 07
April 14	29 22 10	— 0 43	Solar Eclipse,	Im. 2 37 23	08 18	09 01
.. .. ..	....	....	....	Em. 5 11 17	08 17	09 00
Mar. 26	....	....	α^2 Cancri, ..	Im. 8 21 00	08 30	09 13
Sept. 19	28 27 30	— 0 48	[1] Capricorni,	Im. 7 39 40	07 31	08 19
1829. Jan. 12	28 14 39	— 0 39	o Piscium, ..	Im. 6 30 12	08 20	08 59
....	....	....	δ	Em. 7 42 48	08 11	08 50
15	....	....	$_2$ Tauri, ...	Im. 5 30 45	07 19	07 58
April 8	28 04 33	+ 0 23	No. 651[1]	Im. 9 11 02	09 22	08 59
10	....	....	No. 898	Im. 11 25 50	09 16	08 53
Nov. 2	28 27 30	— 0 48	No. 2248	Im. 8 05 37	08 04	08 55
Dec. 10	....	....	No. 651	Im. 7 34 55	08 07	08 52
1830. Mar. 1	....	....	α Tauri,....	Im. 7 40 22	08 10	08 58
....	....	....	....	Em. 8 52 28	08 17	09 05

[1] The numbers refer to the Catalogue of the London Astronomical Society.

Mean of the whole,		5	08	52	
Mean, rejecting the two doubtful ones,		5	08	57	
		h.	m.	s.	
Longitude of Dehli, by Lunar Transits,	=	5	08	58	
Ditto, by Occultations,	=			52	
Ditto, mean of the whole,	=	5	08	55	= 77° 13′ 45″

Places of observation. Alipúr, Purkhás, Bál, Gassínah, Ch'hájpúr of Gúrgáon Sónah, Phulwári, Gurgáon.

VII.—*Miscellaneous Notices.*

1.—*Contributions to Zoological Society.*

We are happy to make known the following extract from a letter from N. Vigers, Esq. Secretary to the Zoological Society of London, to his correspondent in Calcutta, and doubt not that those of our readers who have an opportunity, will be happy to aid the Society in the way indicated.

" We should be very glad to pay the expenses of any of the animals of India, which you could send us alive, more particularly the cassowary, gigantic or other cranes, custards, or any other of the gallinaceous birds ; the antilopes and deer, except among the latter what are called the *sumboo* and the *axis*, of both of which we have abundance in this country. Among the gallinaceous birds I would particularize the pheasants, such as the Impeyan, the horned pheasant, and the Fire-backe, as particularly acceptable, and also the jungle-fowl, male and female."

Note on the Article on Value.

The following note was received too late to be inserted in its place; we therefore print it here for the information of those who have read the paper on Value.

On referring to the article on Mr. Ricardo's theory of wealth and value, which appeared in the November number, in connexion with what has been given above, and indeed with Mr. Ricardo's work itself, I find that I ought not, strictly speaking, to have attributed to him, the denial of the existence of positive value ; for this he now here verbally does. He does so, however, by implications ; for he entirely loses sight of it, and reasons as if none but relative value were in being ; otherwise, he could not attain the conclusion on which he grounds all that is peculiar in his doctrines. As it was not the direct verbal admissions, but the whole tenor of the argument which occupied my mind in writing that article, I naturally attributed to him what his reasonings implied ; but as this opens a door to such objections as those would be apt to raise, who are imperfectly acquainted with the subject, and who can perceive, more readily, the words employed therein than the drift of an argument, I should wish the reader to consider the subject as if I attributed to Mr. Ricardo the denial of the influence of positive value, and not the denial of its existence in the article in question.—The matter is of no real importance, further than that it may afford a handle to the critic whereby attention may be wrested from the main question, and fixed on what is trivial, and of no moment.

VIII.—*Proceedings of Societies.*

1.—Asiatic Society.

Wednesday, the 2d February.

The Reverend Mr. Withers and Mr. Mendes were elected Members. The meeting then proceeded to ballot for Vice-Presidents, when the following were elected :—

Sir E. Ryan ; Sir J. Franks ; Sir C. Metcalfe, and the Lord Bishop.

After which, the Committee of Papers were elected as following :

Mr. Calder ; the Reverend Dr. Carey ; Major Everest ; Captain Herbert ; Mr. Grant ; The Reverend Principal Mill ; Mr. J. Prinsep ; Mr. J. Tytler ; and Mr. J. Thomason.

The following donations and communications were then submitted : The scull and horns of the wild cow of Tenasserim, presented by Mr. Bayley, with a descriptive note by Mr. Maingy ; by which it appears that, when full grown, it is about thirteen hands high, and of a most beautiful red colour, except under the belly, which is white. It has no hump, like the cow of India. Altogether it resembles the red cow of England, but is a much handsomer animal. The bull is a large and fine animal, and with the exception of having a white forehead, resembles the cow. Mr. Maingy has seen twenty or more of the animals in a herd, but it is a most difficult thing to get a shot at them, as they have a most acute sense of hearing and smelling ; one or two appear to act as sentinels, while the others graze or drink. If in snuffing the air, they find it tainted, off they fly in a moment, with a speed almost inconceivable, considering the form and bulk of the animal. The hunters say that it is impossible to take one of the full grown ones alive, although sometimes they manage to capture a young one—first killing the dam. A dried fish, by Baboo Ramcomul Sen. Read a letter from Dr. Macculloch, accompanying his work on the Aborigines of America. The Transactions of the Royal Society, part 1, for 1830—and of the Linnæan Society, 15th vol. part 2—presented by these Associations. The Journal Asiatique, No 1—as also presentation copies of works from Von Hammer, Schlegel, &c. A description of the shells of the genus Unio, found in America, presented on behalf of the author, by the Revd. Dr. Carey. Dr. Tytler submitted to the meeting some illustrative drawings and remarks on the Esdrean Eagle of Scripture.

2.—Medical and Physical Society.

Saturday, the 5th February.

Messrs. Jackson, Brien, Laing and Falconer were elected Members. The following communications were laid before the Meeting : A letter from Mr. Preston, of Cuddalore, with a paper on ligature of the common carotid artery in Palsy, and a case of the disease so treated ; a statement relative to Vaccination in Bengal, by Mr. W. Cameron.

Dr. Fontaine's Essay on Scorbutus, and his remarks on Vomiting ; Rajah Cali-Cissen's letter on *Gentiana Cheraytta ;* Mr. Lowther's case of fish bone removed from the gullet by an operation. Mr. Rogers' case of Hydrophobia, and Mr. Boswell's paper on the utility of blisters of Lunar Caustic, in pulmonary consumption, were then read and discussed.

After noticing the division of Scorbutus into land and sea scurvy, M. Fontaine defines the disease to consist of great muscular debility, with a discharge of blood more or less considerable, as the case may be, from the capillary vessels, caused by a great change in the vitality and chemical composition of the blood. M. Fontaine, in stating the Etiology of the disease, offers nothing new. He divides the symptoms into three periods, deepening in intensity, until death closes the scene. In the treatment. M. Fontaine does not differ from that usually prescribed by British practitioners, both as respects the physical and moral condition of the patient. In the administration of purgatives, he recommends great caution with reference to their tendency of increasing debility. Wine, cordials, and bitters, &c. properly administered, are productive of beneficial effects in the latter stage of the complaint. Acid gargles are to be given freely—and where the hemorrhage and bowel complaint are considerable, the mineral acids, and astringent vegetable substances, as Kino, Rhatany root, &c. He recommends for relieving the pains in the limbs, the application of a roller, with frictions and aromatic fomentations.

In his communication on the *Gentiana Cheraytta*, after noticing that it is known in Sanscrit by eight synonymes, Rajah Cali Cissen states, that the plant is very frequently used by the Hindoos, but in some instances, grounded on a theory entirely Native, such as its increasing the *air* of the body—for, like their European colleagues of the olden time, Native physiologists have it, that the human body is formed of five elements, viz. earth, water, air, ether, and light or energy. Indeed the probability is, that this theory is originally purely Asiatic, whence it extended to Greece, &c. We are further told that the *Cheraytta* is an anti-bilious remedy, as well as a febrifuge. It is prescribed in the form of cold infusion, to be taken in the morning.

The case of a bone sticking in the gullet, where it remained firmly impacted, until removed by operation, is interesting in more points of view than one. Up to a very recent period, wounds of the Œsophagus were deemed mortal. The case before us is, among several, a happy illustration of the contrary, as well as of the beneficial effects of presence of mind, on occasions urgently demanding its exercise. The patient in this case was Mr. Dodsworth, a young gentleman, about seventeen years of age, who, while breakfasting upon fish and rice, on the 27th of November last, swallowed a bone, which stuck cross-wise in the gullet. During the whole of that day, and succeeding night, he suffered severe pain, and in consequence of having swallowed some tough meat, in the hopes of forcing the bone into the stomach, an opposite effect had been produced, the sharp point having been forced deeper into the throat. Mr. Lowther (Collector of Boolundshuher,) received a note on the following day, representing the condition of his young friend. On examination, he found that the point of the bone had protruded through the gullet " into the fleshy part of the left front of the neck. As surgical aid was not within reach, and as the accident had now been of thirty-two hours standing, Mr. L. felt that no time was to be lost. Backed, therefore, by the concurrence of a friend, respecting the expediency of making an incision externally, in order to extract the foreign body—he proposed the measure to the patient, who readily consented. Mr. L. accordingly procured a bistory, with which he made an incision down to the point of the bone, and in the course of two or three minutes, with the assistance of Mr. Ewer, extracted the bone with a forceps, to the great relief of the patient. The extracted body was the rib bone of a small sized Rooe, and in its curved form measured about an inch and a quarter. Adhesive plaster was applied to the wound—and opening medicine, with slop diet, prescribed. In four days the wound healed by the first intention. We need scarcely advert to the highly creditable degree of decision evinced on the occasion.

Mr. Rogers's case of Hydrophobia, was in a Sepoy. The disease, which had the usual characteristics, appeared some three months after the man's being bitten by a dog in the upper part of the left leg. He was a patient in hospital at the time, and after a slight effusion of blood, lunar caustic was immediately applied, and repeated occasionally for two days. The wound was very small, and healed suddenly. The appearance of the bitten part, when the Hydrophobic symptoms first manifested themselves, is described as of a small cicatrix on the outer side of the left leg, about two inches below the head of the smaller bone (fibula), slightly elevated above the level of the skin. There was no appearance of inflammation or ulceration, and pressure was allowed without occasioning any uneasiness. The patient expired three days after admission.

Mr. Boswell's favourable opinion of the counter-irritative powers of Lunar Caustic blisters, in pulmonary and other affections, is supported, he states, by that of his brother, who also made repeated trials of the remedy. After full depletion in the first stages of Pneumonia (inflammation of the lungs), and in confirmed Pthisis (consumption), he has applied the lunar caustic, as a blister, of about two inches square, to the chest every morning and evening, exhibiting, at the same time, a dram of Paregoric Elixir at bed time, and giving five grains of Squill pill three or four times a day. The effect of such treatment, he states, is almost instantaneous. The fluid is discharged in about three hours after the application of the caustic, by small punctures—and in three days, let the application be repeated in the same place, if necessary. Mr. Boswell has put on more than thirty blisters in the course of cure—making the intervals longer or shorter, as the case required. In Rheumatism and Paralysis, the application has been followed by evident benefit. In Dysentery, he always uses it as a valuable adjuvant. It has great effect, as a stimulant, in restoring the energies of the system. The advantages which it possesses over Cantharides, appear to be, that its action is more immediate and more powerful. It is always available, easy of application, and requires no dressing.

Meteorological Register kept at the Surveyor General's Office, Calcutta, for the Month of January, 1831.

Day of the Month.	Minimum Temperature observed at Sunrise.					Maximum Pressure observed at 9h. 40m.					Observations made at apparent Noon.					Max. Temp. and Dep. of M.B.Ther. obs. at 2h. 40m					Minimum Pressure observed at 4h. 0m.					Observations made at Sunset.				
	Barometer reduced to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the Air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°	Temper. of the Air	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the Air.	Depres. of M.B Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.
1	29,983	54,3	2,2	cm.	cl.	,037	65,4	7,8	cm.	cl.	,992	71,5	11,5	n.w.	cl.											,929	66,5	8,4	cm.	cl.
2	30,002	53,7	2,6	do.	do.										do.															
3	29,982	54,8	0,4	n.w.	do.	,932	67,	8,6	n.w	do.	,996	73,	14,6	do.	do.	,935	75,3	18,6	n.w.	cl.	,927	75,3	19,6	n.w.	cl.	,941	67,	9,3	n.w.	do.
4	30,012	53,3	3,4	do.	do.	,060	67,3	11,1	do.	do.	,010	73,3	16,9	do.	do.	,947	76,	17,3	do.	do.	,944	74,6	18,6	do.	do.	,951	69,8	12,6	do.	do.
5	,012	56,3	1,4	cm.	do.	,064	66,6	9,2	cm.	do.	,025	73,5	14,8	do.	do.	,947	76,6	15,9	do.	do.	,940	75,6	15,9	do.	do.	,946	70,5	2,4	cm.	do.
6	,010	59,	7,6	do.	do.	,062	67,6	10,9	n.w.	do.	,023	75,5	16,4	do.	do.	,952	77,8	17,6	do.	do.	,950	76,5	16,3	do.	do.	,961	70,7	10,5	do.	do.
7	,042	57,	5,1	do.	do.	,089	68,	9,6	cm.	do.	,034	74,8	17,1	do.	do.	,990	76,7	17,0	do.	do.	,992	75,6	15,9	do.	do.	,001	70,	10,9	do.	do.
8	,098	56,	4,6	do.	do.	,111	66,5	11,1	do.	do.	,095	72,3	17,3	do.	do.	,044	75,6	18,9	do.	do.	,028	74,6	18,9	do.	do.	,044	70,	12,8	n.w.	do.
9	,132	55,	6,6	do.	do.	,194	64,5	9,1	n.w.	do.	,133	76,5	14,1	do.	do.	,080	77,	11,6	do.	do.	,079	74,	15,1	do.	do.	,084	69,	13,6	cm.	do.
10	,177	54,5	1,6	n.w.	do.	,219	65,5	5,1	do.	do.	,176	73,5	11,6	do.	do.	,121	75,3	12,9	do.	do.	,114	75,	14,3	do.	do.	,120	69,	6,1	do.	do.
11	,134	56,7	4,8	cm.	do.	,191	65,6	7,2	cm.	do.	,149	74,3	11,9	n.	do	,078	75,7	12,8	n.	do.	,073	75,3	11,9	n.	do.	,078	70,5	7,6	n.	do.
12	,152	58,	2,6	do.	do.	,178	69,	9,6	n.	do.	,126	75,6	13,3	do.	do.	,078	76,8	13,4	do.	do.	,078	76,3	13,4	do.	do.	,088	72,5	9,6	do.	do.
13	,140	58,	4,6	do.	do.	,177	69,8	10,7	n.w.	do.	,132	75,	12,3	n.w.	do.	,049	78,3	14,1	n.w.	do.	,048	76,5	13,3	n.w.	do.	,056	71,7	8,8	n.w.	do.
14	,177	60,	4,6	n.w.	do.	,214	70,3	9,9	do.	do.	,167	76,7	16,0	do.	do.	,111	78,3	13,9	do.	do.	,104	76,8	13,4	cm.	do.	,115	70,5	6,6	cm	do.
15	,174	57,	1,6	cm.	do.	,214	68,	7,3	cm.	do.	,158	77,	14,3	cm.	do.	,101	78,	14,1	do.	do.	,091	76,8	13,6	n.w	do.	,102	70,7	7,3	do.	do.
16	,149	56,	1,1	do.	do.	,171	68,5	8,1	n.w.	do.	,119	77,	12,6	n.w.	do.	,061	77,5	13,1	do.	do.	,064	77,	12,9	do.	do.	,072	70,5	6,1	do.	do.
17	,149	59,	1,1	do.	do.	,173	70,	7,6	cm.	do.	,127	77,	12,3	cm.	do.	,054	78,	13,0	do.	do.	,047	77,3	11,9	do	do.	,055	71,	6,1	do.	do.
18	,119	59,	1,6	do.	do.	,139	69,8	6,9	n.w.	do.	,092	76,5	11,5	do.	do.	,033	79,	13,0	do.	do.	,023	78,3	12,3	do.	do.	,028	72,5	7,1	do.	do.
19	,101	59,	0,6	do.	fg.	,127	71,5	6,3	do.	do.	,070	76,8	11,4	n.	do.	,994	79,8	11,4	do.	do.	,996	78,	10,6	do.	do.	,008	70,5	4,6	do.	do.
20	,047	58,5	1,8	do.	do.	,085	70,	3,0	do.	do.	,992	76,3	8,4	n.w.	do.	,983	79,5	10,5	do.	cu.	,965	78,5	10,6	do.	do.	,995	72,3	4,9	do.	do.
21	,060	62,	0,6	do.	cl.	,087	71,	2,6	s. w.	do.	,058	74,	4,1	cm.	do.	,976	79,8	7,8	do.	do.	,953	79,	7,3	do.	do.	,981	65,	1,6	do.	do.
22	,062	62,	1,6	do.	do.	,099	74,3	4,1	n.w.	do.	,067	77,3	7,9	s. w.	do.						,987	79,5	8,8	s. w.	do.	,005	75,	5,6	do.	do.
23	,107	62,7	0,8	do.	do.	,147	74,	5,6	s. e.	do.	,062	78,	7,6	n.w.	do.	,023	81,	9,6	do.	cl.	,017	80,	8,6	n.w.	cu	,026	76,3	5,2	do.	do.
24	,117	62,	2,6	n. e.	do.	,146	72,8	7,1	n. e.	do.	,094	79,3	11,9	n. e.	do.	,027	80,	14,3	n. e.	cu.	,015	79,5	13,8	n. e.	do.	,039	75,5	10,1	do.	do.
25	,115	58,5	2,1	cm.	do.	,155	72,5	11,8	do.	do.	,121	78,2	15,5	do.	do.	,046	80,5	15,6	do.	cl.	,033	78,8	14,1	do.	cl.	,066	66,	3,6	do.	do.
26	,102	58,	0,6	do.	do.	,142	70,7	7,3	cm.	do.	,086	77,3	13,2	do.	do.	,016	78,8	15,4	n.w.	do.	,004	78,3	14,4	n.w.	do.	,008	74,5	6,1	do.	do.
27	,062	62,5	4,1	do.	do.	,084	72,	9,3	n.w.	do.	,046	78,8	14,6	do.	do.	,968	79,8	16,1	n. e.	do.	,949	79,	15,6	n. e.	do.	,946	73,	8,6	do.	do.
28	,011	57,5	1,1	do.	do.	,063	74,3	9,9	n. e.	do.	,037	78,3	15,4	n.w.	do.	,970	80,2	15,8	w.	do.	,966	79,4	13,5	w.	do.	,981	72,	5,6	do.	do.
29	,035	56,5	0,6	do.	do.	,080	72,	11,3	do.	do.	,046	78,6	14,0	n. e.	do.	,084	81,	16,6	n. e.	do.	,967	79,6	15,9	n.w.	do.	,978	75,	7,1	do.	do.
30	,043	57,	0,6	do.	do.	,077	75,5	13,1	do.	do.	,035	79,	15,6	do.	do.	,964	82,	17,9	do.	do.	,943	80,7	15,7	n. e.	do.	,968	73,7	8,3	do.	do.
31	29,996	58,8	2,0	do.	ci.	,036	73,5	8,9	do.	do.	,982	80,3	15,6	do.	do.	,910	82,3	17,3	do.	ci.	,884	81,5	15,1	do.	ci.	,899	72,5	3,6	do.	do.
Mean,	30,081	57,8	2,5			1,22	69,8	8,3			,075	76,2	13,1			,019	78,3	14,5			,016	77,5	13,8			,016	71,1	7,4		

Abbreviations. In the column "wind," small letters have been used instead of capitals; *cm.* means *calm.* In the column "Aspect of the sky," *cy.* is *cloudy*; *cl. clear*; *rn. rain*; *ci. cirrus*; *cu. cumulus*; *cs. cirro-stratus*; *cus. cumulo-stratus*; *cc. cirro-cumulus*; *n. nimbus.* During this month no rain fell.

Meteorological Register kept at the Surveyor General's Office, Calcutta, for the Month of February, 1831.

Day of the Month.	Minimum Temperature observed at Sunrise. Barometer reduced to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Maximum Pressure observed at 9h. 40m. Barom. red. to 32°.	Temper. of the Air.	Depres. of M B.Ther.	Wind.	Aspect of the sky.
1	29,968	58,	0,6	cm.	cl.	,008	69,8	8,9	n.w.	cl.
2	,930	63,5	1,1	s.w.	ci.	,976	72,6	5,2	s.w.	ci.
3	,911	65,7	1,3	do.	do.	,955	70,5	4,3	do.	cis.
4	,948	63,	1,6	cm.	cl.	,992	76,3	10,6	n.	cl.
5	,952	68,3	0,4	do.	do.	,993	74,5	3,6	s.w.	cu.
6	,923	69,5	0,4	do.	do.	,976	77,7	2,7	n.w.	cl.
7	,924	67,5	0,1	do.	do.	,971	75,5	3,6	cm.	do.
8	,006	69,	2,6	n.	n.	,027	73,	4,3	n.	cus.
9	,957	68,	1,6	cm.	cl.	,022	76,	6,3	s. w.	cl.
10	,912	66,5	2,1	w.	do.	,960	76,3	5,6	w.	do.
11	,946	65,	7,6	n.	do.	,011	70,	13,6	n.	do.
12	,984	59,	3,9	n.e.	do.	,034	72,6	15,4	n. e.	do.
13	,969	65,	4,1	cm.	cu.	,000	73,5	8,6	do.	cus.
14	,940	62,	3,6	n.e.	do.	,987	70,6	7,9	do.	ci.
15	,993	66,3	1,6	do.	do.	,031	76,	6,8	do.	cl.
16	,952	65,3	2,2	cm.	do.	,007	67,7	2,1	do.	cis.
17	,980	58,5	2,1	n.e.	do.	,027	66,8	6,9	do.	cus.
18	,985	62,	3,6	do.	do.	,038	66,3	6,4	do.	do.
19	,040	65,	4,1	do.	n.	,046	68,5	6,8	do.	do.
20	,004	62,5	2,1	do.	cus.	,001	71,5	6,1	do.	do.
21	,996	64,	0,1	cm.	n.	,026	68,5	1,8	cm.	cy.
22	,989	73,5	0,6	do.	cy.	,022	77,6	2,6	do.	cus.
23	,965	75,	0,6	n.w.	cus.	,990	79,5	4,1	n.w.	do.
24	,938	69,7	0,3	n.e.	n.	,016	72,3	1,6	n.e.	cis.
25	,015	68,	1,1	n.w.	do.	,072	70,3	2,6	n.w.	do.
26	,088	61,	6,6	cm.	cl.	,129	67,6	10,7	do.	cl.
27	,122	61,7	9,6	do.	cu.	,159	67,5	11,8	do.	cis.
28	,079	62,	7,1	do.	cis.	,120	66,3	13,1	do.	do.
Mean,	29,979	65,2	2,6			,021	72,	6,6		

Day of the Month.	Observations made at apparent Noon. Barom. red. to 32°	Temper. of the Air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Max. Temp. and Dep. of M.B.Ther. obs. at 2h. 40m. Barom. red. to 32°.	Temper. of the Air.	Depres of M.B.Ther.	Wind.	Aspect of the sky.
1	,962	79,2	14,6	n.w.	cl.	,886	82,	16,	n.w.	cl.
2	,943	79,5	11,8	s.w.	ci.	,873	82,5	12,8	s.	ci.
3	,916	80,2	12,8	do.	cl.	,860	71,8	5,1	s. w.	cis.
4	,958	81,8	13,4	n. -	do.	,879	85,5	15,6	do.	cu.
5	,950	81,6	7,9	s. w.	cu.	,874	85,5	11,3	n.w.	do.
6	,916	86,5	4,6	n.w.	cl.	,818	88,3	10,9	s. w.	ci.
7	,925	82,5	13,8	n.e.	do.	,867	87,2	14,8	cm.	cl.
8	,003	74,	4,6	n.	n.	,919	78,8	8,1	n. e.	cus.
9	,998	79,5	8,5	s.w.	cus.	,898	85,	11,3	s.w.	cu.
10	,926	82,3	9,9	w.	cl.	,842	86,3	13,1	w.	cl.
11	,982	76,	18,3	n.w.	do.	,906	78,6	18,2	n.w.	do.
12	,994	79,8	19,6	n.e.	do.	,906	81,6	17,7	n.e.	do.
13	,986	72,	9,6	do.	n.	,924	69,	8,6	do.	cus.
14	,939	72,	7,	do.	cy.	,855	77,8	8,1	do.	cu.
15	,965	80,5	9,1	do.	cus.	,863	80,5	8,1	do.	do.
16	,962	74,	5,1	do.	cis.	,871	79,	8,9	do.	do.
17	,008	69,3	8,9	do.	cus.	,938	70,6	8,6	do.	cus.
18	,025	68,	6,3	do.	do.	,975	69,3	6,6	cm.	do.
19	,019	72,6	8,9	do.	do.	,975	72,5	9,8	n.e.	cis.
20	,969	73,	6,6	do.	n.	,919	75,	7,1	do.	rn.
21	,975	75,8	4,6	cm.	cus.	,915	75,3	3,8	n.	cus.
22	,973	81,5	4,3	n.w.	do.	,931	82,3	5,4	n.w.	do.
23	,959	84,6	6,9	do.	do.	,837	82,3	5,6	do.	n.
24	,968	78,8	6,4	n.e.	cu.	,918	80,5	7,3	n.e.	cu.
25	,035	73,8	5,9	n.w.	do.	,009	72,3	5,4	n.w.	cus
26	,110	71,5	12,1	do.	cis.	,047	74,8	14,1	do.	cl.
27	,124	70,3	10,4	cm.	do	,074	73,5	12,1	do.	cis.
28	,097	68,3	12,6	n.w.	cu	,038	70,3	13,3	do.	cu.
Mean,	,986	6,7	9,4			,915	78,5	10,3		

Day of the Month.	Minimum Pressure observed at 4h. 0m. Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Observations made at Sunset. Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Rain gauge No. 1.	Rain gauge No. 2.
1	,880	80,8	15,4	n.w.	cl.	,883	73,7	7,3	cm.	cl.		
2	,854	81,6	11,4	s.	ci.	,867	76,7	7,8	do.	ci.		
3	,839	82,3	14,7	s. w.	cl.	,855	76,5	7,1	do.	el.		
4	,866	85,	15,3	do.	cu.	,877	78,	3,1	s. w.	ci.		
5	,860	84,6	12,9	n.w.	do.	,864	80,5	10,1	cm.	ci.		
6	,805	86,5	7,6	s.w.	ci.	,800	80,5	7,6	do.	ci.		
7	,844	86,8	13,8	cm.	cl.	,868	81,7	9,8	do.	cl.		
8	,904	77,5	6,5	n.e.	cus.	,922	76,	3,6	do.	do.		
9	,880	81,6	11,7	cm.	cl.	,870	77,7	5,	do.	do.	0,30	0,28
10	,820	85,3	12,4	do.	do.	,824	82,	9,1	do.	do.		
11	,881	77,	16,9	n.	do.	,889	72,5	9,6	do.	do.		
12	,901	80,	15,1	n.e.	do.	,922	77,7	14,3	do.	do.		
13	,918	68,5	8,6	do.	cus.	,936	67,	7,	do.	cus.		
14	,854	77,3	7,6	do.	do.	,867	73,7	5,	n.e.	cis.		
15	,836	80,6	7,9	do.	ci.	,843	78,5	7,4	do.	ci.		
16	,846	77,3	7,6	do.	cu.	,868	72,6	3,5	cm.	cu.		
17	,940	67,	4,3	cm.	rn.	,950	65,	2,6	n.e.	cus.		
18	,943	69,	5,3	do.	cus.	,947	66,5	8,6	cm.	cis.		
19	,946	70,9	8,0	n.	cis.	,958	68,3	5,9	n.	do.		
20	,917	72,5	4,6	n.e.	cus.	,936	69,7	3,	cm.	cus.		
21	,913	74,3	2,3	n.	cu.	,935	72,5	2,1	n.	cu.		
22	,903	81,6	4,6	n.w.	cis.	,920	79,	3,6	n.w.	cus.	0,76	0,64
23	,841	78,3	2,2	do.	rn.	,877	75,3	4,9	cm.	n.	0,54	0,50
24	,906	78,3	4,8	n.e.	cu.	,905	74,5	2,6	do.	cus.		
25	,005	72,3	5,9	n.w.	cis.	,038	71,5	5,1	n.w.	cis.		
26	,035	74,3	13,3	do.	cu.	,008	69,	8,1	cm.	cu.		
27	,040	72,	11,6	do.	cis.	,060	69,7	8,7	do.	cis.		
28	,020	70,	12,3	do.	do.	,032	67,8	10,4	do.	do.		
Mean,	,900	77,8	9,4			,915	74,	6,5			1,60	1,42

Abbreviations. In the column " wind," small letters have been used instead of capitals ; *cm.* means *calm*. In the column " Aspect of the sky, *cy.* is *cloudy* ; *cl. clear* ; *rn. rain* ; *ci. cirrus* ; *cu. cumulus* ; *cs. cirro-stratus* ; *cus. cumulo-stratus* ; *cc. cirro-cumulus* ; *n. nimbus*. The Rain-guage No. 1, is on the ground : No. 2 is on the roof of the house, 45 feet above it.

GLEANINGS

IN

SCIENCE.

No. 27.—*March*, 1831.

I.—*Observations upon the natural Water Cements of England, and on the artificial Cements that may be used as substitutes for them. By* C. W. Pasley, *Lieut. Col. in the Corps of Royal Engineers,* F. R. S., &c.

[From a pamphlet published by authority in England.]

INTRODUCTION.

In 1826, in consequence of having received directions the year before, that Practical Architecture was, in future, to form a part of the course of instruction for the Junior Officers of the Corps of Royal Engineers attending this Establishment; I was induced, whilst investigating the general properties of limes and cements, to try a great number of experiments, in hopes of obtaining an artificial water cement from chalk and clay, all of which failed; owing to the neglect of a precaution usually observed in respect to bodies about to be subjected to chemical analysis, or prepared for chemical combination, but of the necessity of which I was not at that time aware.

In 1828, Major Reid having come to Chatham for a few months, requested me to show him in what manner I had proceeded in those experiments; and the original stock of clay, which was procured from a considerable distance, having been expended, a different kind was used, as being nearer to the spot, which to our mutual surprise, for I had prepared him for certain failure, formed a very good artificial cement. This mere accident led me to resume, under more favourable circumstances, an investigation that I had entirely given up, and since that period, many hundred experiments of a satisfactory nature have been tried upon the subject of artificial cements, a detailed account of which will probably hereafter appear in the Transactions of the Royal Society, and which will also be noticed in an Essay on Practical Architecture, that I propose to publish.

In the mean time, under an impression, that the inferences drawn from these experiments, might be very useful to Engineer Officers, especially in the Colonies, I had previously condensed them into as brief a form as possible, in the following paper, which contains all the Rules applicable to practical purposes, and which having been laid before Major-General Sir Alexander Bryce, the Inspector General of Fortifications, and through him submitted to his Lordship the Master-General, and the Honourable Board of Ordnance, has been so far honoured by their approbation, that I have received authority to print a hundred copies for circulation in the Department.

The very satisfactory results of the long series of experiments alluded to, are in a great measure owing to the zeal, intelligence and industry of Private (now Lance Corporal) James Menzies, of the 19th Company, who assisted me in the operative part, sometimes working alone, sometimes in the superintendence of other Privates.

Establishment for Field Instruction,
Chatham, 7th of July, 1830.

§ 1.—*Of the Natural Water Cements of England.*

1. The best natural water Cements of England are the Yorkshire Cement, the Sheppy Cement, and the Harwich Cement.

As analyzed by Mr. Porrett, and other eminent chemists, these stones consist chiefly of carbonate of lime, silica and alumina, with a proportion of the oxides of iron and manganese, and of carbonate of magnesia. To analyze any mineral substance accurately, so as to ascertain the precise quantities or proportions of all its component parts, requires more time than architects, engineers, or builders, in full employment, can usually spare; but to judge whether any stone be a water cement or not, the following rough analysis will be perfectly satisfactory.

2. Take any of the powerful acids, such as the muriatic or nitric acid, and pour a little into a wine glass, diluted with about an equal quantity of water, and into this drop a fragment of the stone. If it should not effervesce at all, there is no calcareous or magnesian matter in it, and therefore it cannot be a cement. If it should effervesce, and entirely dissolve, it is pure lime or magnesia, both of which are white. If it should effervesce, and partially dissolve, leaving a residue, it is probably a water cement, or a water lime.

3. The next test, and the most conclusive one, is to burn another fragment of the stone, in a Cornish crucible, with a cover, in a common fire, or simply in the fire itself, without a crucible, heating the specimen gradually, that it may not burst, and keeping it afterwards exposed to a full red heat for two or three hours.

Take it out of the fire, and put a small fragment of it into a wine glass of diluted muriatic (or other) acid: if it should effervesce violently in the acid, it is imperfectly burned.

If it should not effervesce at all, or very moderately in the acid, and if its original colour be not changed to a much darker one, it is burned enough.

If in the burning, it be changed to a much darker colour, which is a proof of incipient vitrification, or if it be completely fused or vitrified, like the clinkers or burrs in brick making, it is overburned, and will either be injured or spoiled as a cement, by the excess of burning.

If, therefore, a calcined stone do not effervesce at all, or very moderately, in an acid, and if its original colour be not changed to a much darker one, after taking it out of the fire, it is a proof of its being properly burned.

4. In this case, dip a fragment of the calcined stone repeatedly in water, or pour water over it. If it slake and fall to pieces, it is a lime, and not a water cement.

5. If it do not slake in water, pound another piece of the calcined stone in a mortar, until it be reduced to an impalpable powder, and mix it up into a paste with a moderate quantity of water, by means of a knife or spatula, upon a porcelain slab, and knead it into a ball in the hands. It will then soon become warm or hot, sometimes so as to emit smoke; and if it be a good water cement, it will harden or set in the heating; and if put into a basin of water, after it begins to cool, it will continue hard, and even become harder in the basin.

6. A water lime, or an imperfect water cement, treated in the same way, will not harden in heating, and will either swell and fall to pieces, or will continue soft in a basin of water.

§ 2.—*Of the Pure Limes and Water Limes.*

7. The pure limes, such as chalk and statuary marble, are all white, and are quite unfit for building under water, as they never set at all, but remain in a state of pulp.

8. The water limes, such as the aberthaw, blue lyas, &c., are generally coloured by the oxides of iron, and consist of the same component parts as the water cements, but with more of carbonate of lime, and less of silica and alumina, than the latter. These limes, when made into mortar, are good for the body of wharf walls, as they set under the level of water: but for the facings of wharf walls, it is common to add to them a proportion of puzzolana, or to use the water cements in preference, as the latter are better calculated to resist the action of water in mass.

§ 3.—*The Subject of Water Cements continued.*

9. Calcined water cements require to be ground or pounded to a state of impalpable powder, before they are used. The best and most powerful natural cements, after being burned to the greatest nicety, are not fit for use, when imperfectly pulverized. The calcined Harwich cement, which is the hardest of the natural calcined cements, is often spoiled or injured from this cause, as the same process that may grind the Sheppy cement well, is not capable of reducing this harder substance to the state of impalpable powder. I believe that this circumstance, which is not generally understood, is the chief cause of the Harwich cement being considered inferior to the other natural cements. I have scarcely ever seen any of it ground so fine as it ought to be.

10. Moisture, or even damp air, will soon ruin the best calcined cements in the state of powder.

11. Dry air does not spoil the calcined cement powder all at once, but by slow degrees. When this powder is quite perfect, is does not effervesce in a diluted acid, but remains undissolved at the bottom. By exposure to air, it gradually absorbs carbonic acid gas, which causes it to effervesce more and more in a diluted acid, until by degrees it is acted upon as much as the natural cement stone, previously to calcination, would be by the same diluted acid. At this period, it loses all its power as a water cement. In the intermediate states, between the absolute non-effervescence, and the entire solution of all the calcareous and magnesian parts of the cement, in the diluted acid, it will act as a more or less perfect cement, in proportion to the period of its having been exposed to air.

12. We found, by experiment, that a small quantity of calcined cement powder, exposed to dry air, in a saucer, was very little injured for the first week or two, but that it gradually deteriorated, and was nearly spoiled at the end of the sixth week of such exposure. At first it set immediately, and with great heat. After each successive week it set slower and slower, and with less heat. Latterly, the warmth was not perceptible.

§ 4.—*Method of Testing the Quality of the Manufactured Cements.*

The manufactured cements are always put into air-tight casks, after being calcined and pulverized. The following are the means of judging of their quality.

13. Put a part of the cement powder into the diluted muriatic (or other) acid. If little or no effervescence takes place, the cement is sufficiently burned, but it may be overburned.

14. If considerable effervescence takes place, it may either have been underburned, or what is more probable, it may have become stale by exposure to air, through a defect in the cask or otherwise.

15. If the cement powder be gritty, separate the coarser parts by washing, and by decantation, or by filtering, and let them stand in a moist state for a few hours. Subject the sand thus obtained to the diluted muriatic acid. If it do not effervesce in the acid, the cement has evidently been adulterated by common silicious sand[1].

16. If the coarser parts of the cement should be acted upon by the acid, after the above treatment, it is a proof that the calcined cement has not been properly pulverized.

17. If the cement from the cask, be in the state of impalpable powder, and effervesce very little or not at all, in a diluted acid, the chances are, that it is good. Make it up into a moist ball, with a moderate quantity of water, and it ought to heat in a few minutes, and become exceeding hard. If these effects do not take place, it must have been overburned, and is good for nothing.

18. The cement powder that heats and indurates in a few minutes after being taken out of the cask, will be unfit for present use, from this very circumstance, which proves its superior excellence. You must, therefore, either dilute it well with water in using it, or let it previously stand some days exposed to dry air, to prevent it from setting too rapidly. That which sets in about half an hour, and with moderate warmth, is in the best state for general purposes.

19. If the cement from the cask be in the state of impalpable powder, but effervesce with acids, with a partial solution of the powder, it is not to be condemned on that account; for cement, little underburned or rather stale, is not altogether unfit for use, as was proved by the experiments recorded in Article 12. Make a moist ball with it, and do not put it under water immediately, as you may do with well burned cement powder, fresh from the kiln; but allow it to stand some hours before you immerse it, and the result will sufficiently test its fitness or unfitness for practical purposes.

20. All gritty cement powder ought to be peremptorily rejected. But supposing you are at a foreign station, and it has come out in this imperfect state from England, and you have no other alternative between receiving it and going without, I would recommend sifting it with a very fine sieve, and pounding the coarser parts, previously to use.

21. The necessity of cement powder being reduced to the most minute state of division possible, may easily be proved thus:—Take a small quantity of common Harwich cement from the cask, which is usually gritty, and make it up into a moist ball with water. Pound an equal quantity of the same in a common mortar, until you reduce it to an impalpable powder; and make another moist ball with this. The finely pounded cement ball will set much quicker than the other, and with more heat; and will be close grained and hard; whilst the other will remain soft, and porous, and will imbibe a great quantity of water on being immersed; and will give out a soft matter like moist clay, on being rubbed when wet against the back of the hand. Moreover, the finely pounded cement will adhere to the surface of dry brick work, from which the coarse cement will be liable to detach itself.

[1] I have no reason to suppose, that this practice prevails at present, although the earliest cement manufacturers in this country used to sell not only casks of pure cement, but also casks of stucco, consisting of the cement powder mixed with sand, and bearing, of course, different prices. The sale of stucco having become obsolete, there ought to be no silicious sand in a cask of cement.

§ 5.—*Of Artificial Water Cements.*

22. A mixture of carbonate of lime with pure silica, and a mixture of carbonate of lime with pure alumina, will sometimes, but very rarely, combine into a water cement.

23. A mixture of 5 measures of carbonate of lime, with 2 measures of any mixture of silica and alumina, will generally form a water cement, but one that hardens very slowly, and which is not always quite perfect, as you may prove, by mixing 5 measures of chalk, with 2 measures of pipe clay.

24. To the above mixture of carbonate of lime, silica, and alumina, add either the protoxide of iron or the carbonate of magnesia, in a proportion which need not exceed one-fifteenth part of the whole compound, and this will form an artificial water cement equal to those of nature. A much less proportion of the protoxide of iron will answer the purpose. The most convenient for use is that which is obtained, by collecting the scales struck off from red hot iron, by anchor-smiths, at work in a dock-yard.

25. The above mixtures of chalk and pipe clay, with the protoxide of iron, or the carbonate of magnesia, being rather expensive, you may use, in preference, a mixture of 5 measures of chalk, with 2 measures of the common blue or brown clays of nature, as the latter contain iron in combination, which pipe clay does not.

26. Every compound used as an artificial cement, must have its ingredients reduced to a state of impalpable powder, and intimately mixed with a moderate quantity of water: then moulded nearly to the size of common bricks, but using water instead of sand, to prevent adhesion, and afterwards cut into cubes, of about 2½ inches each side; which must be compressed by beating, moderately dried, and burned in a common lime kiln, to the degree before specified in Article 3; after which, they must be ground to an impalpable powder, and secured in air-tight casks, like the natural cements.

27. A proportion of fine coal dust, of about one-twentieth part of the compound of chalk and clay, should be mixed with the raw cement, previously to the moulding and burning. Any oil, tar, or other combustible, of which coal tar, next to coal dust, is the cheapest, will answer the same purpose. The object is to restore the iron in the clay, as much as possible, to the state of protoxide, during the burning of the mixture.

28. Coal dust is not absolutely necessary to all artificial cement mixtures, but it does no harm to any, and our experiments have proved that it often does good. It is not altogether an additional expense, for it helps to burn the artificial cement, with which it is incorporated, with less extra fuel than would otherwise be required.

29. Five measures of chalk, and 2 measures of the blue clay of the Medway, make a good cement, if mixed without excess of water, and burned within a fortnight after the clay is taken out of the river. A long exposure to air gradually changes the colour of this clay from a very dark blue, almost to a dull or dirty white, and robs it also of its chemical properties, so as to render it altogether unfit for a water cement, when mixed with chalk alone. This is probably owing to the gradual decomposition of animal and vegetable matter, contained in the clay. The like unfavourable effect is produced in a shorter time, by a great excess of water, or by repeated washings, when it is about to be mixed with the chalk.

30. The brown clays, being of a much purer quality, do not appear to be liable to such deterioration by exposure to air; but they have the disadvantage of being generally coarse, and, therefore, incapable of forming an efficient cement when mixed with chalk in their natural state. They require, either to have the coarser

parts broken down, by grinding or pounding, until reduced to an impalpable powder, or to have them separated by repeated washings. The blue clay, on the contrary, as obtained from the Medway at low water, by digging from one to two feet below the surface of the mud, is in a sufficiently minute state of division, without requiring either of those troublesome processes.

31. The most suitable clays for artificial cements would, therefore, be those which contain the least of animal or vegetable matter, and which, consequently, do not sensibly alter their colour or chemical properties, by continued exposure to air, and which are at the same time in a state of minute division. I am not aware that any clay of the above description, quite fine enough for such purposes, is to be found in this neighbourhood.

32. None but plastic clays, or those which are capable of burning into hard sound bricks, or earthenware, are fit ingredients for water cements. Those which burn into unsound slag or scoria, ought to be rejected.

33. In ascertaining, by experiment, whether any mixture will answer the purpose of an artificial cement, make it up, with a moderate quantity of water, into balls or cubes of about 2½ inches diameter, or side, if you propose to burn it in a common fireplace ; or into balls of about 1 inch in diameter, if you propose to use a crucible. The ingredients cannot be pounded too fine, or mixed too well. Burn them in the manner, and to the degree directed in Article 3, and then try the strength of your cement according to Article 5. Before you put the mixture into the fire, whether protected by a crucible or not, let it be dried gradually, and heated a little.

34. A curious result developed itself in the course of our experiments, at Chatham. The carbonate of magnesia is, in itself, an excellent water cement. When calcined, and made up into a moist ball with water, it does not heat perceptibly, and it sets very slowly ; but if allowed to stand for about 12 hours, it may then be put under water, and will, by degrees, become equal to the natural cements in hardness.

35. Magnesian lime stone, mixed with plastic clay alone, no matter of what kind, produces a good water cement; for where magnesia is present in any artificial cement mixture, the oxide of iron may be dispensed with. Hence magnesian lime stone and pipe clay make an excellent cement, although chalk and pipe clay do not always form a good one ; and the magnesian lime stone will always succeed with the blue or changeable alluvial clays, although chalk and the same clays are liable to fail, under peculiar circumstances.

36. It is not an easy task to determine the precise proportions of magnesia and of lime, contained in any magnesian lime stone by chemical analysis. Therefore, if we suppose, agreeably to the results of our experiments, that in forming an artificial cement, by a mixture of clay with this kind of stone, the clay ought to be two-fifths, not of the whole mass of the stone with which it is combined, but of the proportion of carbonate of lime contained therein ; the easiest method of determining this point, will be by experiment; mixing the clay with the pulverized stone in various proportions, all less than two of the former to five of the latter, until that which forms the best water cement shall be discovered.

37. The proportion of 5 measures of carbonate of lime to two measures of clay, (or to 2 of silica and alumina,) which has before been repeatedly recommended, as the most suitable for artificial cements, is not imperative. We found by repeated experiments, that 2 measures of carbonate of lime to 1 measure of silica and alumina, or 3 measures of the former to 1 of the latter, will answer almost equally well ; but any considerable excess or defect of the carbonate of lime, beyond these

two extremes, spoils the cement. It was before observed, that the proportion of the protoxide of iron may vary in a still greater degree. In short, the above ingredients, which are the most proper for forming an efficient artificial water cement, do not combine in absolutely definite proportions, although there are certain limits that cannot be passed without failure.

38. The carbonate of magnesia alone may be added previously to calcination, to any artificial cement mixture, or to any of the natural cement stones, both being pulverized, in any quantity, or to any given excess, without spoiling them, it being, as was before observed, an efficient water cement in itself[2].

39. In those countries, in which none but very hard lime stone is to be had, an artificial cement may be formed, by using a mixture of clay and of calcined lime, that has been long and thoroughly slaked, in the usual proportions, instead of pulverizing the lime stone itself.

40. Our experiments at Chatham have also proved, that a mixture of quick lime, with calcined and pulverized clay, forms a very inferior cement, although it has occasionally been used for that purpose, since the time of the Romans. In order to succeed properly, all the ingredients for an artificial water cement, must be mixed previously to calcination, not afterwards.

§ 6.—*Of the Practical Purposes to which Water Cements are applied.*

41. First, instead of mortar for wharf walls, docks, &c., and more especially for the facings of such walls, as it is not deemed necessary to use cement throughout their whole thickness.

42. Secondly, for arches over doors and windows, and for bond courses in the walls of buildings.

By using cement for such arches, the thrust upon the piers and abutments is done away: also, by using cement instead of common mortar, in three or four successive courses of brick work, in the walls of a building, in one or two parts of each story, a beneficial bond is obtained.

43. Thirdly, as stucco for the external walls of buildings, in which case it is generally applied about three quarters of an inch in thickness, and is finished by floating.

44. For all of the above purposes, the cement is almost always mixed with clean sharp sand, in equal quantities. The addition of a great proportion of sand makes the mixture too gritty, and prevents it from setting so well as it ought to do.

45. Fourthly, for the lining of tanks, or for the covering of casemates.

For these purposes, the cement is generally applied about three quarters of an inch thick, but it is always used pure, instead of mixing it with sand. In all cases, it is usual to apply it in two successive coats, of about three-eighths of an inch in thickness; and in tanks or casemates, each of those coats must be well worked in by the trowel, not by floating. The surface of the first is left rough or uneven: the second or external coat, on the contrary, cannot be made too smooth.

46. The second coat should be laid on before the first is quite set, and therefore one plasterer should apply the first, followed by another plasterer, who should be in readiness to apply the second as soon as possible. Hence, these two coats are virtually one, and may be considered as such. Stucco or plastering in cement is

[2] A calcined mixture of chalk, pipe clay, and the carbonate of magnesia, which forms the handsomest of all the artificial cements made by us at Chatham, promises fairer to become a substitute for the German lithographic stone, than any substance I know. It is my intention to prosecute this research, but I am not sanguine as to final success.

always commenced from the top downwards: and as the whole cannot be done at once, the edges of the first portions are bevelled or sloped, and made rough, on leaving off work, by which means the new cement applied next day is made to adhere.

47. When the surface of a wall is to be stuccoed with cement, or the inside of a tank lined, or the outside of a casemated roof coated with it, before the usual mass of earth is applied, the joints of the brick work must be raked out, and if the surface be dirty, it must be well cleaned, and it should be wetted before the cement is applied.

48. Cement in itself is porous, and will imbibe water, unless it be well worked up, and pressed in by the trowel, and the surface made quite smooth, which will render it sufficiently water-tight either for tanks or casemates, as has been proved by the efficient state of the great reservoir on the western heights of Dover, and by the dry state of a part of the casemates in Chatham lines, which since they have been coated with cement, have been used as powder magazines, although before this precaustion was taken, the upper story of those casmates was so damp as to be uninhabitable.

49. Some persons doubt, whether cement, that has completely set, will receive a second coat of the same material. I believe that it is best to avoid this arrangement, if possible. Sometimes, however, it may become absolutely necessary, as was the case in respect to two small tanks, one executed at Dover, the other at Chatham, neither of which, after being lined with cement of the usual thickness, would hold water. In both cases, a second coat of cement was applied, either of a better quality or with greater care, which proved effectual. In applying a second coat of cement, under the above circumstances, I would recommend that the first coat should previously be roughed by a light pole pick.

50. Every coating of pure cement must be carefully protected from the sun, which has a tendency to cause the surface of it to crack, in the course of a few days, after it has been applied. This precaution is unnecessary in respect to cement stucco, of which sand is a component part.

51. I cannot discover whether a surface of cement is proper for flat roofs or flat terraces over vaults. One instance has come to my knowledge where it has failed: but there does not as yet appear sufficient experience to decide against it.

52. The Harwich cement is almost black; the Sheppy cement a very dark brown; the Yorkshire cement rather lighter. When used as stucco they, therefore, require to be coloured, to make them resemble stone.

§ 7.—*Of the Washes for colouring Cement Fronts.*

53. It is understood, that different plasterers use very different washes for covering the cement fronts of buildings, and that they endeavour to keep their own mixture secret. The article common to all is whitewash made of quick lime, to which they add copperas to take off the dead white, and give it a brownish colour, more resembling stone; and with the water, they usually mix a proportion of beer grounds, and sometimes of alum. The dry ingredients are sometimes previously mixed with tallow. Sometimes also cement powder is used as part of the compound, under an idea, that it will cause the whole to be set. Lamp black and spruce yellow ochre have also been observed amongst the ingredients used. These two last mentioned substances are probably intended to vary the colour, and to produce a resemblance of stone of different tints: for great pains is often taken to imitate the joints, &c. of stone work. Sometimes one uniform colour, having a general resemblance to that of stone, is applied to the whole surface. The latter method, as

being the simplest, and obviously much the cheapest, appears to me to be preferable to the former; particularly as the architectural effect of any building depends more upon the general proportions of the various parts, whether plain or ornamental, than on such minutiæ as the tints or veins of particular stones.

54. The wash used for the colouring of cement stucco requires to be renewed after a certain period. It may be considered very good, if it can last for two or three years.

55. We are now trying various combinations of all the ingredients known to be used by plasterers, in order to endeavour to discover, which are the most useful, and which may be rejected as superfluous; but it will, of course, require some months to elapse, before any definitive conclusion can be drawn from these experiments. We have, however, already satisfied ourselves, that beer grounds and cement powder are useless, or rather prejudicial.

56. The artificial cement made of chalk and blue clay is of an extremely light buff colour, which has a handsome appearance in itself, and requires no colouring.

§ 8.—*Of Cement Grouting.*

57. Cement may be used as grout for the walls of buildings, by mixing it with no more water than will just enable it to run into every crevice. In this state it sets very slowly, and rather like a mortar than a cement, but eventually it becomes hard and sound. A much greater excess of water will ruin cement altogether, as we proved, by putting cement grout into a basin, with about an inch of clear water over it. This effect, however, can scarcely take place in grouting a wall of common brick work, because the excess of water has an opportunity of running off, or of being absorbed by the bricks.

58. Cement grouting should never be used with gravel to form a concretion for the foundations of buildings, it being peculiarly liable to fail in that situation. For this important purpose, none but the water limes are applicable, which must be pulverized in the state of quick lime, immediately before they are used. One measure of such lime to six or seven measures of gravel, are the most common proportions.

II.—*Of the Original Source of Wealth, and Periodical Increase.*

In answer to the question, what is the original source of wealth and revenue? I find the following passages in the book of Genesis.

Chapter 1st, 20th verse. "And God said, Let the waters bring forth abundantly, the moving creature that hath life; and fowl that may fly above the earth, in the open firmament of heaven."

22d. "And God blessed them, saying, Be fruitful and multiply, and fill the waters in the seas; and let fowl multiply in the earth."

24th. "And God said; Let the earth bring forth the living creatures after his kind, cattle and creeping thing, and beast of the earth, after his kind; and it was so."

27th. "So God created man in his own image, in the image of God created he him; male and female created he them."

28th. "And God blessed them; and God said unto them, Be fruitful and multiply, and replenish the earth, and subdue it."

29th. "And God said, Behold, I have given you every herb bearing seed, which is upon the face of all the earth; and every tree, in which is the fruit of a tree yielding seed; to you it shall be for meat."

30th. "And to every beast of the earth, and to every fowl of the air, and to every thing that creepeth upon the earth, wherein there is life, I have given every green herb for meat; and it was so."

Chapter 3d, Verse 17th. "And unto Adam he said, Because thou hast hearkened unto the voice of thy wife, and hast eaten of the tree, of which I commanded thee, saying, Thou shalt not eat of it; cursed is the ground for thy sake, in sorrow shall thou eat of it all the days of thy life."

18th. "Thorns also and thistles shall it bring forth to thee, and thou shalt eat the herb of the field."

19th. "In the sweat of thy face shalt thou eat bread, till thou return unto the ground."

Chapter 9th, Verse 1st. "And God blessed Noah, and his sons, and said unto them, Be fruitful and multiply, and replenish the earth."

3d. "Every moving thing, that liveth, shall be meat for you, even as the green herb have I given you all things."

In the foregoing passages from holy writ, the circumstances of man on earth, with respect to what forms the basis of all wealth, are clearly described.

His dependence on food is pointed out.

The nature and properties of that which constitutes his food, are distinctly shewn.

The original gift of a parent stock, whence all future supplies were to spring, the dependence of man for these future supplies, on the influence of that principle of fructification and increase, wherewith God imbued all vegetable and animal products, these are all fully displayed.

From these passages, we further learn, how man, like that whereon it was ordained that he should subsist, was destined to be fruitful, and to multiply; and again, how the earth was cursed for his sake, and made the matrix whence not only food was to be wrung; but from which noxious products and weeds were to spring: man being thus doomed to sorrow, and to eat in the sweat of his face, then and for ever.

Man, therefore, stimulated to a constant increase of numbers, and predestined to obtain, with pain, and labour, only so much, of that which constitutes the basis of all wealth, as serves to his immediate subsistence, must, in all ordinary circumstances, be found busied in securing and increasing a supply of these joint products of the living principle and of labour: a store of these must constitute his original productive stock; and the periodical reproduction and increase, which proceeds from the unchecked progress of such living germs as yield him food, must form his original revenue, or income.

If the food of this season had not been rendered dependent on that of the season which has passed; and if, like air, or water, the nutriment of man had been obtainable by the influence of causes of which the mode of operation was obscure; and over which man's endeavours could have exercised no controul; it is evident that his increasing numbers must have depended for their increasing means of subsistence, not on their own exertions, but on the influence of these remote causes: and further, that the storing of productive stock for succeeding years, and the periodical reproduction and increase on which, under existing circumstances, all social arrangements turn, would have been utterly unknown.

Although it has been long admitted, that man's original wealth is the produce of the earth's surface; and although it is not my intention to gainsay this truth; I would direct attention, most particularly, to the circumstance of the soil itself being perfectly passive during the whole period of germination, and subsequent developement, and increase in those products, which constitute the basis of our wealth; and that the real agent, in effecting what follows, is the life, or what I may term indifferently, the vital or procreative, the reproductive, and incremental principle, inherent in the products themselves which have been reserved with this particular object in view.

The vital principle inherent in the reserved stock of organic germs, and not the passive soil, is, therefore, to be treated as the source of future wealth, and of periodical increase; and we must in vain seek elsewhere for a competent cause for such phenomena, as are continually exhibited in the reproduction and increase of wealth. Let other active principles be substituted for this power, although we may perceive amongst them sufficient causes for modification and change, yet we cannot, in the whole range of nature, find the means of obtaining one set of products from the destruction or modification of similar products: far less can we perceive competent causes, not only for a reproduction of qualities similar to those destroyed, but for a reproduction and increase also of the products in which these qualities inhere.

The labour of man, when alone applied to existing products, can effect nothing but the destruction of existing properties, followed, it is true, by the acquisition of new, (for destruction of the component matter itself is beyond human power;) the last result differing, of necessity, however, in many of its essential qualities, from the subject on which industry was first exerted; and labour even, when guiding in some destined channel the physical forces of nature, as it may be said to do, when employing the stupendous machinery of the present day, can effect nothing but a change. To this I beg the most particular attention; for to labour alone is reproduction now attributed.

Let well directed industry, however, co-operate with the vital principle inherent in the reserved stock of seed, and we witness, as the result, a periodical reproduction, and a progressive increase, brought within the reach of man, of those things of which he originally feels most intensely the want. We witness, on the one hand, as the effects of industry, a destruction of existing properties; a smooth soil made rough with the plough, or the spade; or a dry spot made wet. We see a modification effected in the soil, and its former products; and an alteration in the relations of the soil and its former products; also, a change brought about in the relations of the soil, and the seed which man desires to plant: but we perceive, on the other hand, as the results of the living principle, the destruction of existing properties; their gradual re-formation; and the creation, not of one, but of hundreds of products, similar to the one originally destroyed; each capable, in its turn, of running the same career, provided the circumstances under which it is placed correspond in some particulars, with those of its parent germ.

These considerations are important; as I conceive, that to the want of attention to the difference between the effects of the vital energy in the organic products of nature, and the other active principles in nature, and between these, and the effects of labour, may be traced many of the errors of political economists.

My system of wealth, therefore, commences with the adoption of the principle warranted by history, and by the testimony of all voyagers who have visited nations in their infancy; and still more forcibly, by the denouncement in holy writ, that a little only existed originally of that description of produce which forms human nutriment, as well as the means of its subsequent increase: and it proceeds with this other equally well established principle; that man's numbers, and subsistence, at first limited in amount, must subsequently increase together in mutual and constant dependence one upon the other.

But whether the former principle have, in all cases, been found in actual operation, is, however, a matter of little consequence to the doctrines I wish to elucidate;

for even if it had not been strictly as is here assumed, human nutriment, being yielded, not by the most hardy and durable descriptions of organic products; and all organic products, whether useful or noxious to man, being gifted with the power of reproduction and increase; it follows, that even if we supposed the earth, in the first instance, yielding principally food, a short period only could elapse, ere the more hardy and durable products shall be found to have usurped that space which had originally been possessed by the more delicate and useful; and hence it follows, that man, stimulated as he is to increase of numbers, will very early be found suffering embarrassment on either hand; on this, by the energy of the vital power, urging him to constant increase, by its inherent influence on himself; and on that, by the same influence, exhibiting its power in the progress of all descriptions of noxious vegetation.

I am, therefore, justified in the assumption, that a necessity, in all ordinary circumstances, may be assumed to exist in an infant agricultural population, for endeavours to avert the miseries incident on insufficient nourishment; and that human labour is, in all ordinary circumstances, continually required for dressing and preparing the soil; and for displacing those germs, the developement of which is prejudicial to the well being of man; as also in preserving and planting, in due season, such germs alone as are calculated to yield him nutriment.

But man, with his naked hands, is but powerless when compared with the mighty obstacles he may be destined to encounter; and when we contemplate the gigantic effects of his antagonist, vegetation, as exhibited in most uncultivated countries of the world, we may check surprize at finding him so very frequently, a helpless savage, ignorant of the elements even of agricultural science, and depending for subsistence, not on products which his reason and industry enabled him to secure and increase, but in the scanty and uncertain pittance which circumstances casually supply, or which the fortune of the chace brings within his reach.

In these circumstances, as wealth can hardly be said to exist, all which men at that time possess and enjoy, making a near approximation to that on which the lower animals subsist, all of which exercise, to a certain extent, what may be called appropriative industry, we may pass to that state of society, where man, under more favourable circumstances, has succeeded in bringing the reproductive and incremental principle under his controul, and where true wealth and revenue are consequently found. Commencing from this point, it will be the province of the political economist to mark the successive steps, by which that powerful principle is forced to yield to man, greater and greater obedience; and to grant to his increasing numbers, a constantly increasing quantity of the products essential to his well being. Nor will the supposition of great or little fertility in the soil, alter the first principle here assumed, that labour is inevitable; for in proportion to the fertility of the tracts man wishes to cultivate, so must be the vigour of opposing vegetation, demanding the incited endeavours of many labourers to check its career: and in proportion to the sterility of the land to be tilled, so will the necessity be great for the combined co-operation of many labourers, in manuring and irrigation.

In either case, and in all situations, we may, therefore, admit the existence of a necessity for labour, before that net surplus is periodically obtained, which constitutes income or revenue, whether the tracts at the free disposal of man be rich, or poor, extensive, or the reverse.

From any given extent of ground, it is self-evident, that only a certain net surplus can be obtained. Between a very small, and an excessive expenditure of seed, there must be a point in expenditure at which the clear surplus realized is greatest. If a very small quantity of seed be employed; a net return, small in some proportion, must be the result; and in an excessive employment of seed, a part will not be able to germinate from want of space; while all the plants, by interfering with each other, during the course of their developement, will be prevented coming to full growth and maturity. There is, therefore, one particular point at which the relations of outlay, and net return in seed, are most advantageous to man, and yield him the greatest net reproduction; and man must be intensely interested, that these relations should shortly be practically established, stimulated, as he is, to a constant increase of numbers.

The same remark holds with regard to the application of labour on any given extent of ground. The labour of one man being incapable of fitting, say 20 acres, for the peculiar growth and fullest developement of useful germs; while the application of 100 men to the same extent, might produce no effect commensurate to feeding and rewarding with an income, so many labourers as a hundred.

Twenty men might, however, force from the soil such a net surplus as rewarded each with a maintenance, while to the labour of twenty-one a less proportionate return would be secured. If then we proceed with the supposition, that so large a net reproduction as twenty labourers obtain from this tract, is absolutely essential to the existence of each of these twenty; and if we suppose, further, that the net produce falling to the share of each of the twenty-one, is short of this quantity, we find that there is a limit to the number who could be fed by the net produce of that extent of country, and consequently to the number which could be permanently employed upon it; and as population must come up to the means of subsistence, obtainable by the employment of labour; we see, on the other hand, why fewer than this number will not permanently be found occupying this tract.

In productive expenditure, therefore, in either seed, or labour, there is a point which man is interested in reaching; and which must be reached: an expenditure, too, which he cannot, even if he would, continue to exceed; for if more seed be thrown into the ground than can come to maturity; the means of existence are taken from all who otherwise might have consumed it as food; and from those who would otherwise have enjoyed that of which the growth has been interfered with; and thus a reduction of the means of subsistence, and consequently of population, follows the excessive employment of seed, while the diminution of the share of nourishment falling to the lot of each of the persons labouring, and consequent starvation of the whole, immediately threatens, where industry is employed in excess.

Conceiving it then to be undeniable, that man's original wealth is only obtainable as the recompence of so much labour as the naked savage must bestow in overcoming the mighty obstacles opposed to him by nature; and that, during the progress of an increasing population, as each individual comes to maturity, he brings to the society so much labour as serves for his own support; and taking into consideration the inevitable progress of population and wealth, till that extent be reached in productive expenditure, which we have pointed out above; it must be granted, that the wealth of each period, will have been pressing against the limits, which the population and knowledge of productive arts possessed by that population, actually did prescribe; and that after wealth and population have reached the limit to production marked by the physical circumstances of the country, they can, neither of them, be found permanently greater or less in amount than what they hold, so long as the productive circumstances of the country remain unchanged.

It has been assumed by many reasoners, that when population is scanty, none but fertile spots are under cultivation, and that a great proportional return is in consequence obtained for productive outlay; it has further been assumed, that such tracts as we, in the present times, find comparatively rich, and peculiarly fitted for yielding such products as man desires, were always in a similar state of superiority; and hence the inference has been drawn, that, at such times, and in such situations, man lightly earns his food, and revels in comparative abundance. But these are, I conceive, gratuitous assumptions, not warranted either by sound reasoning, or by the test of experience. History, on the contrary, represents man in almost every stage of his career, as struggling for a sufficient subsistence; and shews us infant and uninstructed nations, with nature's products strong around them, barely able to wring but scanty means of subsistence from the tracts their labour suffices to keep clear; the extent of these cultivated tracts being gradually enlarged, as the additional labour, and increasing knowledge of increasing numbers of the inhabitants become available to this purpose.

We find then, that even in this early stage of productive knowledge, any given extent of country is capable of ultimately giving productive employment to a certain population only; and that all who occupy themselves in cultivation beyond this number, impoverish not only themselves, but the society to which they belong: and we learn, that it is not even then, more than at any future period, optional with man to increase his wealth, provided he be willing to bestow labour only on his own enrichment, as those contend, who treat labour as the sole source of wealth: all additional labour being shewn to be nugatory, unless it co-operate with the principle of reproduction and increase, under circumstances enabling that principle more fully to exert its power in increasing the quantity of such products, as constitute man's original wealth.

The popular theories of the present day treat labour as being the only source of wealth. But if our original wealth be that which is periodically rendered available to our use; then I say, that the source thereof is the active principle of periodical reproduction and increase, wherewith God endowed such organic germs as are suitable for human purposes; and if the Almighty also doomed man to continual co-operation with this principle, then I say, that labour also is essential to our obtaining the important products in question. And I maintain, that it is of vital importance to the full understanding of the subject, that we should neither treat the reproductive and incremental principle alone, nor labour (which is merely the principle of modification) alone, as being, in themselves, sufficient causes for the effects which follow; for the leading fallacies into which we should in this case run, would, on the one hand, be that of supposing no necessity for human exertion to exist; a fallacy which has at present no supporters; and on the other, that of supposing men have only occasion to labour, whenever they may happen to be in want of wealth; a fallacy which, in my opinion, vitiates, more or less, all the reasonings which have as yet been put forth, professedly with a view to determining the principles of production.

Neither can any reasoners be justified in the assumption, that the soil, in conjunction with labour, is the original source of wealth; for in so doing, they run into the palpable error, of attributing active power to what is manifestly passive and inert; an admission from which their own minds must, unconsciously perhaps, revolt in their subsequent reasonings; and thus leading them, naturally, to attribute active power to the only active principle of which they have taken notice, namely labour; and thus beguiling them into the errors of those, who originally attributed all effects on wealth to labour alone.

And if, on the very threshold of the inquiry, a proposition so manifestly wrong, as that labour is the only active principle concerned in the creation, reproduction, and periodical increase of wealth, be permitted, either avowedly, or by implication, to hold its ground, it is quite out of the question to look for ought but false conclusions in the sequel; for this science can only be prosecuted with success by the determination of a vast number of consecutive truths, to the establishment of the more remote of which in particular, the correctness of every preceding proposition is absolutely essential.

III.—*An Essay on the Game of Billiards.*

The following essay on the popular game of billiards, taken from a printed work, scarce in India, will, we doubt not, be acceptable to many of our subscribers, who may be pleased to see the theory of the game, and may find amusement in tracing their own play to first principles. Notwithstanding its quaint style, it appears to be worthy of the attentive reader's study. It will be found to treat pretty largely on a supposed new method of play, which it thus appears is not so new, for our book was published at Bath 25 years ago. A work like ours must study variety, but even were it otherwise, the present essay would demand admission, as a branch of practical science, not the less entitled to the term " utility," because its more immediate object is recreation only.

Introduction.

It is not supposed, that a perusal of the following pages can be of any use to a good player; for, to play well, practice is indispensibly requisite; and experience, the most infallible test of theoretical opinions, serves to point out the means; therefore, the information necessary to that purpose is already acquired, from documents that blend the greatest simplicity with the strongest proofs. Neither is it expected, that a novice in the game will derive much advantage from it; as that course of instruction, which affords the most entertainment, having always a predilection in its favour, is generally preferred. Yet, whether at the instance of some friends, or prompted by a desire to find out intermediate affinities between causes and effects, now viewed in proximity; so that, by shortening the stages, and promoting the intercourse, the " Inquisitive Traveller" may be better accommodated on the road to Science; or whatever else may have urged an examination of the present subject; if a few hours thus employed, should elicit a further investigation of NATURE'S Laws, by which her works may be subdivided more minutely, or shown collectively with better success, this attempt cannot be charged as altogether useless.

THE THEORY OF THE GAME OF BILLIARDS.

The motion of a ball struck[1] by a CUE[2], depends not only on the direction in which it is impelled, but, very considerably, on the manner of striking it; and it is resolvable into two or more divisions; which, together with their efficient causes, ere now separately brought into view, and should be carried in the mind, as respectively distinguished, that their effects in composition may afterwards be rendered the more explicit.

[1] The word *strike* and its inflections, whenever they occur, refer immediately to the CUE; but *hit* and its inflections, to a ball, cushion, &c.

[2] This is the proper instrument to play with; the other (not worth naming) is no better than a trifling contemptible toy.

Viz. The first is *simply forward:* it is produced by the CUE only, and analogous to the motion of the body of a wheel carriage, which preserves a relative position of its parts with the plane whereon it moves; and may be called the PROGRESSIVE.

The second is *forward* and *rotary*: it arises from attrition, by the action of the ball, while in progression, against the surface of the table: hence a rotation is produced, analogous to the wheels, which change the relative position of their parts, by turning at the same time round their axis—this will be named the ATTRITIVE[3].

These two motions constitute what may be termed the plain game of Billiards, and are always coincident upon the same line; but there are others also, which (if introduced) affect them with various influence, in different directions, modifications and degrees; and these likewise, with their origin and characters, it is now endeavoured to discriminate and explain, on physical principles, without the intervention of CHANCE—the common enemy of bad players—who are ever intruding this unbegotten phantom, between NATURE and her operations, to fill up imaginary voids, with metaphysical agency; hoping thus to find, by the subversion of her order, some palliation for want of judgment, or deficiency of execution in themselves.

But let it not be inferred, that it is here intended to expunge the word from the player's vocabulary—far from it—no more is endeavoured, than to have it confined within due and reasonable bounds: where it is made to signify only an *effect*, contrary to expectation, or beyond design, it is without objection; for there it occupies its proper place: but when it is used as a cause, originating with itself, an independent and unaccountable *principle*, the phrase then becomes absurd. Yet in this sense it is often used; and, though intemperate or bad players (as before observed) are most sedulous advocates in favour of its existence, and clamorous supporters of its authority, from a worthless *client* out of place and notice, it (courtier-like) becomes, in power, an ungrateful reprobate; for they all charge it with injustice or ill-natured partiality, insist it rarely does them a friendly office, and declare aloud that most of its acts are hostile.

Chance and Luck are terms nearly synonymous, at least in common use, yet, strictly considered, Chance seems to be, in the technicals of logic, the *Genus*, and Luck the *Species*; for though the latter frequently has an adjective to qualify its meaning, as good, or bad, &c. it is often also without one, and then always taken in a good sense. But the quality of Chance, is unintelligible in this last predicament, and must, therefore, indispensably have an epithet to specify it, which being sometimes formed from an inflection of the very word with which it is compared, viz. "lucky chance," the distinction at once becomes manifest, and further proof needless.

It may not be amiss to take notice also, of a consequence from using those terms, either as affections only, appertaining to the persons of particular players, or as characters of beings that have a separate and independent existence; but which, considered abstractedly, would be perhaps denied. This will appear in such trite remarks (which also exemplify their comparative meaning) as "he has so much LUCK, (i. e. *good* LUCK) and I have so little, that there is not a fair CHANCE, (i. e. *simple* accidence) in playing with him." If LUCK then exists, it must be in

[3] This word (not sanctioned by the dictionaries) the author ventures to form from *attrition*, and assimilate in termination to PROGRESSIVE, as likely to convey his meaning better than any single one of established use, whilst it precludes the necessity of a *periphrasis*, which frequently repeated would be intolerable.

substance, or in *spirit*; but it cannot belong to the first class, otherwise it would, at one time or other, be evident to some of the senses; and if it belongs to the second, what can possibly be the object of its mission, attendance, or presence, unless to influence the actions of mankind: yet, if this be admitted, which cannot be denied, without destroying the only evidence offered to support its existence, it is inconsistent with free agency, and this is the doctrine of necessity; the merits whereof, however, being foreign from the subject of this essay, it is not intended to discuss, having made the deduction only to prevent a negligent incongruity of diction with sentiment, as it is much suspected those words are often employed, without any precise or definite ideas annexed to them. If, on the other hand, they be supposed only affections or qualities of individuals; the two opinions, when examined, will be found, like neighbouring streams, converging towards the same pool, either to unite upon the way, or having finished their courses separately, to become stagnant in the same place[4].

To return from this digression: the *progressive* motion takes place, when the middle points, at both ends of the cue, and the centre of the ball makes part of a right line at the time of impulsion; and if this position be also parallel[5] with the table, as *a (see fig.* 1.) it will be smoothest, lightest, and least impeded. For should the cue be pointed downwards, as *b*, the motion of the ball must be partly destroyed by reaction from the table; and, if pointed upwards, as *c*, or any where else, the power of gravity would be more directly in opposition to it, and, contracted at the same time within narrower limits, as *d*, *e*, still further in effect augmented. But, when pointed horizontally, that power acts against the ball at right angles only, and being extended, by a stroke of no more than equal violence, between limits that embrace a greater latitude, as *d*, *f*; it is weakened by diffusion, and, if the *impetus* be considerable, will be almost lost in the minuteness of division; till by continued operation, together with the resistance arising from the roughness of the cloth, and opposition from the air, the volocity of the ball becomes so mnch diminished, that, though at first it scarcely touches the surface, it afterwards (more emphatically) rubs, and at length constrained to roll, (as the only means of discharging the progressive force which remains,) it thus advances to the place of rest.

[To be continued.]

IV.—*On Varieties in the Animal Kingdom, depending upon procreation between individuals of different species.*

[From Meckel's Comparative Anatomy.]

When procreation takes place between two beings of different species, the progeny is said to be *hybrid*, and is denominated *mule*, or *bastard;* the latter of which terms will be employed in the following observations, as the former is generally used in a more restricted sense, being applicable to a particular hybrid animal.

[4] The frequency of repetition, and extraordinary remarks, besides the absurdity and inconsistency so common in the use of these words, it is hoped will palliate this digression.

[5] This stroke is seldom *completely* necessary; and, as it cannot be given with any part of the CUE over the cushion, nor very conveniently in any situation: with the but end held so low it is seldom made.

The circumstances, under which these varieties present themselves, are the following:—

1st. A great analogy in the organization to render generation possible. Cases are related, it is true, in which procreation hath followed the mutual copulation of dogs and cats, of turkeys and fowls, and of the cock and duck; and perfect copulation between the *Cantharis melanura*, and *Elater niger*, is generally received as fact. Even the great number of species in the insect world may possibly depend upon unions of this kind being prolific, such is the resemblance between many of the species.

Jumarts have, in like manner, been considered as the produce of similar copulations, between individuals of the genus Bos, and others of the genus Equus. It has even been believed, that animals differing still more, as rabbits and cats, could procreate together, and those cats, which have a short tail, furnished with a pencil of hairs, and whose hind legs are more elevated than the fore, have been adduced in proof of this opinion. But most of the stories of this sort are entirely without foundation.

In the case related by Rossi, i. e. perfect copulation between the *Cantharis melanura* and *Elater niger*, and doubtless in others also, (especially where union has taken place between animals of different classes,) copulation has been accomplished, but has procreation been the results thereof? Of this, we are ignorant. As for *Jumarts*, these animals are apparently small asses, or stunted mules, and many circumstances tend to confirm this conclusion. 1st. All the signs, proper for characterizing them as such, are met with in these animals. 2dly. Their diminutive size proves, at least, that they are not the offspring of a prolific union between a bull and a mare, since animals, in respect to dimensions, generally take after the female. 3dly. Their supposed origin has never been attested by creditable witnesses, notwithstanding the frequency of their existence. 4thly. Sexual congress between the species, which are regarded as the progenitors of these beings, has never been known to take place, spontaneously, in a state of nature, though it has often been the results of experiments made for the purpose, and in these cases, has been invariably unattended with fruitfulness. 5thly. Dissection has always proved these animals to be either asses or mules.

Between animals, whose approximation is closer, we find, on the other hand, that copulation is fruitful; but also, that, in some instances, the produce of this union are endowed with powers of procreation. Examples of this kind between the wolf and dog occasionally present themselves to our notice, so that Buffon, who, at one period, denied the possibility of procreation between these two species, has himself observed, and given a description of cases in which these bastards have reproduced even the fourth generation.

It is equally certain, that the fox and the dog, the Llama and the she-goat, the roe-buck and the she-goat, the ass and zebra, as well as the horse and ass, produce bastards, which are themselves, sometimes, capable of procreation.

The experiments of Springer have proved, also, a similar fecundity in hybrid birds. Daily examples, occurring in the genus Fringilla, remove all doubt on the subject.

It is worthy of remark, that female bastards are frequently prolific, whilst barrenness invariably exists in males; and the most plausible explanation of such a fact appears to be, that the organs of generation (which, in the early state of their developement, are female) are incapable, in bastards, of attaining that degree of perfection which is manifested in the organization of the male genital parts of regular animals.

The faculty of procreating bastards is not confined solely to the neighbouring species of those animals, in which fecundation takes place in the interior of the female, but we find it also in animals in which, as in fishes, the semen is poured upon the ova, after they have issued from the female. Many species of carp are produced in this way.

The extreme resemblance between most of the Tritons, renders it very probable, that many of the species are capable of mutual copulation.

2dly.—Bastards are more numerous, and at the same time more prolific, in the lower than in the higher animals, because, no doubt, the organic power is, in the former, more strictly confined to the phenomena of formation, and on that account more energetic. To this cause must be attributed the greater frequency of bastardy in birds than in the mammalia. All these circumstances tend to substantiate the opinion expressed above, that a great number of species of insects are thus produced.

3dly.—Bastards are more readily generated, and are more prolific, in proportion as their progenitors themselves possess great powers of procreation. To this circumstance we attribute the different degrees of fertility in hybrid birds, and hybrid mammals, as well as those by which bastards of the genus *Canis* and genus *Equus*, are so variously characterized.

4thly.—The degree of resemblance is, beyond all doubt, another cause of the want of equality in the faculty of begetting bastards. The greater the resemblance between the species, and the more gradual the passage from one to the other, the more readily are these hybrid beings produced, and the more powerfully are they endowed with the reproductive faculty.

5thly.—According to Buffon, bastards are more frequently males than females. If this be true, it would seem contradictory of the explanation above given, of the circumstance of female bastards being prolific and males barren; a contradiction, which is, however, reconciled by the remark cited by Buffon, as an example of animals much more prolific, such as the dog and wolf, the he-goat and sheep, and the goldfinch and canary bird. This, however, is but an apparent contradiction; for though the form of the genital parts be more elevated in males, inasmuch as they exceed the degree of organization at which the female genital organs stop, the formative power is, nevertheless, more active in the female, and the smaller number of female bastards appears, consequently, to prove that they are produced under circumstances less favorable than those which attend the birth of regular animals.

6thly.—Do bastards present any characteristic signs of their mixed origin, and, if so, what are those signs?

From certain experiments, by Buffon, upon the production of bastards between the he-goat and sheep, in which the offspring had greater resemblance to the former, we should be inclined to believe, that the form depends, in a great measure, on the male. This is positively admitted by Linnæus, with respect to the outward form at least; but so little is at present known upon the subject, that nothing can be laid down with certainty.

Thus, the *hinnus*, the progeny of a stallion and a she-ass, resembles the latter more in its slender neck, dorsal stripe, as well as in the form of its hind quarters, whilst the mule, bred between a mare and male-ass, receives from the former the strength of hoof, rounded form of body, and the size, beauty, and strength of its posterior parts. The hinnus is small, the mule large. In one case the bastard of a dog and wolf, had more the form of the male than of the female. Knight has remarked, that the size of the female progenitor greatly influences that of the bastard.

It must be admitted, that the form of certain parts is determined by the male, and that of certain other parts by the female; since the hinnus has greater resemblance to the horse in its head, ears, tail, and limbs, and to the ass in the other parts of its body; the mule, on the contrary, has the former parts more like those of the ass, whilst the latter are modelled on those of the mare. This rule, however, is not without its exceptions; for example, in a case of bastards, produced by the dog and wolf, one was formed exactly like the male, whereas the other was compounded of the forms of both its progenitors.

V.—*Population of the City of Dacca.*

The following tables exhibit an abstract of the results of a census of the population of Dacca, made by H. Walters, Esqr. Judge and Magistrate of that place, lately presented by him to the Asiatic Society.

The present enumeration falls very far short of the estimates hitherto made of the magnitude of that city, being hardly one-half of the population given by Hamilton in his Gazetteer, (150,000,) and less than a quarter of Bishop Heber's more vague assertion in 1823, where it is stated to contain 300,000 inhabitants, and 90,000 houses.

In an abstract, published in a former number of Mr. J. Prinsep's census of Benares, for 1829, the same rate of diminution was observed, when the exaggerated assumption of former times was brought to the test of actual scrutiny. No doubt a similar rate of reduction would attend every careful enquiry of the sort, and until the laudable example set by Mr. Walters shall have stimulated other public officers to favor us with statistical intelligence, founded on equally just and accurate foundations, we can form no correct notion of the real magnitude of the cities of Hindoostan, unless, indeed, it be deemed sufficient to curtail, by one-half or two-thirds, the general accounts met with in publications on this department of the geography of India.

Mr. Walters observes, however, that the population of Dacca must have fallen off very rapidly since the opening of the free trade, for the Chowkeedaree tax, when instituted in 1814, was levied upon 21,361 houses, and the amount collected at an average of 2 annas per house, maintained nearly 800 Police Chowkeedars,—whereas, in the present year, 1830, the number of houses actually assessed amounted only to 10,708, and the number of Chowkeedars maintained, to 236 : hence, in 16 years, a diminution in the population of about one half may be assumed. This falling off is mainly attributable to the gradual decrease of the manufacture of those beautiful cotton fabricks for which Dacca was once without a rival in the world : previous to 1801, the advances made by the Company, and private traders, for Dacca muslins, were estimated at upwards of 25 lacs ; in 1807 they had fallen down to one half : in 1813 the private trade did not exceed 2,05,950, and that of the Company was scarcely more considerable, and in 1817 the English Commercial Residency was altogether discontinued. Coarse cotton piece goods still continue to be manufactured, though from the extreme cheapness of English cloths, it is not improbable that the native manufacture will be altogether superseded ere long.

Notwithstanding its present insignificance, as compared with its former grandeur, Dacca may, nevertheless, still be classed among second-rate cities. It has a population greater than that of Plymouth or Brussels. Some new brick dwellings have silently sprung up here and there:—an oil mill, driven by steam, has lately been erected; and an iron suspension bridge, and three more steam engines, are in the course of erection, for various purposes.

The number of native males, as shewn by the statements, exceeds that of the females in the ratio of $103\frac{2}{3}$ to 100. This is the converse of what is found to occur in other countries : it is supported, however, by Captain Wroughton's census of Gorukhpoor, wherein the proportion of males to females was given as 108 to 100, (*Gleanings*, 1829, No. 12,) but there is great difficulty in obtaining occurate returns of the female members of families, particularly among the Musulmáns.

TABLE I.

Caste.	Number of houses.	Males above 16 years.	Females above 16 years.	Males below 16 years.	Females below 16 years.	Total.	Proportion to a house.
Armenian, ..	42	49	37	25	15	126	3
Greek,......	21	19	12	10	7	48	$2\frac{1}{4}$
Portuguese,	41	52	36	38	18	144	$3\frac{1}{2}$
French, ...	1	2	0	2	0	4	4
Total,	105	122	85	75	40	322	$3\frac{1}{15}$
Hindoo, ...	7327	13045	9907	4678	3799	31429	$4\frac{2}{7}$ } $4\frac{1}{8}$
Musulmán,	8825	14428	11741	5271	3798	35238	4
Total,	16257	27595	21733	10024	7637	66989	$4\frac{1}{12}$

Males above 16	27595	Females above 16	121733	Adults,	49328
under 16	10024	under 16	7637	Minors,	17669

Total males,	37619
Total females,	29370
	66989

The number of native inhabitants found actually existing in each house or *chauc*, varies from 1 to 90, the average being $4\frac{1}{8}$, a less proportion than at Burdwan, which is stated at $5\frac{1}{2}$; or than at Benares, where 6 has been assumed as a fair average for houses situated within the limits of the town.

Mr. Walter's tables specify the numbers belonging to each caste and profession, but we cannot afford room for more than the following general statement :

	Houses.	*Inhabitants.*
Hindus of the Brahmin caste, ...	285	1,336
Cshetri, (merchants, servants, &c.) ..	376	1,153
Byshye,..........................	17	60
Sudra, including 89 trades, &c.	6,359	28,327
Musulmáns, Zemindárs, ...	74	1,065
In service,...........	1,067	9,056
Independent families, ...	1,070	3,879
58 professions and trades, ...	5,634	21,238

TABLE II.

Names of Thannahs.	No. of Muhullus.	Brick houses of one story.	Do. 2 stories.	Do. 3 stories.	Total Brick houses.	Straw houses, including golas, shops, &c.	Total houses or chouks.	Gardens encompassed with walls.	No. of fixed native inhabitants.	No. of lodgers.	Total inhabitants.
Islampoor, ...	20	276	321	71	604	2513	3117	24	6586	2659	9245
Sultangung, ...	12	14	12	0	18	1927	1945	0	4459	50	4509
Poorubdarwaza, ...	19	139	45	2	192	1674	1866	10	7673	826	8499
Soojaitpoor, ...	11	28	18	1	53	541	594	6	2716	290	3006
Naraindeeah, ...	18	133	113	2	238	1749	1987	29	8008	718	8726
Surafutgung, ...	16	132	127	6	259	1169	1428	4	4957	1492	6449
Girdgilah, ...	31	221	1001	4	1225	2110	3335	10	6775	1301	8076
Dacca Sherry, ...	10	66	35	2	112	694	806	14	3017	497	3514
Nuwabpoor, ...	17	105	153	12	212	1558	1770	20	8756	1287	10043
Imleegda, ...	24	139	85	4	251	4028	4279	36	4320	280	4600
Total, ...	178	1253	1910	104	3164	17963	21127	153	57267	9400	66667

Besides the buildings included in this statement, are the ruins of the palace erected by Azimushán towards the end of the 17th century, compared by Bishop Heber to the Kremlin.

also
2 Gateways.
158 Musjids or Mosques.
109 Mugburahs or Mausoleums.
12 Sunguts or Hindoo monasteries.
52 Akrahs.
55 Kalee Barees or Temples of Kalee.
4 Christian Churches.
3 Kutras or Caravanseries.

TABLE III.

Average price of Articles of Food at Dacca, from 1820 *to* 1830.

Years. A D.	Rice. Fine.		Rice. Coarse.		Salt.		Oil.		*Ghi.*		*Jagri.*		Turmeric.	
	sr.	ch.	sr.	ch.	sr.	ch.	sr.	ch.	sr.	ch.	sr.	ch.	sr.	ch.
1820-1	31	4	33	0	8	12	5	0	2	8	9	0	9	0
21-2	35	0	39	0	8	8	5	8	2	8	9	8	8	0
22-3	37	8	43	0	6	8	4	8	2	2	11	0	8	8
23-4	23	0	28	0	8	0	5	8	1	8	11	4	10	8
24-5	22	4	27	12	8	4	6	4	2	0	9	12	12	2
25-6	31	4	36	4	8	2	5	1	1	12	8	12	15	4
26-7	33	12	41	4	7	0	3	8	2	0	10	8	16	6
27-8	33	0	36	8	7	4	4	15	2	8	11	8	20	4
28-9	35	10	38	14	8	4	6	5	2	8	13	5	18	0
29-30	30	8	36	6	8	6	5	12	2	0	10	4	8	0
Average,	31	5	36	0	7	14	5	4	2	2	10	8	12	9

This table expresses, according to the native marketing system, the weight of each article in seers and chuttacks, procurable for one Rupee. The value of seer, or maund of 40 seers, is not expressed, but for our English readers we may remark, that the bazar seer is a little more than 2 lbs. avoirdupois.

VI.—*On the Errors of Thermometers, and on a correct Method of Graduation. By Lieut.* R. Shortreed, *Bom. Est.*

The errors of Thermometers are so notorious, that scarcely can any two be found to agree in their indications from freezing to boiling, unless they be graduated from each other, or from a common standard. A great deal of the discrepancy in the results of the different observers, are doubtless to be attributed to this cause alone.—I shall give one instance out of the many which might be produced.—From the experiments of Mr. Southern and Dr. Ure, on the force of steam at different temperatures, it would appear, that their Thermometers, though agreeing at 212, differed 3° at 290 ; Dr. Ure's 290 corresponds almost exactly to Mr. Southern's 293, and there is a gradual increase in the difference of their indications at all the intermediate temperatures.—In order to ascertain whose thermometer is in fault, it is very desirable, that each of them should be examined by the method which I shall have occasion presently to propose. It is quite possible that both thermometers may be wrong, but both cannot be right. Perhaps I may have occasion, hereafter, to advert to this subject.

When the freezing and boiling points are properly ascertained, the next object is the graduation of the scale. The methods of doing this are generally very defective in several respects. They may be seen at length, in the article Thermometer, published by the Society for the Diffusion of Useful Knowledge.

When a thermometer is properly filled, and exhausted, the mercury will flow along the tube, when it is reversed and shaken ; and on holding it upright, it will flow again into the bulb. On repeating the operation, it may be observed, that the mercury will begin to leave the bulb at the point which was last filled, or the vacuum in the bulb will commence from the place where it previously existed. If the mercury be made to flow along the tube, and at the instant be quickly brought into a vertical position, and shaken so as to bring the vacuum exactly under the bottom of the stem before the bulb becomes full, it will be found, on reversing, that now the mercury will not flow from the bulb as formerly, but the whole thread of mercury in the tube, will separate from the bulb. This is commonly considered to be an imperfection in the instrument, but it is easily remedied, as will presently appear ; and it is by means of this thread that I propose to graduate the scales of all thermometers correctly, independent of any reference to a common standard or register. When the thread separates in this way from the bulb, hold it in a vertical position, and adjust the temperature, so that the length of the thread, in the tube, may be nearly, or exactly equal, to half the distance between the freezing and boiling points. In this state reverse the instrument, so as to separate the thread from the bulb, and bring the lower end to coincide with the freezing point, and carefully mark the termination of the upper extremity. Then make the upper end of the thread to coincide with the boiling point, and mark, in like manner, the termination of the lower extremity. If these two marks coincide, we have got the exact middle point on the scale ; if not, the mean of the two is the middle point. It is desirable to repeat the operation, so as, if possible, to get both to coincide—and to prove the former trial. On the centigrade scale, freezing being 0°, and boiling 100°, the middle point, so found, is the correct 50, and in like manner may be obtained, equally correctly, the points corresponding to 25 and 75.

We thus obtain three intermediate points, as correctly as the freezing and boiling points ; and if the distances of these points be tolerably uniform, the intermediate degrees may be obtained in the ordinary way by simple division.

By farther bisections, other points may, likewise, be found; but as, on both centigrade and Fahrenheit, these would correspond to fractional parts of degrees, the following mode may be adopted: divide one of the distance portions before found, suppose the lower, into 5 equal parts by compass, the upper division will then be the approximate 20—let it be assumed for the present as correct; then separate, as before, a thread about 40° long, and with this bisect the tube between 20 and 100—Whatever error might be at the 20 will thus be reduced one half. In like manner, bisect between the 60 and 100, and we get the 80 point with only ¼ of the error at the approximate 20; the error is thus reduced to a quantity almost insensible. The 80 may, therefore, be assumed to be correct. In the same manner get 40 by bisecting between 0 and 80, and then bisect each of these portions, and we have correctly 20, 40, 60 and 80. In the same manner we may, if we choose, get the tens and fives. Each of these points is obtained as correctly as the original freezing and boiling points, and thus the scale is graduated according to the capacity of the tube, independant of any partial irregularities. In this way I have graduated different thermometers, whose indications agreed perfectly through their whole extent. The same method is applicable, with equal facility, to ascertain the position of the degrees above the boiling point, and below freezing. If the operator have a little dexterity, he will do the whole in a very short time. In the course of a single day a good workman may thus ascertain the 25, 50 and 75 points, on a very great number of thermometers, each independent of any thing but the extreme points of its own scale, and with less trouble than by a careful comparison with a register which, very probably, may be incorrect. I have found thermometers graduated from a register having scales sensibly unequable, though the bore of the tube, ascertained by this method, was to all sense perfectly so, and others having equable scales with unequable bores. The thermometers which I examined in this way, were made by Cary, Newman, and Jones; in every one of which I found serious discrepancies: so that I am inclined to believe, that the registers from which they are in the habit of graduating their instruments, would be found defective, if examined in this manner.

I have been thus particular on this subject, for it is obvious, that whatever be the laws of expansion, &c. it is quite impossible that they can be correctly ascertained, if the instruments employed be essentially defective. I hope, therefore, that experimenters will see the necessity of using more correct instruments than heretofore, and that workmen will see the necessity of paying more attention to the graduation of their instruments, laying aside the present system of *assuming*, without sufficient proof, *one* instrument to be correct, and then graduating others from it.

The separated thread in the stem is very easily obtained of any required length, or finally joined to the mercury in the bulb. For example, if we want to increase the length of the detached thread, we have merely to cool the bulb, and then bring the detached portion in the stem into contact with that from the bulb; then on heating the bulb the point of junction will not alter its position, while the mercury rises; and when it is of the desired length above the point of junction, it will separate at that point on reversing the instrument. The detached portion may be lessened by the reverse process, by first causing it to run to the upper end of the tube, and while in that position, cause the mercury from the bulb to join it; then, by cooling the bulb, the detached portion may be reduced, or exhausted, according to pleasure. A little practice will explain these operations much better than any verbal description, and I desire to be as brief as consists with perspicuity.

VII.—*Miscellaneous Notices.*

1.—*Mortality in Calcutta.*

The following list of Protestant burials is believed to be tolerably correct. The results deducible from it are rather different, we believe, to the conclusions generally acquiesced in; we mean the superior healthiness of the years 1829-30. In 1829 the deaths appear to have been but two-thirds of what they were in 1822. If the number of Protestant inhabitants could be accurately ascertained, we should have some grounds for inferring the value of life in Calcutta. Perhaps some of our readers could give us some information on this subject.

Burials in Calcutta of Protestant Christians.

1820,..............	281
1821,..............	246
1822,..............	324
1823,..............	270
1824,..............	278
1825,..............	297
1826,..............	275
1827,..............	254
1828,..............	256
1829,..............	184
1830,..............	224

2.—*Elevation of the Station of Health at Cherrapunji.*

From a series of corresponding observations made in October last, at this station, and in Calcutta, with Barometers previously compared, the following results were deduced.

By 10 observations made at 10 o'clock, the height seemed to be		4282 feet.
By 10 do. do.	at noon,	4289 ,,
By 7 do. do.	at 4 P. M.	4287 ,,
	Mean,	4286

3.—*Mr. Muston's Method of restoring damaged Drawing Paper.*

A wash is composed of isinglass one drachm, steeped for twelve hours in two ounces of water; then simmered for 15 or 20 minutes over a fire. When nearly ready, add twenty grains of common alum, in powder, and strain it through linen for use.

I apply this wash when the paper is on the drawing board, and *damp*: and I work it with the flat brush so that the wash shall be absorbed.

When dry, I wash the paper with clean water, which tells me if a second wash be necessary. When the paper is recovered, I wash it again with plain water, and a flat brush, to take off any superfluous isinglass, and then absorb the superfluous water with a clean piece of rag. When nearly dry, I throw in my sky, &c. as usual on good paper.

4.—*Demonstration of the Theorem, pages* 160, 161. *Vol.* 1. *Tr. Survey.*

PA being the Meridian of Greenwich and GE and SD perpendicular thereto, they are great circles, and of course they gradually approach each other till they intersect in the pole of PA—Their mutual distance at any intermediate corresponding point is as the sine of the distance from their point of intersection; or what is the same thing, as the cosine of the distance from PA, the great circle passing through their middle, hence GS : ED (= GR) : : Rad : cos. SD.

R. S.

VIII.—*Proceedings of Societies.*

1.—ASIATIC SOCIETY.

Wednesday, the 9th March.

The President, Sir C. Grey, in the Chair.

The Reverend Mr. Robertson, and the Reverend Mr. Proctor were elected Members.

Letters were read from the Royal Asiatic and the Geological Societies of London, acknowledging the 1st Part of the Transactions of the Physical Class. Also one from Mr. Pakenham, and another from Mr. Bilderbeck, on the subject of the publication of a History of Goa, by the latter.

The following resolutions moved by Dr. Grant, and seconded by Mr. Baillie, were adopted:—

That, where circumstances admit of it, the subject of the papers to be read, be stated in the Circular calling the Meeting.

That the names of the Members to be balloted for, be also specified in the same.

Resolved, upon the motion of the Secretary, seconded by Sir C. Grey—That it shall be optional with Members, who have subscribed for twenty years and upwards, to continue their pecuniary contributions.

A letter was read from the Secretary to the Physical Class, forwarding a Report from the Sub-Committee appointed to superintend the works carried on in the Fort, for the discovery of a fresh water spring, and requesting a further pecuniary grant in aid of the same. Resolved, upon a motion made by Sir Edward Ryan, seconded by Dr. Grant—That, with reference to the Report just read, and the progress of the boring experiment now carrying on in Fort William, a further advance of 1,000 Rupees be placed at the disposal of the Physical Class, for the continuance of the same.

The Secretary announced his intention of submitting through the Committee, the names of four foreign gentlemen for election, as Honorary Members of the Society. It was resolved, that the Committee take into consideration also, and Report at the next meeting, how far it may be expedient to extend admission to the Society to residents in India as non-subscribing members.

Read a letter from Dr. Renselaer, presenting the continuation of the *Annals of the Museum of Natural History at New York*. The following books were presented—1st Volume of a *Dictionary, Bengali and English*, by Baboo Ram Comul Sen. The *Mahabharat*, in Hindee, by Lakhinarain Pundit. *Journal Asiatique*, Nos. 27-28, by the Asiatic Society of Paris. Third Volume of the *Transactions of the Society of Commerce and Agriculture at Caen*, by the Society. Twelfth Vol. of the *Transactions of the Batavian Society*, by the Association. *Ashbach's History of the Ommiades* in Spain, by the Author. The *Meteorological Registers*, for November, December, and January, from the Surveyor General's Office. A paper by the Secretary was then read, entitled Notes on the portion of the *Dionysiacs* of Nonnus, relating to the Indians.

In the IXth vol., page 93, of the *Researches*, the late Colonel Wilford, quoting the *Dionysiaca* of Nonnus, asserts that they "are really the history of the Mahabharata, or great war. A certain Dionysius, he continues, wrote also a history of the Mahabharata in Greek, which is lost, but from the few fragments remaining, it appears that it was nearly the same with that of Nonnus, and he entitled his work *Bassarica*. The Dionysiacs supply deficiencies in the Mahabharata in Sanscrit, such as some emigrations from India, which it is highly probable, took place in consequence of the bloody war." Sir William Jones, observes Mr. Wilson, had a different notion of the *Dionysiacs*, although he also was disposed to draw a parallel between them and a Hindu poem—the *Ramayana*; expressing himself confident that an accurate comparison of the two poems would establish the identity of Dionysius, and the elder Rama. The writer proceeds to examine the analogies traceable between the Poem of Nonnus and the great Indian Epic. That any affinity between Dionysius and Rama is evinced by the *Dionysiacs*, as compared with the *Ramayana*, is an assertion, he thinks, which a comparison will scarcely justify.

'There is no resemblance between the heroes, nor in the course of events, and the whole identity resolves itself into whatever likeness Hanuman and his Apes may be thought to bear to Pan and his Satyrs. The opinion of Sir William Jones rested therefore on more unsatisfactory grounds than he suspected. With the Mahabharat, there is perhaps a rather less questionable analogy; but we can scarcely admit with Wilford, that the work of Nonnus is the history of the Great War, or that it supplies any deficiencies in the Sanscrit composition.'

In order to set this in a clearer light, Mr. Wilson adverts briefly to the subjects of the two Indian Epics, and gives a detail more at length of such portions of the *Dionysiaca* as relate to the events, of which India is the site or theme.

The *Ramayana* relates, as is well known, a leading event in the life of RAMA, king of Ayodhya, or Oude. Having been banished by his father Dasaratha, he adopted the life of an Ascetic in the forests, at the sources of the Godaveri, accompanied by his brother Lakshmana, and his wife Sita. The latter being stolen from him by RAVANA, king of *Lancá*, RAMA, with the assistance of SUGRIVA, king of the Monkeys, or foresters and mountaineers of Karnata, invaded the capital of the ravisher, took it, killed RAVANA in battle, established VEBHISHANA, that monarch's brother, on the throne, and returned to Ayodhya, of which, his father being dead, he assumed the sovereignty.

The Mahabharat details the dissensions of the Pandava and Kaurava princes, who were cousins by birth, and rival competitors for the throne of Hastinapur. The latter were at first successful, and compelled the former to secrete themselves for a season, until they contracted an alliance with a powerful prince in the Punjab, when a part of the kingdom was transferred to them. Subsequently, this was lost by the Pandavas at dice, and they were again driven into exile, from which they emerged to assert their rights in arms. All the princes of India took part with one or other of the contending kinsmen, and a series of battles took place in Kurukshetra, the modern Tahnesar, which ended in the destruction of Duryodhan and the other Kaurava princes, and the elevation of Yadhishthera, the elder of the Pandava brothers, to the supreme sovereignty over India. I shall now offer a sketch of that portion of the Dionysiacs which I have noticed above, premising, however, that I cannot pretend to have done more than cursorily inspect the work, and form a general idea of its details. Sir William Jones acknowledges he never read more than half of it, and those to whom the composition is known, will probably be disposed to admit, that to have effected even so much, was a proof of no ordinary patience and assiduity. The general character of the poem is exceedingly Indian, being of extreme prolixity, and the course of the story being incessantly interrupted by mythological episodes, more curious often than instructive or interesting.

The Hero of the Poem of Nonnus, (a Christian Monk, and native of Egypt, who flourished in the 5th Century,) is *Bacchus*, or Dionysos, one of whose exploits is the conquest of India. In the thirteenth Book, Jupiters ends his son Bacchus to direct him to force the impious Indians to drink wine and celebrate nocturnal orgies, or to expel them from Asia. The King of the Indians is named *Deriades*, and in this, perhaps, an affinity may be found to the *Kuru* Prince *Duryodhan.* From the thirteenth to the twentieth Books, it requires some ingenuity to find any thing decidedly Hindu. The distinguished personage Morrheus, may possibly, as conjectured by Wilford, be a corruption of Maharaja; Moricis, (as it was pronounced by the Greeks,) being, according to Hesychius, the Indian term for King, and *Mai* implying great. In the twenty-third Book, the followers of Bacchus cross the Hydaspes by various means, amongst which is that of inflated skins, still common on the rivers of the Punjab. In the beginning of the twenty-sixth Book, Deriaden, after his repulse, again prepares for war, and in the enumeration of his forces, some of his troops are said to have come from the strong hold of Rodoes, conjectured, by Major Wilford, to be Rotas, and from the Parapomisan mountains, the western portion of the Imaus or Himalaya chain. There also came the Dards, with whom we are familiar in Hindu history, as the Daradas, or mountaineers of the borders of Kashmir, and the people of Patalinne, with a saline soil, which place is readily identifiable with the Indo-Scythic town Patalene, at the mouth of the Indus. With these march the hairy-breasted Dussæi Subiri—the latter, possibly, the Suviras, or Subiras of the Puranas. We have also, along with various others, (adverted to more particularly in the paper,) the Xuthri, Arieni, Za-ori, I-öri, Kaspein, whom we know to be Kashmirians. We have also the Sibæ, the Sivas of Pauranic Geography. According to Wilford, Gaur-ades is Bengal, and O-eta, furnishing superior Elephants, he conjectures to be Ayodhya or Oude. All these forces obey Deriaden, who is the son of Hydaspes, by the nymph Astris, a daughter of the Sun by Ceto the Naiad. The Hindu legend makes Duryodhan, not the son exactly, but the descendant of the Sun, through his daughter Tapati, the Naiad, or Goddess, from whom the Taptí river derives its name. In the twenty-eighth Book, a battle takes place betwen the forces of Bacchus and Deriaden. The Indians are described as armed with swords and shields, bows and arrows; and their chiefs wearing mail, and mounted on chariots, or riding on elephants. 'In the thirtieth Book, Morrheus falls upon the Satyrs, and wounds Eurymedon, the son of Vulcan, who comes to his succour, and involves the victor in a flame of fire. Hydaspes comes to his aid, and extinguishes the flame. This is undoubtedly Indian, and both in the Mahabharat and Ramayana, we have repeated introduction of the counteracting elements, fire and water, employed as weapons by the chief heroes.' After a tremendous conflict, in which the Gods, as in Homer, espouse different sides, Bacchus finding that the Indians are not to be subdued by land, prepares to attack them by sea. With this view he orders the Arab Rhadamenes to build him a fleet. A few lines at the beginning of the thirty-seventh Book, correctly express Hindu sentiments. The Indians, says Nonnus, burnt their dead with tearless eyes, considering that the deceased had escaped the bonds of life, and the spirit had returned to its circular revolution, to the goal from whence it first set out. In the thirty-ninth and fortieth Books, the Rhadamanes, or Arabs, enter the Hydaspes with their fleet, which is encountered, under the walls of Deris, by the Indian flotilla, commanded by Deriaden and Morrheus. A sanguinary conflict ensues—and the war is terminated by the triumph of Bacchus. On the whole, Mr. Wilson observes, that it is clear the Dionysiacs have nothing in common with the Ramayana, and little more with the Mahabharat; although they no doubt offer some analogies in the names of persons and places.

There can be no doubt, that an active intercourse subsisted between India and Egypt in the early ages of Christianity, by way of the Red Sea, carried on by both Arab and Indian vessels. The ancient fictions, and, it may be added, laws of the Hindus—and the vestiges of their race, language, and religion, found in distant countries, particularly in the Eastern Archipelago, prove that there was a time when they were enterprising navigators, and that they were, as Nonnus asserts, accustomed to naval tactics. That they should visit Egypt—that some of them, probably many, were to be found at Alexandria and other cities of that country, is therefore nothing unaccountable; and from them Nonnus, himself an Egyptian, might easily have collected much more valuable accessions to his long and elaborate composition, than those which it actually affords.

Class of Natural History and Physics.

Friday, March 11th, 1831.

Sir Edward Ryan in the chair.

1.—Letters were read from the Secretaries of the Royal Asiatic and the Geological Societies, acknowledging the receipt of the first volume of the Physical Department, Asiatic Researches.

2.—A letter from the Secretary to the Asiatic Society communicated a Resolution of the last meeting of the Society, granting a further assignment of Rupees One Thousand towards the experimental borings in Fort William.

3.—*The Annals of the Lycæum of Natural History at New York*, and some other Scientific American publications, were presented on the part of that Institution.

Some discussion here occurred on the propriety of the distribution of the Transactions of the Class, in return for compliments of this nature, which led to remarks on the general subject of the publication of papers read at the Meetings. The Class adopted the opinion of their Committee of Papers, that many communications with which they were favored, more particularly those of ephemeral interest, might be appropriately disposed of by publication in the *Gleanings in Science*, a monthly journal, edited by a Member of the Society: they would thus appear in print, without the delay unavoidable in completing the volume of Transactions, and by means of the twelve copies subscribed for by the Class, their immediate circulation would be ensured. It was resolved, that copies of the Gleanings should be sent, as issued from the press, to the Editors of the following Scientific Periodicals—the *Bulletin Universelle*, the *Royal Institution*, and the *Edinburgh Journals;* also to the following Literary Societies—the Royal Asiatic, the Madras, the Bombay, the Ceylon, and the Batavian. The Committee of Papers to exercise, as usual, their discretion in all matters connected with this subject.

4.—A letter was read from G. Swinton, Esq. Chief Secretary to Government, transmitting a specimen of the Ava Platina, in grains, received from Major Burney.

As it is now ascertained, that the Mineral comes from a place called Kannee, on the Kuenduen river, which is the eastern boundary of Munnipoor, we may hope soon to become better acquainted with the localities of the Platina mines of Ava.

5.—A letter was read from Dr. Gerard, on the subject of the fossil shell strata of the Himmalaya. The shells resembling the Unio, were mostly found in a loose stratum of black slatey schist, minutely pulverized, and at a varying elevation between thirteen and fifteen thousand feet, both upon the declivity of the Speetee and upon the outward corresponding slope of the marginal rocks. They also occurred in the soil of the fields, and upon the surface of waste tracts, in a wide hollow between the limestone rocks, which contained the profusion of pectens and other shells imbedded; they are never found in the massive shell formation itself, but abound in the loose soil, and are sometimes seen adhering to, or imbedded in schist. The ammonites occur in the sandstone on the summit of the calcareous rocks above-mentioned, at an elevation of fifteen thousand feet. One cliff, rising vertically at this altitude, appeared to be formed of alternate strata of "shell rock, black slate, and horizontal sandstone."

The terebratulæ, detached and in mass, were particulurly remarked in the Laitche Lang Chain, the third great ridge of the Himmalaya, at an elevation of seventeen thousand feet, altogether distinct from the other formation.

Dr. Gerard is preparing a geological section of the Speetee valley, which will materially assist in developing the facts of his most interesting researches.

6.—A stuffed animal, brought from Van Diemen's Land, by Dr. Henderson, was presented, by his permission, for the inspection of the Society, by Dr. Grant[1].

7.—A fragment of Calcareous Rock, received from Dr. Govan, of Soobatoo, was presented by the Hon'ble Sir Charles Grey; supposed to contain the fossil impression of a lizard's tail.

8. A paper was read " on Artificial Hydraulic Cements, by Lieutenant W. Saunders, Madras Engineers," communicated by the Secretary[2].

The thanks of the Society having been voted for these various contributions, the Class proceeded to the inspection of the new Compensation Bars provided by the Hon'ble Company, for the measurement of base lines in the Grand Trigonometrical Survey of India. They were placed along the apartment exactly as prepared for use, with the various apparatus mounted, to shew the construction, the adjustments, &c. Captain Everest, Surveyor General and Superintendent of the Trigonometrical Survey, entered into a complete and highly interesting explanation of the subject.

He first adverted to the great difficulty of performing, within certain limits of accuracy, that apparently simple operation of measuring a straight line;—the number of linear units in use among different nations, all at variance, though nominally derived from the same primitive sources, the human foot, and the barley corn : the very recent date of their actual lengths being compared by Captain Kater's experiments under the orders of Parliament. He traced the origin of the modern measurements of the earth to M. Richer's observation on the diminished length of the seconds pendulum at Cayenne, in 1672, and the consequent investigation of the figure of the earth by Huygens and Newton, which stimulated the exertions of the philosophers of France, Italy, Sweden, and last of all, England, to the practical solution of this important problem, by the measurement of meridianal arcs in different parts of the world. As the chief accuracy of the results of these depended on the base or portion of the line actually measured, every means were sought of attaining perfection in the instruments used for this purpose. Wooden rods were subject to warp and lengthen, from humidity;—chains to wear at the joints, and vary with alternations of heat and cold;—glass rods were troublesome and fragile.—The French had at last the merit of introducing a compound bar of platina and brass, which, by the unequal expansion of the two metals, always pointed out its own correction for temperature; but Colonel Colby, of the Irish Trigonometrical Survey, the inventor of the present apparatus, has surpassed them, by doing away with all correction whatever. The principal of his invention, as far as it is possible to explain it in so brief a notice, is as follows. Brass expands nearly half as much again with heat as steel; two bars of these metals, ten feet in length, are in practice, therefore placed side by side, say one inch apart, and firmly united together in the centre; upon heating these, the brass bar will expand one part in three more than the other: if therefore their ends be united together by a moveable lever, projecting two inches beyond the steel bar, (making the whole length of the lever three inches,) then a point at the end of this lever will always remain fixed, because we have two similar triangles superposed, the sides of which are three and two inches respectively, and their variable bases (i. e. their expansion) also in the same ratio. There are similar levers at both ends of the double bars, so that the distance between the fine dots adjusted upon these, remains invariable. There are three pairs of bars, which are placed in extension along the line, and adjusted by means of a " boning" telescope : the ends of the bars are kept six inches apart, to prevent any shake or disturbance, and this distance is set off by means of double microscopes, so fitted as to bisect the dots of two adjacent bars: these microscopes are also compensated, that their distance apart may be invariable like that of the bars. It will be sufficient to give some idea of the perfection of this mode of measuring, by stating, that in an experimental trial of the rods in Lord's Cricket Ground, a length of five hundred and sixty-seven feet was twice measured with a difference in result of only $\frac{3}{40}$ of an inch, which is equal to $\frac{3}{10}$ of an inch per mile. Former operations of the best geologists, have frequently varied upwards of ten inches in the mile.

The thanks of the Class were voted to Captain Everest, and the Meeting adjourned at 11 P. M.

[1] The notice which accompanied this specimen will be found in our next number.
[2] This paper was published in our last number, p. 54.

2.—Medical and Physical Society.

Tuesday, 5*th March.*

The President in the Chair.

Drs. MacNab, Bruce, and Voight were elected Members.

The following communications received since last meeting, were laid before the Society. 1—A letter from Mr. Grierson, (from London,) forwarding a print of the great Sympathetic Nerve, and an Articulated Skeleton, formerly ordered by the Society. 2—A letter from Assistant Surgeon Spry, (presented by the Medical Board,) on the manufacture of Glauber's Salt at Cawnpore. 3—A letter from Dr. Stevenson, His Majesty's 13th Light Dragoons, from Trichinopoly, with a specimen of *Lichen Vulgaris*, which is used as a Dietetic on that side of India. 4—A communication from Dr. Minto, with a specimen of *lumbricus* from the stomach of a child. 5—A report on fractures, by Mr. Raleigh. 6—An account of the Cholera which appeared on board the H. C. Chartered ship Abercrombie Robinson, on her voyage from Bombay to China. 7—A book, with detail of all the cases alluded to in the above report. 8—An account of the Medical properties of the *Haritaka*, or Myrobolan, from Rajah Kali Kissen, presented by Mr. Grant. 9—A Report of experiments, by Mr. Twining, to ascertain the Medical properties of Senna produced at the Honorable Company's Botanic Garden, Saharunpore, and sent down by Mr. Royle. A specimen of Hill Rhubarb, prepared by Mr. Royle, of Saharunpore, was laid upon the table. Mr. Spry's letter on the manufacture of Sulphate of Soda; Mr. Preston's communication on ligature of the Carotid Artery; and Mr. Raleigh's report on fractures, were then read, and gave rise to some interesting discussion.

Sulphate of Soda, or Glauber's Salt, it appears, exists in a native state in different parts of this country. That prepared and reported on by Mr. Spry, is derived from a mineral earth, well known to the natives by the name of *Khare Muttie*, the former word being the Arabic for Alkali, and the latter Sanscrit for earth. The only use made of the salts, by the Natives of Oude, is to give it to their sheep, it being supposed to have the effect of fining the fleece. The face of the country whence it is brought, is flat, and intersected by deep ravines. It abounds in the neighbourhood of Onaoo, about ten miles from the banks of the Ganges, and is in hard striated masses, mixed with sand. In rendering the salt free from impurities, little difficulty is experienced. The process adopted by the Natives is both easy and simple. It consists in boiling the *Khare Muttie* in little more than its weight of water, the whites of eggs having been previously beaten up and mixed with it until a pellicle forms. It is then allowed to stand for about half an hour, that the impurities may subside—after which the supernatant liquor is set aside to crystallize. This process is repeated to free the crystals from any remaining impurities, and the salt is then laid apart for use. Two pounds of earth treated in this manner, yields one pound of pure Glauber's Salt.

With reference to Mr. Preston's deviation from the usual mode of treating Palsy, he states, that he conceived generally, that the operation of tying the Carotid Artery might be had recourse to with advantage in diseases of the brain, especially such as we have reason to believe depend upon congestion, inflammation, or irritation of that organ; as its principal effect would be to diminish the supply of blood, an object we have more or less in view, in the treatment of cerebral affections, although it cannot always be accomplished by depletory measures. Venesection, and the application of leeches, often increase the determination to the head, partly by the disturbance they excite in the system, and partly by the reaction which frequently follows their employment. A more durable and more decided effect, it appeared to Mr. Preston, might be induced by this operation than by any mode of depletion; and he inclined to the opinion that it might entirely remove or greatly diminish congestion, and chronic inflammation of the brain, and its membranes, the cause he believes of many diseases, which the common mode of treatment too frequently fail of relieving. At length, a case came under Mr. Preston's care, which appearing hopeless, the disease being altogether unaffected by the remedies employed, and the strength beginning to sink; he determined on tying the common carotid artery, which he did accordingly on the right side—bearing in mind the circumstance, that injury of either hemisphere of the brain effects the side of the body opposite the lesion, and here the paralytic affection was on the left side. The case is minutely reported on for about twenty days after the operation, but the paralysis, it seems, was not cured; though the man had somewhat improved, having recovered the power of articulating as distinctly as before the attack, which did not exist before the operation; and being able to walk about with the help of a stick.

Mr. Raleigh's paper is in continuation of his report on the treatment of fractures according to the principles laid down, and with the apparatus recommended by Mr.

Amesbury, in elucidation of which several cases are given. These strongly illustrate the great improvement in the treatment of fractures which Mr. Amesbury's plan has introduced, for in fractures of the leg, the limb being secured according to it—the patient, instead of lying on his back in bed, according to the old system, for many wearisome days—may sit up or walk about by the help of crutches. In disunited fractures of the upper part of the thigh bone, the efficacy of the fracture-bed, in promoting and establishing union, without leaving any apparent deformity, is proved by these cases—and Mr. Raleigh concludes, by repeating Mr. Amesbury's injunctions against the use of the several apparatuses, in cases to which they are not applicable, reminding those who make use of them, that in all cases of fracture above the middle of the thigh, the fracture-bed should be had recourse to. Mr. Raleigh's experience has convinced him of the necessity of attending to this injunction.

3.—Agricultural and Horticultural Society.

Monday, March 9, 1831.

Sir Edward Ryan, President, in the chair.

The following gentlemen were proposed, and admitted as Members:

D. McFarlan, Esq. C. G. Blagrave, Esq. W. Bell, Esq. Capt. T. M. Taylor.

Sir Edward Ryan read a letter from Mr. Deverinne, the Superintendent of the Society's farm at Dacca, soliciting permission to cultivate, for his private benefit, a piece of land containing about 120 beegahs, lying adjacent to the farm and the river.

A statement was delivered of Mr. Deverinne's connexion with the Society: by which it appeared, that on a former occasion his salary had been raised from 100 to 200 Rupees per month, but he was then bound to enter into no engagements or services, beside those with the Society.

It was contended by several members, thatan acquiescence with Mr. Deverinne's petition would be an innovation on the principles of the Society.

The proposal was negatived by votes of 8 to 2.

Sir Edward Ryan read a letter from Dr. Tytler, on the evil effects of a coarse rice produced in different parts of Bengal. Experiments had been tried on goats, with the worst possible results, from which he argued that this grain is unwholesome. The letter ordered to remain for future consideration.

Mr. Robison read a letter from Mr. Henley, of Barripore, to Mr. Calder, on the subject of the cultivation of sugar at that place. The specimens were not intended to prove that the manufacture had yet arrived at any degree of perfection, but merely to shew, that a certain sort of cane, hitherto much neglected by the natives, is worthy of cultivation.

Another letter from Mr. Henley was read, which stated, that the proper season for planting Cotton is from March to May. Mr. H. also tendered a considerable quantity of South-Sea-Island Cotton seed, which is of a much superior quality to that imported by the Company.

Resolved, that Mr. Henley's tender be accepted, and that he receive the thanks of the Society.

Mr. Robison presented a bottle, containing the seeds of various sorts of plantains, from Captain Jenkins, to enable the Society to make experiments for rearing the fruit in the manner that is now adopted with apples, pears, &c.

Specimens of Tenasserim Cotton, from Mr. F. Harris, of Cawnpore, were examined. A member observed, that though the Cotton was of a coarse description, yet its softness would admit of its being mixed with some of a finer quality with great advantage.

A petition was read from Mr. W. Bull, for the assistance of the Society, to enable him to procure the necessaries for supplying Calcutta with hermetically sealed vegetables. Mr. Robison observed, that " articles of a similar description to the specimens sent by Mr. Bull, are brought out from England, and are readily sold at exorbitant prices. Mr. Bull being in distress, is not able to advance his scheme, without aid from the Society; we have only to consider how far his project comes within the views of the Society."

The specimens to be kept for examination.

Sir Edward Ryan proposed, that it be now stated on what articles premium were to be advanced in next January. Mr. Parker recommended that premiums be given for the production of vegetables at the periods in which they are now not procurable. Resolved,

That premiums be given for the best guavas, mangoes, pine-apples, and other native fruits.

Mr. Earle recommended that a Committee be formed, to examine the production on the soil.

The President, in conclusion, proposed, that a notice of the premiums to be given this year, for the best samples of cotton, fruits, and vegetables, be forthwith drawn up, and widely circulated through the interior, which was unanimously agreed to.

The meeting broke up at 6 o'clock.

Meteorological Register kept at the Surveyor General's Office, Calcutta, for the Month of March, 1831.

Day of the Month.	Minimum Temperature observed at Sunrise.					Maximum Pressure observed at 9h. 40m.					Observations made at apparent Noon.					Max. Temp. and Dep. of M.B.Ther. obs. at 2h. 40m.					Minimum Pressure observed at 4h. 0m.					Observations made at Sunset.					Rain gauge No. 1.	Rain gauge No. 2.
	Barometer reduced to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the Air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the Air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the Air.	Depres of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.		
1	30,065	60,	6,9	n.w.	cis.	,107	64,6	11,2	n.w.	cus.	,077	67,	12,4	n.w.	cis.	,013	68,5	13,1	n.w	cis.	,999	68,3	12,9	n.w.	ci.	,993	63,5	5,1	n. w.	ci.		
2	,044	50,3	0,9	cm.	cl.	,083	66,8	12,1	do.	cl.	,042	73,	17,6	do.	cl.	,964	75,2	18,	do.	ci.	,982	74,8	18,4	do.	cis.	,965	70,	5,6	cm.	cis.		
3	,115	58,	4,6	do.	do.	,136	71,5	13,8	cm.	do.	,085	73,8	13,9	do.	do.	,009	77,3	16,9	do.	do.	,998	76,7	10,	do.	cl.	,005	69,	8,6	do.	cl.		
4	,055	63,	7,6	n.w.	do.	,074	72,3	11,9	n.w.	do.	,026	79,6	14,6	do.	do.	,959	82,	15,8	do.	do.	,946	82,	15,3	do.	do.	,944	74,5	8,6	do.	do.		
5	29,964	63,3	5,9	do.	do.	,003	75,7	11,	cm.	do.	,961	81,3	16,4	do.	do.	,880	84,5	17,8	do.	do.	,849	85,3	16,6	do.	do.	,862	77,	9,1	do.	do.		
6	,867	67,3	0,6	cm.	do.	,899	79,5	9,1	s.w.	do.	,857	84,5	11,1	s. w.	do.	,811	85,5	11,1	s. w.	do.	,782	85,	11,1	s. w.	do.	,786	79,	8,1	s. w.	do.		
7	,836	70,	0,3	s.w.	cus.	,891	77,7	5,	do.	cu.	,841	86,	12,6	do.	do.	,770	87,3	10,4	do.	do.	,770	85,3	12,3	do.	do.	,768	79,	7,6	do.	do.		
8	,855	72,5	1,1	cm.	do.	,893	78,8	5,8	do.	do.	,877	85,6	8,6	cm.	do.	,820	88,6	14,6	do.	do.	,796	88,3	14,1	do.	do.	,821	84,5	8,1	cm.	do.		
9	,959	73,5	0,5	do.	cy.	,072	77,8	3,1	cm.	do.	,995	86,8	7,8	w.	do.	,928	89,6	12,7	w.	do.	,923	89,	11,4	w.	do.	,956	83,5	6,6	do.	do.		
10	,987	74,5	2,3	do.	do.	,021	79,5	5,1	s. w.	do.	,990	85,5	7,8	do.	ci.	,908	90,3	11,4	s. w.	cu.	,879	90,3	9,9	n.w.	cus.	,895	86,	5,6	do.	cis.		
11	,939	74,	0,6	s. w.	cl.	,977	82,5	5,6	do.	do.	,945	86,2	7,5	do.	cu.	,869	90,2	11,	do.	do.	,868	87,8	11,1	do.	do.	,880	85,3	9,2	do.	do.		
12	,918	74,8	0,4	cm.	cus.	,989	78,8	8,4	do.	cus.	,959	81,6	10,6	n.w.	cis.	,897	84,8	12,9	do.	cus.	,896	84,5	12,3	do.	cis.	,919	80,	9,6	do.	do.		
13	30,009	72,	2,6	s. w.	do.	,030	83,	11,6	s. w.	cis.	,998	85,	11,6	s. w.	do.	,939	87,5	13,6	do.	do.	,916	84,	12,1	s. w.	do.	,937	75,5	5,1	s. w.	cus.		
14	,023	69,8	0,9	cm.	n.	,125	77,3	5,7	cm.	do.	,042	78,3	8,4	do.	rn.	,003	74,3	4,4	do.	rn.	,974	72,8	3,4	do.	n.	,969	71,5	3,6	cm.	cy.	0,15	0,13
15	,013	67,5	0,6	do.	cis.	,058	77,	4,3	s. w.	do.	,010	83,3	8,4	do.	cu.	,919	82,8	10,1	cm.	do.	,932	76,5	4,1	cm.	rn.	,943	75,3	4,9	do.	cis.	0,05	0,02
16	29,972	68,5	1,1	do.	cy.	,034	73,	3,6	do.	cu.	,017	78,5	6,8	do.	do.	,940	84,3	13,3	s. w.	cu.	,917	83,8	10,4	do.	cu.	,923	79,	7,1	do.	do.		
17	,928	69,	0,6	do.	cl.	,968	80,2	8,5	do.	ci.	,918	84,3	14,1	do.	ci.	,865	88,	20,2	do.	ci.	,835	86,5	19,3	s. w.	ci.	,852	84,7	17,9	s. w.	cl.		
18	,873	70,	1,3	do.	do.	,886	80,3	10,9	do.	cl.	,847	87,	16,8	do.	cl.	,779	91,5	19,1	do.	cl.	,767	91,3	10,6	do.	cl.	,772	85,3	15,1	cm.	do.		
19	,826	72,5	1,6	do.	do.	,861	82,8	9,4	cm.	do.	,829	89,5	15,3	do.	do.	,751	94,8	20,6	do.	cu.	,745	94,	11,	cm.	cu.	,824	85,	10,6	do.	ci.		
20	,864	73,3	0,9	do.	cu.	,908	85,5	12,6	s. w.	do.	,854	87,7	15,3	do.	co.	,851	94,3	21,9	do.	ci.	,802	94,	12,1	do.	ci.	,814	86,3	12,9	do.	do.		
21	,895	72,3	1,4	s. w.	cl.	,937	82,8	6,4	cm.	do.	,906	88,9	12.2	w.	cu	,837	90,2	15,	w.	do.	,837	90,	15,1	w.	do.	,836	85,5	8,6	do.	do.		
22	,909	74,5	3,5	do.	do.	,957	85,	9,1	n. e.	do.	,906	89,9	12,5	cm.	cl.	,838	93,5	18,8	n. e.	do.	,816	93,3	18,3	n. e.	do.	,852	82,5	9,6	do.	cl.		
23	,940	72,	3,6	cm.	do.	,001	81,3	10,9	e.	ci.	,966	86,5	12,8	n. e.	ci.	,890	91,6	15,7	do.	do.	,874	90,5	14,8	cm.	do.	,864	86,5	12,6	do.	do.		
24	,941	74,	0,6	do.	cu.	,987	78,5	5,1	cm.	cis.	,960	83,5	10,9	s. w.	cis.	,863	86,3	12,4	s. w.	cis.	,861	85,	9,6	do.	cis.	,878	81,5	7,1	do.	do.		
25	,897	73,5	2,4	do.	cl.	,959	84,	6,1	n. e.	cu.	,834	87,5	10,8	n. e.	cu.	,796	92,6	14,9	n. e.	cu.	,787	87,5	11,9	e.	cu.	,832	76,	4,6	do.	n.		
26	,871	69,5	0,4	do.		,935	79,	5,6	c.	cus.	,908	82,5	5,6	e.	cus.	,828	88,3	10,1	do.	cus.	,809	87,	9,6	n. e.	cus.	,816	82,	4,6	do.	cis.	0,30	0,28
27	,923	74,	0,6	do.	cl.	,981	85,	8,6	n. c.	cis.	,938	86,7	9,	n. e.	do.	,858	93,	16,6	do.	cis.	,834	92,5	16,1	do.	cis.	,877	85,5	7,1	do.	cu.		
28	,955	77,	0,6	s. w.	cis.	,007	82,	3,6	s. w.	cus.	,961	88,3	7,9	s. w.	cu.	,879	92,5	11,6	s. w.	cu.	,867	92,6	11,4	cm.	cl.	,837	86,	9,6	do.	cl.		
29	,922	76,	1,6	do.	cl.	,979	87,5	8,8	do.	cl.	,922	95,	14,3	do.	cl.	,843	96,3	15,9	cm.	cl.	,829	96,3	17,4	s. w.	do.	,838	88,5	11,1	do.	do.		
30	,852	76,	0,6	cm.	do.	,887	89,3	9,6	do.	do.	,838	94,3	16,1	w.	do.	,738	97,	14,	w.	do.	,737	95,	13,	cm.	ci.	,739	89,	7,6	do.	cis.		
31	,761	77,7	1,	s. w.	do.	,793	90,8	11,5	do.	do.	,769	96,	16,3	s. w.	do.	,704	99,3	15,4	s. w.	ci.	,672	98,8	17,6	s. w.	ci.	,699	87,5	8,6	cm.	cl.		
Mean,	29,935	70,3	1,9			,981	79,7	8,2			,938	84,6	11,8			,866	87,8	14,5			,854	86,7	12,7			,868	80,8	8,4			0,50	0,43

Abbreviations. In the column "wind," small letters have been used instead of capitals; *cm.* means *calm*. In the column "Aspect of the sky, *cy.* is *cloudy*; *cl. clear*; *rn. rain*; *ci. cirrus*; *cu. cumulus*; *cs. cirro-stratus*; *cus. cumulo-stratus*; *cc. cirro-cumulus*; *n. nimbus*. The Rain-guage No. 1. is on the ground: No. 2 is on the roof of the house, 45 feet above it.

GLEANINGS

IN

SCIENCE.

No. 28.—*April,* 1831.

I.—*On the Source of Wealth.*

§ 2.—*Of Manufactured Wealth, and of the Income of Manufacturers.*

When we call to mind the absolute dependence of men upon food, and when we reflect on the continued struggles they are necessitated to make for its possession, we can readily discover the original motive by which those are actuated, who labour in rendering other products besides food applicable to the purposes of their fellow men. They seek to procure a maintenance from those who have something to spare, and who, under these circumstances, more intensely desire the enjoyment wrought products are capable of affording, than the gratification the quantity of food is calculated to yield, which suffices to supply the wants of the manufacturer.

Imagine now the case of the man who first applied metal to agricultural instruments: these, shod with iron, however rude and simple, must be considerably more powerful and durable than any before in use: agriculturalists will therefore readily give the constructor the food in exchange, which he may require: if in needy circumstances when he first commences his trade, his demand in return may be no more than suffices for his subsistence while employed upon the instrument: but as the utility of this implement becomes known, many more will be required at his hands than he can possibly supply; and he may then prescribe his own terms to his customers.

We have seen, that man's original income consists of the net produce which the reproductive principle leaves at his disposal; this, therefore, we may reckon the primary wealth of the society, in contradistinction to the produce of mere manipulation, which is wealth of a secondary description. We have also seen, that at any time, in the course of the progress of enrichment, the surplus of primary wealth set free for man's use, can only be a near approximation to what serves to satisfy the wants of the persons through whose instrumentality it is obtained. Individuals, in the early period of society now under consideration, can therefore have but little at their disposal, to offer in exchange for wrought goods. Where one has disposable, what will repay the person who prepares an item of secondary wealth, there will be hundreds who cannot part with the quantity he requires; and yet, however small the disposable fund possessed by individuals may be, wrought products may be so eminently useful, that even the least wealthy shall be willing to sacrifice a portion of their pittance to obtain them. And, provided there be a prospect of success in acquiring what they so intensely desire, they may thus be urged to increasing vigilance and exertion, in order that they may be enabled to add sufficiently to their income. Many, on these accounts, must be able to make a transfer to the preparers of wrought wares, which bears a small proportion to their whole income, who would look with apathy, as being beyond their reach, on manufactures which required the payment of a much larger proportion.

It follows from these considerations, that in proportion as the recompense demanded by manufacturers for their products, falls or rises, so must the demand for them be extended or contracted.

Now if we admit, that the sale of ten articles, each realizing twenty measures of corn, brings a less aggregate gain to the seller, than the sale of fifty of the same articles, at ten measures each; we must allow, that the maker of instruments shod with metal, with whose case we opened the discussion, in place of enriching himself, by continually raising his price when the demand grew brisk for his wares, might ultimately be producing a contrary effect. His true interest is connected, not with the height of the recompense obtained on each article sold, but with the amount of the gain realized in the aggregate, on all the sales he may be able to effect within a certain time. He may prefer, indeed, to get a high price on a few articles, provided that high price enables him to subsist in comparative idleness; but this conduct could only, for a short time, affect society; for other labourers, seeing his easy circumstances, would speedily flock to the trade, and the supply would be brought to market by a new class, in place of a single individual. There will be no difficulty in finding proper workmen to effect this; for however rare the genius which originates happy inventions, no extraordinary powers are requisite, after the process has been once suggested, practically to apply the same invention.

Although the gains of the manufacturers would be greater, when a sale was effected of fifty articles at 10 measures each, than when ten only were sold at 20 measures each; yet it does not follow that they will always enrich themselves by increasing the supply, and reducing the price demanded for each product.

If, for instance, they could only find a sale for 60 of their products, when they reduced the price of each to 8 measures of corn, direct impoverishment follows; in return too, for the greater exertions necessary in making the larger supply, than were required in preparing the smaller.

Between a very scanty supply at high prices, and an excessive supply at very low prices, there must, therfore, be some point to which prices must rapidly make an approximation; and that point must have been gained, when prices have settled to that which is found to hold, when the manufacturers enjoy the greatest aggregate of gain; their only motive in bringing any specific quantity to market, no more or less, being to secure this greatest aggregate of gain.

If we now suppose the wrought products of the manufacturer to have been brought into general use, each particular description of wares, being paid for from the net produce beyond their own consumption, remaining in the hands of the agricultural class; each member of that class will now be found regulating his exertions, not by what might suit his own particular consumption, were it entirely composed of food, but by what will feed himself, and serve to reimburse such manufacturers also, as minister to the higher gratification, now brought within his reach.

The quantity and nature of the products of agriculture, the primary wealth of the society, will be presently accommodated, therefore, to the anticipated demand of manufacturers, as inevitably as the produce of manufacturers will be regulated by the anticipated demand of agriculturists. When mutual demand and supply regulate one another, we may be assured, that there will be a constant approximation to such state of things, as leaves the whole society in the best possible circumstances, compatible with their present knowledge of productive arts; that there will come to market, at this time, only so many wrought commodities as, on the sum of the sales effected, yield the greatest aggregate gain to manufacturers; and that there will be offered in exchange for these, only so much agricultural produce as the cultivators find it most to their interest so to appropriate;—also, that any subsequent irregularity in the supply, either of wrought wares or of food, will tend to the impoverishment, not only of one, but of both classes of producers. Suppose an unusually great supply of wrought wares; and manufacturers, for the sake of obtaining a subsistence, may be under the necessity of forcing a sale at prices far below what yielded, on the whole of the sales effected, the greatest aggregate of gain. We may readily imagine the effects, in a sinking price, of a small excess of supply, coupled, as it would shortly be, with unusual eagerness amongst manufacturers for purchasers. But obtaining wrought goods at a price below that for which such wares could permanently be brought to market, would entail ultimate impoverishment on the agriculturists also; because, as the manufacturer's circumstances are reduced, so must their efficient demand for food be reduced also; and a glut brought on of that which, in its present amount and form, was prepared solely with a view to meeting their contingent demand.

If the supply of wrought wares were, on the other hand, suddenly reduced; from this deficiency of supply, manufacturers would not be enriched, but impoverished; in consequence of the rising prices of wrought goods which might be demanded. An efficient demand could only exist for a certain quantity of wrought produce, while the price demanded for each article was of a certain amount; raise that price, and the products are taken out of the reach of the many who had a small excess of food to spare beyond their own consumption; and they are left accessible to the few only, whose incomes are large: the high price cannot, therefore, hold; and the income of the manufacturers must be less in the aggregate than it was before; while the efficient demand of manufacturers for food, on which the well being of cultivators now depends, must suffer corresponding reduction.

Were the supply of food, the primary wealth which alone gives being to the rest, to suffer diminution, it is evident that all would be impoverished; and even if the supply of food were to be suddenly increased, enrichment would not necessarily follow; agriculturists then eagerly seeking purchasers for their perishable wares, the equilibrium of demand and supply would be deranged; and it was by the existence of this equilibrium that all were best enabled to obtain that which they most desired, and were thus kept in the best circumstances.

I have endeavoured to trace the income of manufacturers from the savings agriculturists would be tempted to make in their own consumption of food, and from the greater exertions they would be induced to make to secure the greater enjoyment wrought products yield; although my theory involves the supposition of the greatest exertion of labour being already made, and of a constant accession of numbers, whenever the means exist of supporting an increase of the agricultural class; possibly, however, the intensity of immediate enjoyment, anticipated from the acquisition of wrought goods, may justify the supposition, that sacrifices and exertions would be made by individuals, which the desire to provide their own increasing numbers could not effect. But in the probable event, of wrought wares coming into use, before the utmost spread of population, it is obvious, that providing sufficient food alone for the increasing numbers of their class, will cease to be the sole motive for exertion with agriculturists; and that agricultural population, with corresponding cultivation for their support, will now proceed, with reference to the power enjoyed of securing for each individual, not food alone, but food and those wrought wares also, which contribute more immediately than a small portion of food, to personal enjoyment; agricultural population would, in this case, fail to increase so much as it might have done, had food continued man's only want: the joint population, both agricultural, and manufacturing, will, however, be as great, and probably much greater, if we admit that wrought wares can serve as a motive for such greater exertion, as a mere addition to food was inadequate to call forth.

If, however, we suppose the wrought wares brought into use, to be instruments capable of abridging labour; spades, for instance, to supply the place of the naked hand in turning over the soil; then the source of new income, for the support of the new class, would be palpably evident; for thereby, the labour necessary in realizing any specific quantity of the net produce of the soil, would be greatly reduced; and each cultivator's patch of ground rendered more fit for the full developement and increase of his seed. If, with the co-operation of so much industry, unaided by manufactured implements, such results were given off by the reproductive energy as enabled the existing population to live, and to increase in numbers, surely when a better mode of cultivation is introduced, the means of living and of multiplying must now be vastly enlarged; whether for the consumption of a growing agricultural population, or for the subsistence of manufacturers, the produce of whose labour is more desirable than food. On this subject more will be said when we come to treat of capital; mean time it is obvious, that on any given extent of country, there can only be obtained productive employment for a certain number of manufacturing, as well as agricultural labourers; and that the extent of the secondary wealth must bear some constant relation to the primary wealth which the country can give off; for after the greatest net produce has been obtained from the land, and after the reciprocal demands of agriculturists and manufacturers have been accommodated to one another, any attempt at a further production of wrought products, like attempts to force increase from the soil, by dint of labour alone, must be nugatory. Thus, if after the aggregate gains of the manufacturing class have reached their maximum, more labour be sunk in this mode of production, the food enjoyed by the whole class must be less than it was before, owing to the reduced remuneration in primary wealth, which will be given; in other words, to the fall of price which is inevitable, and which is not, under these circumstances, more than compensated by the extension of sales; and yet more labourers are essential to the creation of the greater supply, by which they are impoverished, than were required for providing the smaller supply, by the sale of which they were rendered more wealthy: a diminution of the numbers of manufacturers is therefore, under these circumstances, inevitable; and the further extension of their markets is interdicted.

In what has been written, I have endeavoured to establish the ultimate connexion with, and dependence on, the reproductive and incremental principle, of all wealth, and all revenue, whether primary or secondary; for although we have seen the society enriched by the addition of all the wrought goods which were produced, still we cannot forget, that it was this most important principle which yielded to the cultivator, that which formed his income, and which periodically gave to the manufacturer, besides, the means of his subsistence. The manufacturer, by giving useful qualities to native products, which they did not before possess, added to the income of the society; the results of his labour, being more desirable than what the cultivator possessed, both classes were rendered more wealthy; and both had the means of enjoyment increased by the subsequent exchange of their respective products; and although the manipulation effected by the manufacturer thus increases the wealth of the society, we must grant, that without the previous or cotemporaneous exhibition of the reproductive energy, there could be no periodical income on which to superadd that wealth which springs from the simple modification effected by the manufacturer.

In the foregoing, I trust the dependence of manufactured wealth, and the periodical income of the classes preparing it, upon the principle of periodical reproduction and increase, has been made sufficiently apparent; and that the utter impossibility is distinctly made out, of these persons being enabled, by any conceivable exertion of mere unaided labour, (as the only active principle of production,) to obtain either the wealth which forms their income, to make any periodical gain whatever, or to increase their wealth at will, whenever they may be inclined to work. I trust this also has been made sufficiently evident, that the ordinary market price of wrought wares is that by which the producers, as a class, are most enriched, and not that by which they are most straitened in their circumstances; as Adam Smith has been understood to say in such passages as the following, "the natural price, or the price of free competition," "is the lowest which can be taken; it is the lowest which the sellers can commonly afford to take, and at the same time continue their business." *Wealth of Nations*, Book 1. Chap. 7.

3. *Of Capital and Profits.*

When we consider how intensely man is interested in effecting certain modifications of the soil and of its produce, and that he is naked and unarmed by nature, we at one perceive motive sufficient for his endeavours at making such combinations and arrangements of natural products, as shall increase his power, in the arduous struggle against those obstacles to enrichment, by which it is his fate to be opposed.

By studying the laws of nature; by making himself conversant with the distinctive properties of bodies, (for no two bodies in nature are alike in these;) and by so combining these bodies, that they shall act, one upon another, in the manner he anticipates, man eventually arms himself with such mighty power, as virtually to bring the elements under his controul. Now these effects can only be brought about by the possessors of accumulations of food, wherewith to support labourers while employed; and such employment of food forms the investment of capital in production.

But from the aid which man receives in production, by thus appropriating accumulations of capital, we must again remark, that nought, independently, results in the shape of reproduction and increase; that no renewal, or increase, takes place of products each after the kind destroyed; that a mere modification is effected, accompanied by a corresponding destruction; and that the qualities of each product acted upon, are changed, of necessity, by the operation to which they have been subjected.

In the earliest stages even of advancement, man, intuitively, I may say, makes use of capital to aid his labour. The savage is rarely found without his spear, or his canoe: nay it is one of the distinctive characteristics of wealth, as peculiarly proceeding from the influence of rational beings, to be the joint result of the reproductive power, of labour, and of capital: for the employment of capital must be consequent on a mental operation, a calculation of contingent, and somewhat distant results, by which man is determined in making a present sacrifice, to secure a future and a greater good. I have, indeed, heretofore been discussing wealth, as resulting from the living principle, and labour; but I did so to keep the subject clear at the outset; and because it is not till after capital has been accumulated into masses, and has become a peculiar possession, that its effects on the evolution and distribution of income, can distinctly be perceived.

Suppose man, in his original endeavours at obtaining food, to employ pointed sticks, or stones, in the preparation of the soil; the rude instruments he then employs are unquestionably capital; some little labour must have been bestowed in obtaining these; and the net produce subsequently obtained is the joint result of the vital principle in the seed, of labour, and of capital. But as each individual has then the power of picking up, and using similar sticks or stones, the whole income of the society may be said to be composed of the recompense of labour alone; it being impossible to determine what has been the result of the labour, and what of the capital employed.

But suppose an individual to discover a new, and better mode of clearing and dressing the soil; by the employment of spades for instance: he is enabled to effect the same extent of work in a much less time; and to effect besides, a more complete clearing and dressing of the soil; thus fitting it in a better manner than before to become exclusively, and peculiarly, the matrix for that particular developement, and subsequent increase, on which his subsistence and enrichment depend. He could not, however, have obtained his spade for nothing: he either devoted his own time and labour to its preparation; or gave some other person a recompense for the time and labour bestowed on it. This recompense, whatever its amount, or the food he might have been aiding in producing, had he not been busied with the spade, is a regular investment of capital stock in productive employment; and the whole difference between his net produce at the end of the season, and the net produce of those cultivating similar tracts with sticks, or stones, constitutes the profits of the capital thus invested.

Again, it is highly probable, that the joint co-operation of many labourers, at particular seasons of the year, would be more effectual towards securing a return than an equal quantity of labour bestowed day by day, and in such manner as a few unaided individuals could apply it. But the occasional and seasonable employment of the greater number of men, could only be effected by one, having by him, a store of food equal to their consumption during the term of employment. Such an appropriation of food would be an investment of capital in production; and the difference between the produce of a tract so treated, and of any other similar tract, which had not been thus cultivated, would form the profits of the stock so invested.

These examples will be sufficient to shew the nature of the influence exercised by capital over production; and to exhibit the evolution of profits, and their dependence, in agriculture, on the cooperation of the reproductive principle.

They will be sufficient also to point out, how very differently capital acts in production, from any conceivable accumulation of labour; and how great the misconception, on this subject, must be, which is involved in the mode, now in common use, of treating capital, as being merely the accumulated labour, directly and indirectly applied, of which products are the result.

In the first case given, for instance, could we with any show of truth maintain, that the increased produce coming to the use of the man first employing a spade in cultivation, would ever have been obtained by the labour, directly employed in making the spade, and the labour directly employed in tilling the ground, if both of these quantities of labour had been appropriated directly to the tilling of the ground? Or could we, with any shew of reason, maintain, that the greater income, falling to that smaller portion of labour which constructed the spade, than would otherwise have fallen to an equal quantity of unaided labour sunk in cultivation, were under the influence of the same laws? Yet both of these suppositions are necessarily involved in the idea, that capital is merely accumulated labour; and as wages are all that can fall to the lot of labour, in the idea, also prevalent, that profits are the wages of the accumulated labour which has been employed.

But the error involved in this misnomer, will be more apparent, when we consider the other case given; where a greater produce is the result of an equal quantity of labour, merely from the circumstance of that equal labour being more seasonably applied. In this case the capital, or what would be termed erroneously, the accumulated labour, is exactly the same in amount as the direct labour; and yet, when this amount is employed as capital, and when it is employed as labour, it gives off very different results.

If capital were merely accumulated labour, it would act in giving off products precisely as labour acts, and the produce of equal quantities of either would be equal. But they act on production in manners perfectly distinct, and produce effects in no way analogous; and, therefore, it appears to me, that nothing but misconception can follow the use of the phrases "accumulated labour," or "labour in the last resort," of which products are the result, when we mean, in reality, the capital which has been sunk in their production.

The produce of labour and capital conjointly, can never be obtained by the separate influence of either. Why then, by calling capital labour, and labour capital, should we confound these palpable and important distinctions? The immediate labour, and the accumulated labour, bestowed on a product, must convey the idea, that a product is solely the result of labour, which labour has, at more than one time or place, been brought into operation upon it: but it conveys no distinct idea that the results of previous labour have been so admirably disposed, and so applied to subsequent production, that a result has been obtained, possibly greatly beyond what direct labour, how much soever accumulated, could ever have yielded. When, on the other hand, we state a produce to be the result of capital, being previously aware how very differently from labour capital may affect production, we at once get rid of the idea that mere labour, however greatly accumulated, had been the sole agents; we know that other productive arrangements, besides mere working, had been introduced; and we know also, that a new class of persons concerned in production as principals, has come into employment; whose incomes are of a nature different from wages, because of their being under the influence of laws very different, indeed, from the laws regulating the incomes of mere labourers.

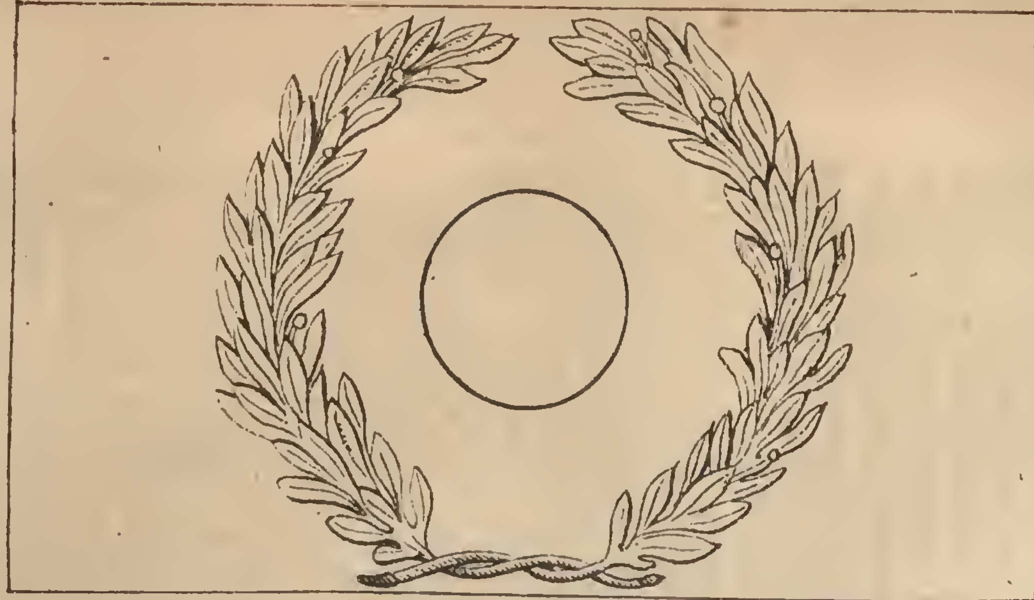
Let us now, after this digression, examine, in detail, the manner in which individuals are affected, by the introduction of capital in masses into cultivation. The motive for limiting production, by which a capitalist is actuated, differs from that by which a person is guided, who, without the use of accumulations, dresses the soil, in order that he and his may subsist on the whole produce realized, in excess to the reserve for next season's seed. Suppose that I and my family, consisting, in all, of five persons, realize from a certain tract, without the aid of accumulated capital, merely sufficient for our maintenance; and that we find, when more than five work on this tract, although our so doing may increase the produce, yet that we do not increase it in such proportion, that a full maintenance for six, or any greater number, is set free, beyond what is required for seed. The employment of labour, therefore, which could by us be effected, had reached its utmost when five worked on the spot: more could not subsist thereby, because their existence depended on the produce of this land: there could not be found fewer permanently working here, because numbers spring into being, while increasing food is obtainable for them; and a greater quantity of food must have been obtainable than actually was realized, if any number, less than five, were employed in this cultivation. In the case above given, it may be supposed, that our labour was continual; that is, day by day, the work of five was expended. Now it might very early be discovered, that the twelve months' continued labour of 5, might be far inferior, in point of productiveness, to the work of 25 labourers, for a fifth part of the year; the time chosen for setting these to work, being determined, as it would be, by the suitableness of the season. This, however, cannot be done without the possession of an accumulation of food, equal to the support of the labourers while thus engaged. Suppose that I obtain such an accumulation of food, and employ it in cultivation, and that the following is the consequence :—formerly 5 men laboured through the year, and realized, say 10 measures each: say also 10 more measures were required for seed; the gross produce was 60 measures. Now I advance subsistence for 25 labourers for a fifth part of the year, or 50 measures, and for seed 10, total 60; and at the end of the year, in consequence of the greater efficacy of seasonable labour, I find an excess beyond this, equal to the support of myself and family; the gross produce realized being 110 measures. I have assumed, that seasonably applying labour, fits the soil, so much better, for the reproduction I sought, as to give off a ten-fold increase for human consumption; whereas the net increase formerly obtained was five-fold. I and my family have, however, ceased to consider, as our gain, the whole produce beyond seed; the former amount of produce has become productive capital, and must be reserved for next year's operation. The capital sunk was 60 measures; and the clear surplus gain, on which I now depend, the profits of my capital, were 50 more: this was my aggregate of gain, and my rate of profit was nearly 84 per cent. What seed formerly was to reproduction, in the eye of the person then principally concerned in the cultivation, so is capital now, which includes both seed, and the advance for labour; that only being now looked upon as net gain, which is in excess to both.

Having now sunk so much capital in cultivation, my rate of profit being 84 per cent. and my aggregate of gain being 50 measures, it by no means follows, that this is the greatest aggregate return obtainable, or that this rate of profit, is what shall be permanent; the success of obtaining an equally great income as formerly, for the support of my family, without their being necessitated to labour, which has attended this investment of 60 measures in production, may lead me to try whether a greater outlay will not again tend to my further enrichment; I, accordingly sink, say 110 measures in cultivation at some future time, and employ, in proper season, double the number of workmen, and find the following to be the result: I realize a gross produce of 10 measures to replace seed, 100 to repay the advance for 50 labourers, and net profit 55 measures; total gross proceeds 165. Here we see, that I have gained my point in obtaining a larger aggregate of profit. The relation of outlay and profit were formerly as 60 to 50: and they are now as to 110 to 55; or, in other words, the rate of profit has fallen from nearly 84 to 50 per cent. Being again successful, I will proceed, therefore, in this course of enrichment as far as possible: my outlay is again increased by the employment of, say 25 labourers more, or for seed, 10 measures; for 75 labourers 150; total outlay in capital 160: and my gross return on this occasion proves to be, say 220 measures: here again I am enriched; my aggregate of profits being 60 measures in place of 55; although the rate of my profits has fallen from 50 to less than 38 per cent. Suppose I proceed, and sink 200 measures in outlay, and that my gross proceeds are, on this occasion, 259: I find that I have over cultivated; that my aggregate of profits is suffering reduction, 59 in place of 60 measures being now my peculiar income, in return too, for the greater risk and trouble of superintending the employment of a capital greatly increased in amount. The rate of profits has now fallen to about 29 per cent : but it cannot for a moment be supposed, that I will persevere in sinking capital in production to an extent so great; that I, a free agent, seeking only my own enrichment and ease, will voluntarily bring on myself the increased risk and trouble of superintending the employment of a greater capital, to be rendered poorer in the end by so doing : I must necessarily reduce my productive expenditure, and bring it to that point at which my gains are greatest in the aggregate. I may, perhaps, find, that when outlay was 160 measures, my aggregate gain was such, that I could not, by sinking more capital, increase it; or, perhaps, that although an increase was obtainable, yet its amount, in proportion to the great additional outlay with which it was obtained, was so trifling, as not to compensate the greater risk and trouble of superintendence. In this case my profits will sink permanently, to somewhere about, or perhaps below, 38 per cent. I say permanently, for I cannot, by withdrawing capital, raise their rate without impoverishing myself, any more than I can enrich myself, by increasing the quantity of capital employed, and thus bringing about a reduction in the rate of profit: so little indeed shall I be guided, in determining productive outlay, by the relative proportions of outlay and net profit, that, but for some accident, I may never give them a thought; all on which I was bent, being an increasing aggregate income, for my own exclusive use. It is true, that by sinking 200 measures in production, the land would thereby be forced to yield the means of subsistence to greater numbers,than when a less outlay was effected; that besides yielding 59 measures for my use, it would give support for one-fifth of the year, to 95 labourers ; and that if this disposition continued to be made by me, and a similar disposition by all other agricultural capitalists, the country would support a much greater number of the labouring class than it could do, when capitalists studied only their own peculiar enrichment. It is also true, that still more labourers than the above might, if set to work, with an increasing expenditure of capital, realize sufficient for their subsistence, from that and every similar tract, similarly treated; the falling rate, and reduced aggregate amount of profits being, for the time, disregarded. We know, however, that there is a point beyond which even labourers, if set to work with the aid of accumulations of capital, could not be benefitted, by increasing their numbers; for ultimately, they could not wring from the soil sufficient to subsist the numbers employed. But as a previous advance of capital is a necessary condition which must be fulfilled, before this effective employment of labour can be brought about; whether, while giving off increasing aggregate profits, in excess to wages, or while swallowing up the income of the capitalists besides, it is quite absurd to calculate on any such employment being given, or on any extent of employment to capital, which does not only feed the labourers, but reimburse also the capitalist for his increasing risk and trouble, in making and disposing of the greater advances; and as the capitalist, in making those advances, is guided, not by the wants of labourers, but by the study of his own enrichment, it is quite impossible that he should sink in employment, any portion of capital beyond what insures him the greatest aggregate gain.

Although then the existence of capitalists, and the evolution of an income for their peculiar use, hinders what might, under certain improbable circumstances, be the greatest possible employment of labour on the land; still it must be remembered, that it is entirely owing to the existence and employment of their accumulations, that any thing beyond a subsistence for a very scanty population is obtainable at all. Thus, in the hypothetical case, which now serves as an illustration, there was, before the employment of capital, only myself, and four individuals of my family, who could wring a maintenance from the extent of soil which it fell to my lot to cultivate: this maintenance was assumed to be 50 measures of food. With the assistance of capital, however, the means of maintaining five was at first realized as profits, together with the means of feeding 25 men besides, for a fifth part of the year; and afterwards, when capital had found the most profitable extent of employment on the soil, the means of subsistence for 75 men for a fifth part of the year, (or for 15 men for the whole year,) was realized, besides the subsistence to which my profits of 60 measures was equal. There cannot, therefore, be ground of complaint, that capital, and the existence of capitalists, keeps the numbers of labourers low; these only permitting so many, and no more, to labour as suits their particular views: for if, at any time, such an impression should get abroad and be acted upon, the means of subsistence, obtained from this single tract of land, and from all land cultivated under similar circumstances, would be reduced from what supported 21 individuals, to what fed only 5.

The case just given, exhibits the effects of the first introduction of accumulations of capital into agriculture, operating on enrichment, by merely permitting a better disposition of labour, with reference to the time of its application. Should this land, subsequently to the full employment of capital invested in this manner, be submitted to the influence of labourers working with improved tools, in the preparation of which an expenditure of capital was necessary, this new mode of applying capital will give another impulse to production, as follows:—If the capitalist had originally set his labourers to work with pointed sticks, and now armed them with spades, he would, if he tried to raise only the same gross produce as before, find himself enriched, by the difference between the expense of feeding the greater number of ill-found labourers, and the smaller number of well-equipped workmen, now requisite to effecting the same extent of work. Whatever his income was, that he still enjoys; and in addition, he obtains all that has been saved in labour, and which formerly constituting a part of his productive outlay for the coming season, is now become the profits of that part of his capital which is vested in tools; in this case we may presume, that the rate of profits accruing to the capital is very high; also, that there hasnot as yet been invested in this way, so much capital as may ultimately find profitable employment there; and that the relation of outlay and net return, are not as yet such as are likely to be permanent. In the illustrative case above given, we have supposed, that when the capitalist ceased to add to his outlay, there was sunk a capital equal to the support of 15 men for a year, or 150 measures of grain: let us now suppose, that the cost of tools is 4 measures, and that the employment of tools does away with the necessity of employing more than 10 workmen. Here, productive outlay is reduced from 160, including seed, to 114 measures; and the gross produce being the same as before, profits are increased in amount to 100 measures, and their rate raised to nearly 88 per cent. Let us suppose the capitalist to proceed, increasing his outlay as before, so long as his profits in the aggregate experience increase; and, after a time, it will be found, that, in accordance with the principles already explained, his rate of profits will again settle to a certain point, below or above which it is not permanently found to stand; and at this time, he will be found to be in better circumstances than he ever was before; and to have the means at his disposal, of expending a greater income than it was ever before in his power to enjoy.

The employment of accumulations of capital tending so eminently to the saving of labour, and consequently, to the saving of the means of supporting labour, we may calculate on the benefit of such employment becoming every day more gene-



Si quid novisti rectius istis
candidus imperti; si non,
his utere mecum.

Ce n'est que le premier pas qui coûte.

بادشاهی را شنیدم که بکشتنِ اسیری
اشارت فرمود بیچاره درحالتِ ناامیدی
بزبانیکه داشت ملک را دشنام داد

CALCUTTA: Drawn & Printed on Jysalmir Stone by J.B.Tassin N° 99 Durrumtollah.

rally known. And as its importance will be becoming every day more manifest, as society advances, the most simple, as well as the most complex processes may be ultimately found to be preceded by an accumulation and appropriation of capital. These accumulations being absolutely essential towards effecting the various processes, to the influence of which the existing society looks for their means of subsistence, will be keenly sought, and will come, naturally enough, to be considered, as possessing in themselves, the incremental and reproductive property; which property in reality, the vital principle, alone enjoys. The accumulations of capital, in causing a greater proportion of the results of the reproductive power to be available to the use of man, cooperate with this principle; and virtually, therefore, produce the same effects, in as far as man is immediately concerned in the result. It is, therefore, very natural, that productive capital should come to be considered the original and independent source of wealth, by persons not looking very deeply into the subject; and it is quite certain, that in practice, accumulations of productively employed capital, will be considered equally important possessions, towards securing an income to their proprietors, as tracts of land, the matrix within which reproduction and increase are effected; or as stores of those very germs themselves, which are the depositaries of latent life; and the revenue, periodically falling to the use of capitalists, will be as confidently anticipated, and as regularly realized, as the income proceeding from the direct influence of that power which alone, in reality, reproduces and yields increase.

II.—*On the application of the Jaísalmír Limestone to the purposes of Lithography.*

In the 5th number of the *Gleanings*, for April, 1829, the first intimation of the discovery in India, of a substitute for the German lithographic stone, was given to the scientific world. At that time a confident hope was expressed, that the Jaísalmír stone would be found adapted for all the ordinary purposes of lithography, and even for the finer descriptions of work. The experience of nearly two years has fully realized the expectations then entertained; during the above period, the stone has been extensively used, indifferently with the German lithographic stone, in the current routine of printing, and the perfection of the impressions obtained from the native material, is such, as to leave no doubt of its perfect utility.

For fine chalk engravings, a description of work not much practised in India, the Jaísalmír stone is not exactly suited, but for all ordinary purposes in the wide range of art to which lithography is applied, there is no hesitation in pronouncing it a valuable auxiliary and substitute, for the more costly foreign article.

At a time like the present, when the disturbed state of the continent threatens to interrupt, if not entirely to suspend our commercial relations with the country whence the lithographic stone has hitherto been almost exclusively procured[1], it becomes matter of good policy, if not of weightier consideration, to shake off a precarious dependence on foreign nations for this article of supply, and to draw on our own resources. The sending of lithographic stones to India, now that there is ample proof of the material existing in abundance in this country, will be an injudicious outlay of funds, which might, with greater benefit and economy, be expended on the spot, devoid of the risks, uncertainty and delay, attendant upon indents to

[1] The best Lithographic stones are found in Bavaria. In France, also, an inferior description is met with; but it is little esteemed.

Europe. This, however, is a point left to the consideration of the practical lithographer, who will not hesitate to avail himself of any improvement in the art, not attended with increased expense or trouble. It may, however, be a matter of more than curiosity, to consider the feasibility of supplying Europe with the Indian material, and thus adding another benefit to the many which England has derived from her Eastern possessions. It is estimated, that exclusive of duty, which, it is hoped, would not, in the first instance, be imposed, as being a measure ill calculated to foster an infant export, the Jaísalmír stone could be supplied, in the London market, at about ⅘ths of the price of the German stone, and probably still lower, were the demand to become extensive. But as this branch of the subject may be considered out of place here, it is left to mercantile men to follow up.

The progress of improvement in every branch of art, is generally tardy; the first step is the great difficulty, but that accomplished, the bringing it to perfection cannot be considered other than the pleasing and comparatively light task of proving and improving another's labors.

Be that as it may, in this instance, no little jealousies are in the way to cast a shade over the merits of the invention, for the field of art here is too confined to hope for any thing like an opinion being given, based on the test of severe and varied experiment. It is in Europe that the question must be decided, and to that arena it is referred with confidence. The plate which accompanies this number will go far to exhibit the capabilities of the Jaísalmír stone, but it may also be satisfactory to learn, that the opinion of practical lithographers, who have tried it in India, is entirely in its favor.

The Government, however, who are the chief consumers of the lithographic material in this country, would reap the greatest benefit from the introduction of the Jaîsalmír stone, as it is cheaper than the German stone, and perfectly adapted for all common writings, forms, papers in the native characters, and similar works, of which the greatest portion of lithographic work executed in this country, consists. Private establishments also, could they provide an ample supply of it, would, no doubt, be glad to avail themselves of the resources of the country, instead of trusting to a precarious and desultory import from Europe.

With the view of assisting, as far as may be practicable, in furthering so desirable an arrangement, the following particulars are offered.

Description and Analysis of the Jaísalmír Limestone.

The Jaísalmîr limestone, which is found in detached masses forming the summits of hills, resting on sandstone, is of an ochre yellow, or when polished, of a reddish brown colour. It breaks with a sub-conchoidal fracture in the large, having thin flinty, and ragged edges; the fracture in the small is uneven. The texture, or composition, as it is sometimes called, is fine granular, something like that of the finest sandstones, but with shining facets, interspersed so as to give it a semi-crystallised appearance. It frequently contains organic remains. It is harder, more sonorous, and more brittle than pure limestone, and yet, by the following analysis, it appears to be little else. Its specific gravity was found to be 2,61 in an ordinary state of the atmosphere; or when saturated with water, of which it took up 0,5 per cent. 2,66.

The following analysis was kindly furnished by James Prinsep, Esq. of the Calcutta Mint:—

Carbonat of lime,	97,5
Yellow ochreous earth, similar in appearance to bole,	2,5
	100,

0,2 per cent. of moisture had been previously driven off.

Traces of magnesia were carefully sought for, but without success.

The above analysis is sufficient to show, that our Indian stone, though not an argillaceous limestone, which is the proper character of the best lithographic stones, has yet, in its freedom from magnesia, a claim on our attention. This freedom from magnesia, with the peculiarity of its grain, fit it for every ordinary sort of work, and except in the chalk department, it will be found a very useful material to the Indian lithographer.

In preparing the Jaísalmír stone for use, no variation takes place in the usual process observed in lithography. The chemical and printing inks, the transfer paper, and other parts of the manipulation, are the same as when using the German stone. There is, however, one exception which requires careful observation, for on it depends the success of the whole operation. The *sleek stone* and pumice, generally used in polishing the German stone, will not bring the Jysalmir material to that high degree of polish, absolutely requisite for a surface on which transfer is to be made. Unless the Jaísalmír stone be brought to a high pitch of polish, good impressions are not to be expected from it. As this part of the process differs widely from the usual practice, it will be here minutely detailed, commencing at the point when a rough trimmed slab is supposed to be laid out for the purpose of grinding and polishing; the lithographer, in practice, will, however, only be concerned with the latter; the former being the work of the lapidary, and only requisite when the slabs are first brought from the quarry.

Method of Grinding and Polishing the Jaísalmír Stone.

The slab of Jaísalmír stone to be polished, after the inequalities have been removed by the common stone-cutter's tool called the *point*, is brought to a general level, by chiselling furrows across it, in a direction parallel to its sides, about 1½ inch apart, so that the surface, in this state, has a chequered appearance; the intervals or squares formed by the furrows being somewhat raised: these are reduced afterwards, to the level of the furrows, and the stone is now ready for the operation of grinding, which may be divided into three separate heads :—1st, the rough grinding; 2nd, the smoothing; and 3rd, the polishing.

The rough grinding is performed with a gritstone rubber, and the surface of the stone is, during the operation, kept constantly wet. The larger the surface of the rubber, the more perfectly will the surface of the slab be reduced; this operation is continued until all the marks of the chisel have entirely disappeared. Then the smoothing is commenced, with rubbers made of common lac and corundum, generally of three kinds : viz, coarse, medium, and fine. The method of preparing these will be described hereafter. Their application is similar in all respects to that of the gritstone rubber; the surface of the slab being kept constantly wet. It must be observed however, that no one rubber is to be changed for a finer one, until it has entirely effaced the scratches made by the one used immediately before it, which may be easily ascertained by observing whether the surface of the slab appears uniform all over; for as the marks made by the coarse rubbers will be larger than those of the finer ones, their presence on the surface will be readily detected. The operation of the fine rubber must be continued until the surface assumes a glossy or pearly appearance, when it is nearly ready for polishing. Should any scratches appear, they must be removed, by using the coarse corundum rubber again; and until this be effected, a perfect polish can never be given.

The last operation, that of polishing, is performed with calcined tin, (the peroxide,) a small quantity of which is laid upon the surface of the slab, and a few drops of water are added. This is to be well rubbed in with a pad made of 4 or 5 folds of fine calico, renewing the calcined tin, and adding, occasionally, a few drops of water, as may seem necessary. The longer this operation is continued, the more perfect will the polish be.

The grinding and smoothing need only be performed when the stone has to be wrought from a rough state. Any two slabs once reduced, may be rubbed together, and it will merely be necessary, when they are sufficiently ground, to use the fine corundum rubbers, to give the surface the pearly appearance before the polishing is commenced.

Note.—That in making the furrows, when levelling the surface, it is usual, first, to cover the stone over with some color, (generally red ochre and water,) that the part which has been submitted to the operation of the chisel, may be distinguished from that which has not; in white marble this is indispensable, for those parts which have been gone over, cannot otherwise be distinguished, and a good level can never be given to any very light colored marble without this precaution.

The Corundum Rubbers.

The proportions generally used in making the corundum rubbers, are for the coarse, lac 8; corundum 1: for the medium, lac 12 to 16, and corundum 1, by weight. The fine rubber is made by mixing the grindings of agates, cornelians, and the like, with lac; and as the lapidaries' wheels, upon which they are ground, are made of corundum and lac also, the grindings must contain a portion of those materials; their proportion, in composition, must vary according to the nature of the stone from which they are ground; but 6 of lac, to 1 of grindings, may be considered a good proportion generally. The lac is first melted, and the corundum, after it has been reduced to a powder, mixed intimately with it; the composition is then moulded in the shape of a brick (about $6 \times 4 \times 1\frac{1}{2}$ inch) with a handle of wood, about six inches long at one end, having a rise of about 30 degrees, for the convenience of working it.

The method of preparing the peroxide of tin, may be found in Dr. Henry's Chemistry, vol. II. page 135.

Having thus given a detail of the introduction of the Jaísalmír stone, I should be wanting in candor were I not to explain, that I lay no claim to the original discovery of the material; that credit is due to an officer of Engineers[2] who sent it to Calcutta, with many others, to be experimented upon. I am satisfied with being the first individual who has brought into use a substitute for the German stone, a point long aimed at in Europe, and where, at this moment, they are engaged in attempting to make artificial cements to answer the same purpose.

From numerous specimens of stones which, from time to time, have been sent to me for experiment, I have little doubt that a stone possessed of qualities similar to the German, will ultimately be found in the lias formation of Bundelkhund, or on the Sylhet frontier; perhaps also in Tenasserim.

A stone from the neighbourhood of Masulipatam, transmitted by the Private Secretary to the Governor General, is possessed of lithographic properties, and tolerable impressions have been produced from it; but as the magnesia in its composition is in excess, it is difficult to keep a clean surface, or to prevent *shading* while printing from it. I should esteem it a favor, if some of your scientific readers, residing in the provinces, would take the trouble to examine the quarries in their neighbourhood, and procure, for the purpose of experiment, specimens (about 6 inches square, by $1\frac{1}{2}$ thick,) of stones, having any resemblance to the true lithographic material: the lighter colored, the better. Sand-stones, or marbles, would not be serviceable, but researches in the limestone formation, would probably lead to successful results.

R. S.

[2] Lieut. J. T. Boileau, Executive Engineer, Agra.

III.—*Some account of the Lead Mines of Ajmír. By Captain* C. G. Dixon, *Ben. Art.*

The Mines are situated on the east face of a range of hills, whose base adjoins, or rather in part encircles, the city of Ajmír. This range, though elevated at the distance of half a mile from the town about 1000 feet, on which stands the fort of Táragerh; is in the vicinity of the mines, not more than 450 feet above the plain, or level of the valley. The apertures of the different mines are at various heights on the side of the hills, from 100 to 350 feet; while the intermediate space between the extreme ones, now worked, occupies 300 yards. No information exists as to the probable period when they were first discovered or worked. That they have been in use for a long time, doubtless many centuries, is satisfactorily attested, by the number that are now lying unemployed; perhaps from the circumstance of water having interrupted the progress of the workmen, or from their comparative unproductiveness. At the distance of 900 yards from this spot, on the same range, are several mines, which, from some cause, have fallen into disuse, and the same is observed in a distinct range, distant 1½ mile from the town, in an opposite direction. The depth of some of those now in use, may, perhaps, with reference to the extent of the work, be received as an additional argument in favour of their age.

To such as have been accustomed to observe the process followed in Europe, the mode here practised is calculated to excite surprise. The colouring of the surface having indicated the presence or proximity of the ore, a perforation is made in the hill; of course in some instances unsuccessfully. Having once met with a vein, its course is pursued; no further excavation being made, than is sufficient to admit of a man moving on his hands. If the vein should expand, and its removal cause an open space, so much of it as is unnecessary for a free communication, is filled by pieces of rock, which so far facilitates their progress, by obviating its removal to the surface. In pursuing the course of a vein, cross ones are not unfrequently met with. The most productive is followed; while recourse is had to the minor ones, when their advance in the main branches is occasionally checked. The system of restricting the communication to the tortuous course of the vein, precludes the practicability of removing the water; in as much as shafts, galleries, adits, and the usual concomitants found in similar cases in Europe, if not quite unknown, are altogether neglected. Neither is much inconvenience experienced from the presence of water; since on meeting with this temporary obstruction, the workmen have recourse to more elevated branches, or in their absence, make new ones, smaller veins being very abundant, again resuming work in the lower courses on the advance of the hot season.

The ore is found in what may be termed a continuous vein; its breadth, generally, averages from 3 to 6 inches; though sometimes it is diffused much wider. As the communication is so narrow and winding, the direction of the veins can only, with tolerable accuracy, be ascertained, by means of a compass. Their courses, generally speaking, bear N. E. or rather between the N. E. and E. points. For the above reason, their declination is difficult of measurement. The descent of some courses is, for a short distance, nearly perpendicular, steps being cut in the rock for facilitating the passage of the workmen; while in most, the fall varies between 30 and 40°. The ore is easily traced, from the innumerable shining particles of which it is composed. Its colour is very variable, doubtless from the nature of the soil in which it is embedded. Sometimes it has a black appearance, being remarkably porous or spongy; at others it is of a deep red; the most prevalent is yellow or ochry. These are dug with comparative ease: that imbedded in quartz, and found in beautiful crystals, and, in a great measure, free from extraneous snbstances, called by the natives *surma*, and sold, as taken from the mines, as antimony, is the most difficult to be removed; lumps of this ore, weighing from 2 to 3 lbs. have been used as antimony, for laboratory purposes, in the Ajmír magazine, in their natural state. The strata, through which the veins traverse, are of various natures; sand-stone, free and slaty; chalk, and quartz-rock; neither do they succeed each other in any thing like regular order. As an instance of this, the main branch of one of the mines, about 200 cubits (diagonally) deep, now passes through a soil composed of chalk[1], or rather greasy, saponaceous earth; sometimes beautifully streaked, at others perfectly white, and of little density. As the rock is never blasted, and as in meeting with quartz-rock it resists the tools, the workmen have recourse to a very simple method; which is in lighting a fire of wood below, or alongside the spot, and thereby, in a degree, calcining the surface. This measure is resorted to, on leaving off work for the day, about noon; when, on their return the following morning, the object has been effected, and the smoke dissipated.

The tools, like those in use with every native artificer, are few, and of simple construction. They consist of two or three hammers of different weights; some iron chisels, or wedges edged with steel, and a few one-armed picks. They commence work about sunrise. Having freed themselves of every article of clothing, they enter on their operations, each man bearing a small lamp in his hand. On the ore being dug, it is broken into small pieces, for the convenience of carriage, and placed in small bamboo baskets. As the gallery is not sufficiently high to allow of the workmen standing upright, they sit on their haunches, arranged in a row, from 4 to 12, according to the capacity of the mine, and pass the baskets on from one to another. When the whole has reached the foremost man, they move upwards, and again range themselves. This is continued until the mouth of the mine is attained. Once or twice a month, it becomes necessary to widen that portion of the passage last worked; the ore generally occupyiug only a small share of the course. This extraneous matter, on being dug, is removed from hand to hand, in baskets, as with respect to the ore. As the apertures of several of the mines are close to each other, it will be conjectured that the workmen occasionally meet. This is of frequent occurrence; and as each main branch, which is designated a mine, belongs to individual head miners, the dispute of to whom belongs the vein both have reached, by different courses, is determined by *panchaíct;* the result, generally, being the erection of a wall of loose stones on the point of contact, when each pursues a different course, or miner vein. This meeting of different channels is so far useful, that it materially tends to the ventilation of the branches. No distinct excavation is made to effect this object; neither is it requisite; as the air receives a full circulation, by passing through numerous vents. The temperature is pretty uniform at all seasons, aad as the workmen rarely remain more than 3 or 4 hours below the surface, they are very healthy. The rocks are so adhesive as to obviate the necessity for any artificial support. The only inconvenience to which they are occasionally subject, is the falling of the loose stones piled along the sides of the branches, which blocks up the communication. Thus the workmen are sometimes confined for many hours in the mines: the only clew to their situation, being

[1] Most likely *indurated talc* or *potstone*, as the mineral is indifferently called; although the impropriety of the former term, at least in this case, be more than doubtful.—Ed.

their absence, beyond the usual time from home; when on discovery, a party of workmen immediately proceed to extricate them, by clearing the rubbish from the branch.

In accordance with the customs of the natives, the work is chiefly conducted by the descendants of those who have followed this occupation from time immemorial. The expense incurred in the different divisions of the labour, is borne by the head miners; the government taking a share of the metal, as lord of the manor, and purchasing the balance at an assigned and rather favourable price. The means of the miners being remarkably limited, funds for the prosecution of the work were heretofore met by advances from moneylenders. These were only granted at a most exorbitant interest, which engrossed the greater portion of their profits. On the occasion of some of the mines decreasing in productiveness, thereby rendering the reimbursement somewhat precarious, it has not been unusual for these men to withhold their assistance; when, as a natural consequence, work in a degree ceased. Under this arrangement, the produce of the mines, it is evident, was solely regulated with reference to the means, or credit of the chief operatives.

But this system has recently undergone a complete change. Advances are now made without interest, by the government; and as the miners are wholly emancipated from the rapacious grasp of the moneylenders, the whole of their earnings are secured to them : independently of this and other boons, the materials requisite in the execution of the work are purchased wholesale, and given out to the workmen as requisite, at prime cost. The result has fully justified the expedient. Work has latterly been considerably augmented, while the indolent habits of the miners, contracted under the former disheartening system, are daily wearing off. The reason is obvious. Their earnings formerly went to enrich the moneylenders, while at present, each increase of labour contributes directly to their personal advantage.

The produce of the mines has hitherto been very limited. The annual quantity of metal smelted, averages about 850 cwt. It is probable the results of the present year will exhibit double this amount. Indeed it is conjectured, that the supply may be very greatly increased; but the demand for the metal will, of course, materially regulate the extent of our operations.

The process of metallising the ore, may be divided into four distinct operations.

1. The ore having been dug and brought to the surface, as already noticed, it is spread out on the hill, levelled for a few square yards at the aperture of the mine, and there allowed to remain for a short time, if wet, until it has become perfectly dry. It is then beaten with cylindrical bars of wood, from 3 to 4 inches diameter, and about 2½ feet long; one end being thinned and curved, for the convenience of receiving the grasp of the hand. Seizing the handle with both hands, the workmen continue beating it, until the whole of the metallic particles have been separated from the matrix. The latter is from time to time collected and thrown down the face of the hill : after being completely pulverized, which is effected much sooner than would be imagined, from the rude manner of execution, and freed from extraneous matter, it is transferred into baskets, and removed by the miners to undergo purification with water. That the workmen may not be subject to the caprice of the head miners, they have a stated number of baskets of pulverized ore to deliver at the washing pits; so that when industrious, their day's work is generally completed in 4 or 5 hours.

2. In the absence of running streams, recourse is had to artificial means; the simplest of which is offered in making pits or reservoirs, which are filled from an adjacent well, by bullocks, in the usual manner observed in irrigating lands.

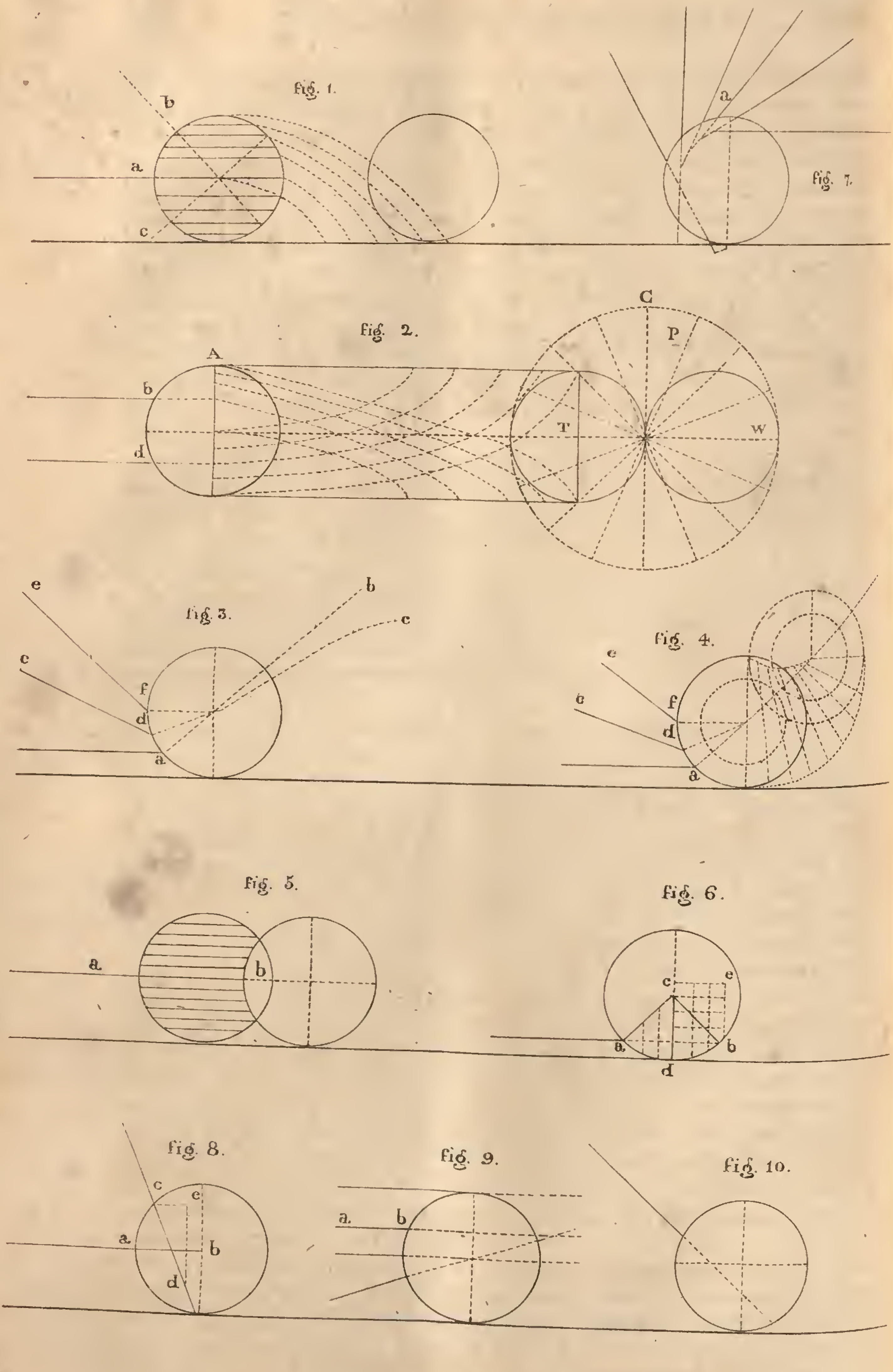
These excavations are from 10 to 12 feet square, and 3 or 4 deep, and having been filled with water, the work of the ore-washers commences. Each man has a wooden tub, its shape being the frustrum of a cone ; altitude 18 inches ; diameter of the top 3 feet, and bottom 1 foot. Having placed themselves on the verge of the pit, and on a level with the water, and a portion of the pulverized ore being thrown into the tub with some water, they are able, from its shape, to keep the tub floating, while the contents are violently stirred up with the hands. After having been well mixed, the ore is allowed to subside, by gradually drawing the tub backwards and forwards on the surface ; and as the metallic particles, from their gravity, quickly sink to the bottom, the sand and other impurities are easily skimmed off by the hand. This operation is repeated 20 or 30 times, until the ore be completely cleansed. The sediment collected in the pits is, from time to time, removed, and the water renewed once a week, or oftener, when the evaporation is considerable.

3. The washing having been completed, the ore is then delivered over to a separate set of people, who, having intimately mixed it with its weight of fresh cowdung, roll it into small balls, about the size of a pigeon's egg, and allow it to remain exposed to the influence of the sun, until it becomes perfectly dry, when it is ready for smelting.

4. The process of smelting is marked by the same simplicity that characterizes the previous operations. The furnace is nearly cylindrical; upper diameter 11 inches, lower 10 inches ; altitude 3 feet. Three clay pipes are luted to the circumference, and serve to communicate the blast from as many bellows ; while from their rather angular shape, a hole is left for clearing the end of the pipe, or stirring up the ignited ore, at the same time that these orifices allow the workmen to observe the state of fusion. Each bellows consists of a half dressed goat skin; the smaller end being tied to the pipe. The mouth of the skin held in the hands, is compressed by a man bearing his weight perpendicularly on it. They are worked simultaneously, and the blast is so disposed as to fall in the centre of the base. The aperture for the escape of the scoria, is 5 inches higher than the taps or metal hole on the opposite side. Two advantages attend the mixture of cowdung with the ore. A cheap fuel is furnished, and from its wide dispersion in this medium, added to the sphericity of the balls, the minutest particles are exposed to the action of the fire, and a most complete fusion is effected. By the use of cowdung, the expenditure of charcoal, the only fuel, is very inconsiderable. Half to three quarters of a *maund* is amply sufficient for one *maund* of fused metal. After it has been lighted, the furnace is, from time to time, alternatively fed with balls and charcoal. In about 3 or 4 hours the ore has become perfectly liquid, when the scoria hole is opened to allow of its passage. The metal is then drawn off, and run into moulds. The subsequent tappings take place about every hour and a half, 4 or 5 being the general number. The quantity of metal smelted in one day, (or about 9 hours,) from this small furnace, averages from 2 to 3 cwt. The worst one yields about 31 per cent. of metal; the general run 40 ; while the best gives from 50 to 58 per cent.

On reviewing the process in all its stages, the question naturally arises, could not improvement be advantageously introduced ; or do the operatives, in their present rude way, make the most of the work ? The introduction of machinery, by decreasing manual labour, naturally tends to a diminution of expense[2]; and were localities to favour its adoption, and the demand to be commensurate with the scale of operations which would thus be extended, its use would be expedient. It is, however, inferred, that local circumstances are unfavourable to the measure.

[2] This will much depend upon the price of labour, as well as the kind of work.—Ed.



GAME OF BILLIARDS.

Drawn on Stone and Printed by J. B. Tassin. 99 Durrumtollah, Calcutta.

Ajmír possesses no navigable river to the north, south, or west. The only outlet is the Jumna; the nearest point, Agra, being 230 miles distant east. The excess of produce beyond local wants could, therefore, only seek a market on this river; inasmuch as the expense of land carriage, added to the duties leviable by numerous surrounding states, would enhance the value of the metal, and render it too dear for remote purchasers. Again, there are no *nallahs* or running streams in this vicinity, whose courses could be turned to account, in the aid of machinery; and although the charge of extracting and metallising the ore may, comparatively speaking, be expensive, still, considering the Government in their situation as junior partners, sharing a portion of the profits, not principals in the works, their revenue is now totally freed from risk; while they are spared the inconvenience of a large outlay. An immediate expense for a prospective gain, it would be necessary to incur, in proceeding upon European principles, in sinking shafts, &c. &c. It is true the depth (from 2 to 300 *háts* obliquely) and tortuous course of the branches, render the removal of the excavated ore the most difficult and expensive part of the process; and although on viewing the other divisions of the work superficially, we are inclined to disparage the native customs, a more intimate acquaintance with their proceedings reconciles us to their practice; and while we wonder at the simplicity, the leading characteristic of their operations, we are compelled to acknowledge our surprise, that the results are so favourable.

IV.—*An Essay on the Game of Billiards.*

[Continued from p. 81.]

But a *third* motion, and a *fourth* in direct opposition to it, which, between them, take in all the radii of a circle, having the middle [1] of the ball played at for its centre, must be taken notice of a little more at large.

They arise from striking the ball in such a manner, that it will follow, or return from the other, directly or obliquely on either side, as circumstances or fancy may require. One of these effects or secondary powers, is called WALKING; it is produced by striking the ball A, [2] any where (as at *b*, see Fig. 2.) in the semicircle, passing through its middle, intercepted between the part it rests on, and that diametrically opposite, but in a direction above its centre; by which means, after hitting the ball p, it radiates from the point of contact, in the most remote division of a circle, as C [3] —denoted by W, and when in action, is frequently taken for the *second* motion already mentioned, into which it at length declines. The other is called TWISTING; it is produced by striking the ball as at *d*, in the same semicircle, but in a direction below its centre, which makes it radiate after contact, in the opposite division—denoted by T, and completes the circle; where,

[1] The middle of the ball is here, and will be hereafter used in contradistinction to the centre—which will be used strictly; and it is intended to denote that part of the surface, with respect to the ball played at, which is in a right line between the centres of both; but as to the ball played with, that part of the surface, which is struck to give it the progressive motion most completely, as has been already shewn.

[2] The capital A denotes the *active*, or hitting ball; and P the *passive*, throughout this inquiry.

[3] This circle is to be supposed horizontal; but its rays are not strictly rectilinear, as the figure represents. They will be shewn hereafter more correctly upon a larger scale, when treated of more particularly.

being excited, rather by a reverse in the mode of application, than a change in the nature of the principle, it rules with equal influence.

The second position of the cue here represented, is chosen only to exhibit the Theory more clearly, by making the contrast with its former place more perfect; for it is obvious, the middle at the but-end cannot, by reason of the cue's thickness there, be so much depressed; neither, perhaps, is it always eligible, as far as it can be done; because, if the violence be considerable, the ball will bounce from it, in a line passing through its centre from the point of impulsion, (see *a*, *b*, Fig. 3.) and turn in the air, (see Fig. 4.) with too small a share of the *progressive* to carry it effectually to its object; whereas, by elevating the but-end, and at the same time applying the point somewhat higher towards the middle, as *c*, *d*, in those figures, that line will approach nearer to a coincidence with the progressive; and the ball be less apt to rise; while, if the direction be equally distant from the centre, the twisting power can suffer no diminution.

Hence a ball is often struck thus, and considerably higher, as *e*, *f*, with good effect, providing the ball played at be remote; and the degree of violence, as well as the mode of applying it, should be in proportion to the distance between the balls, so as to have as little of the progressive, and as much of the twisting motion as possible, at the time of contact, their action being in opposite directions. Because, if the balls be far asunder, and the impulse small, the twist will be quickly overcome by the roughness of the cloth, and sink into the *attritive*; but, if it be great, the twist will be so likewise, and the ball fly over the same space with less interruption from that impediment, as a former observation shews, and consequently less consumption of the twist imparted. If, on the other hand, the balls be not far asunder, and the impulse great, the ball impelled will at first be apt to rise (as above explained); and to hit the other before it falls into level motion; or, should that not be the result, the twist will be counteracted, by the quantity of progressive force remaining after contact, with which the ball had been overcharged; and proportionably destroyed.

These effects also are rotary; but (abstractedly considered) the centre of motion is not confined to the external parts of the ball, as they severally fall in succession upon the table, like the *attritive*; for the ball, according to the nature, manner, and force of the stroke, is often driven with a tendency to move round points beyond its surface, and its course may be assimilated to (see Fig. 2.) that which takes place, before the progressive be sufficiently subdued, to coalesce, and form the attritive; or, the compass may be so reduced, as to have its centre within the ball's surface, (see Fig. 4,) and produce locomotion, by means of repulsive agency against the cloth, without much attrition or any progressive aid.

This last effect, a twisting stroke may exhibit very clearly; for a low application of the point will detach the ball from the table, without imparting almost any progressive motion; but a temporary separation from the table, with so small a share of the progressive, can scarcely (if possible) be produced by a walking stroke; neither can it take place until after reflection, nor even then be seen distinctly.

Yet striking the ball merely as heretofore directed, in order to make it twist, with the point of the cue unprepared or smooth, serves to little purpose; for its absolute tendency afterwards must be upwards, in the line *a*, *b*, from which rectilineal courses however, being continually acted upon by the power of gravity, it will be diverted; and describe a parabola, as *a*, *c*, according to the law of projectiles.

But, should the point be rough, a temporary hold is taken of the ball, and both, like indented machinery, are for an instant locked together in the inequalities of their surfaces[4]; while the centre of the ball not being in the line of direction, the equilibrium of its parts is destroyed by the stroke, in a ratio expressed by the radius of a concentric circle, in the last Fig. to which it is a tangent; and the ball, obedient to its *vis inertiæ*, undergoing less change by avoiding than submitting to the violence that would necessarily ensue in a contention between the *impetus* on one side, and its own weight and resistance from the air, on the other; turns backward round its centre, presenting the parts immediately behind, in quick succession to the cue's surface. For all round bodies can with less force be turned about their centre, than driven in the progressive only; because, in the first case, there is no resistance from the air, except what arises from attrition in its rotation—the ball still occupying the same place; and the opposition from the *vis inertiæ* also, is very much diminished; but locomotion being an inseparable character of the second, the impediments are more considerable.

This will appear in a stronger light, by extending the analysis a little further. Thus (see the line *a*, *b*, and its parallels, Fig. 5.) that part of the ball at *a*, which receives the impression, cannot move in the progressive only, otherwise than by forcing all the rest of which the body consists, to pass in conjunction with it, as it moves to *b*, through equal spaces, in equal times; whereas, by turning round its centre it describes in the periphery of the ball, an arc of equal extent, (see *a*, *b*, Fig. 6.) while every part within the circle, or without its plane, whether the motion be concentrical or parallel, is carried with an inferior degree of velocity, in proportion to its distance from the axis on which it turns; and may be expressed by the sector, or mixed triangle *a*, *b*, *c*, constructed by lines radiating from the centre of the ball, to the extremities of the arc it describes; each division of the intercepted portion, representing, in arithmetical progression, a constituent particle. It also appears, by drawing the line of bisection *c*, *d*, and inverting the position of one half, viz. *a*, *d*, *c*, into *c*, *e*, *b*, a quadrilateral figure *c*, *e*, *b*, *d*, is formed, the breadth of which, *d*, *b*, being equal to half *e*, *b*, is a mean proportional to the sum of its motion; but the *vis inertiæ* excited, is as its motion, therefore the resistance is but half also. Thus, by obeying the impelling power, in moving through a space corresponding with the force impressed, and at the same time avoiding the difficulties opposed, by withdrawing from them; a conflict between Nature and Art is most effectually prevented, while rotary motion seems to be employed as the means.

Or, should a ball be struck above the middle, in a direction below the point resting on the table, as is represented (Fig. 7.) a similar effect may be produced. Here the progressive motion is impeded; and a line drawn between both parts of contact, a lever of the 2d kind, in the order of mechanics, viz. the point touching the table, the fulcrum, that portion of the ball perpendicularly beyond it, the weight to be overcome, and at the part struck, the power, which, being in direct proportion with the distance between the line of direction and the fulcrum, consequently (if similarly applied) increases, as it is advanced towards that point of the semicircle to which it is perpendicular, as *a*; where, after traversing an arc of ninety degrees, it loses its name—in other respects being still the same; and as it passes beyond this boundary, (supposing the stroke made from the opposite side,) acquires that of walking. But, when a ball is struck in this manner to make it twist, as it cannot obey the impulse directly, it is apt to elude the effect by reflection from the table; and besides the inconvenience from attitude, the portion of the cue before the sight, is not only frequently very small, but to the view,

[4] It is best formed for this purpose, by sloping it, and usually prepared by *chalk*, as a substance that does least injury to the cloth.

still further diminished by its elevation; so that the aim must be in the same measure uncertain; neither can the cue be applied in this inclined and limited direction, without much danger of tearing the cloth: for which reasons, this stroke is seldom more than an expedient, when the use of the cue is confined by the ball being close or near to the cushion, and the effect cannot be produced otherwise; or, (if in a more open situation,) to avoid making a foul [5] one, when the interval between both balls is small; for the horizontal distance, over which the point of the cue moves after contact, decreases, as it deviates from the horizontal line; that is (see Fig. 8.) if the line of impulse *a*, *b*, should be placed as *c*, *d*, it will reach horizontally only to *c*, *e*, a distance considerably less. This motion, with its causes, may be clearly exhibited in degrees of slow operation, by turning the ball upon the table, with a dry finger, or any other soft and rough substance; but as, in playing the game, it is never designed to take place, till it hits another ball, the direction given should partake of that necessary for the progressive also, and be a composition of both, as the case may require. Here also, it is obvious the point must be chalked, and that the corresponding parts come into succession as before. It may be added, when rotary motion excited by the cue, and the part of the ball struck, are upon the same side of a perpendicular line passing through the centre of the ball, it is called twisting: and when on opposite sides, it is denominated walking.

In a view of this last power, or effect of power, which is the reverse of the former, and with which it has been in some measure contrasted; in order to be more explicit, it will be necessary to revert to the part the ball rests on, from which the consideration of the twisting power began. In the first arc of ninety degrees, that is, from thence to the middle of the semicircle beforementioned, the cue must be held with the but-end lower than the point (see Fig. 9.), so as to impel the ball in a direction above its centre, which is in this case necessary to make the ball walk; and being thus scarcely applicable to a very small portion of this arch, in the ordinary way of holding it, the power here may be considered as almost useless: but, in the upper arc of the semicircle, though the back-hand be somewhat raised above that position, this impulse may be given easily, and with increasing effect, so far as about the middle of it; and might till the cue became a tangent to the ball's surface, (the power being as the distance between the line of direction and the centre of the ball,) would not the deflection of the arc be thus almost identified with the line of impulse, and make it impossible to prevent the point from slipping; or though it should not slip, the small part exposed to the invading force, being instantly detached by turning under the stroke, while the main body lies intrenched below, and participates equally of the impression made; the walk imparted, as well as the progressive motion, (without which the other is of little use,) must be very trifling. It is better, therefore, to strike the ball in some intermediate part of the arc, where the point will not be so apt to slip, or the force so quickly evaded, and a sufficient of the progressive may be received. The same observation may be made in playing for a twist, where the weight of the ball assists the chalk, and is the only difference.

This effect likewise branches into a division, collateral with that of twisting; and may be produced by striking the ball also above the middle, but in a direction beyond the part whereon its rests, though below its centre. (see Fig. 10.) Here, too, the progressive motion is impeded by the table; neither can the ball obey the impulse directly, otherwise than by passing through its surface, and it is

[5] This will be fully explained hereafter, with some comments—too much at length for a note.

on the same account likely to be reflected by their mutual elasticity, hopping or ricocheting frequently, as it advances ; so that the walk thus produced cannot be very great, though often supposed otherwise, when the ball after hitting another, moves with a celerity not much retarded. This, however, should be ascribed to a different cause, and is the consequence of their centres not being opposed in an horizontal line, at the time of contact ; but let it be remarked, the centre of gravity lying above the line of direction, if the point of the cue be rough, and the ball, therefore, cannot disengage itself, at the instant of reflection from the table, the result must be the contrary. The same expedient by which a foul stroke may be prevented in playing for a twist, will serve here likewise.

It may also, from appearance, be supposed, that the walking is greater than the twisting power, because the ball has more motion after hitting ; but this is a mistake, and takes place from confounding it with those of attrition and progression, which concur in carrying the ball forward; whereas, the other power moves in opposition to them, and unassisted by any co-operating aid, till, combined with the re-action of the ball played at, those allied forces are overcome, and it returns with the difference. Besides, to give effect to either, in every degree; since the cue, as has been shown, should be cut, prepared, and relatively applied, precisely in the same manner, over surfaces equal and similar, and sometimes the same; turning the point respectively, because the objects are different, with every thing else in common between them, it may be concluded, that (abstracted from these intervening powers) both are equal.

A lateral twist or rotation also, may be given, by striking the ball sideways[6], with the point of the cue chalked as before : and though the effect be not easily discerned, in progression, it is very sensible in the angle formed on reflection from the cushion, the check it receives from thence, changing the centre of this twist or rotation, to the point of contact ; for, suppose the ball divided into an indefinite number of horizontal planes, and three of those, represented by three concentric circles (see Fig. 11.) on one of which the curved arrow is intended to exhibit this lateral rotation, given to it by the cue, *a*, *b*, in a direction at right angles with the cushion, *c*, *d* ; and supposing this effect equally distributed through all its parts, in proportion to their distance from the centre respectively, as has been before explained; then, while the chord *e*, *f*, describes the arc *e*, *g*, the diameter at *h*, is advancing to *i*, and will arrive afterwards at *k*, through which point, or with a deviation from it, according to circumstances, the ball will be reflected. The two inferior planes are precisely (as it may be seen) in the same predicament, and so is every other one whereof the ball is composed.

[6] A ball played in this manner often serves to a good purpose, when the cannon ball is within the balk, and neither far from the string-line, nor near to a side-cushion, after both white balls have been pocketed, or off the table ; for, by playing back against the end-cushion opposite, in the usual way, the danger of going out of the balk, from the application of too much force, prevents the use of a sufficient degree, to send the ball so high, on its return from the balk-end, as the player might like. But, if he should strike the ball thus, against that part of the side cushion, just beyond the string-line, it will return within it, and occupy a place high enough, to command a good losing hazard in one of the corner pockets ; and in some situations with the adversary's ball in the balk, a cannon may be expected with confidence, if the player be accustomed to the stroke. The farther from the cushion played against, the ball is laid on the string-line, the better ; for the interior angle will be greater, and the stroke therefore more efficient, or less of it necessary to accomplish the same design.—(See additional note in Appendix.)

V.—*On the Cooling of Wines with Ice.*

The community of Calcutta are much indebted to the gentleman who has succeeded in providing a supply of ice, which, it is understood, will continue to be furnished during the whole of the hot season,—a luxury we have never before enjoyed in the lower provinces. At the price fixed, of eight annas per seer, it will be found to be more economical than saltpetre, and there can be no question as to its superior efficacy. At the same time, it is not improbable that the speculation may fail from want of support, through inattention to the proper manner of using the ice for the cooling of wines, and owing to the jealousy of the *ábdárs*, who must be opposed to the general introduction of its use, as depriving them of their perquisites of the saltpetre water. From the first cause, many people will be led to imagine, that the process of cooling with ice is more expensive, finding that it costs them a seer of ice to cool a bottle of wine, when their *ábdár* cools it as well with saltpetre at half the cost. Properly managed, one quarter of a seer of ice is quite sufficient to cool a bottle of Claret much more effectually than any *ábdár* can do with saltpetre. The best mode of proceeding is, to place the bottle in a tin vessel, cased with staves of wood. The tin vessel should not be larger than easily to admit the bottle, and deep enough to allow the lid to be put on. The ice being unable to fall down between the bottle and the sides of the tin case, will lie round the neck, or rather the upper part of the bottle, below the neck, and in melting will find its way down the sides. But the great body of cold will be kept applied to the upper part of the bottle, and thus the portion of the wine first cooled will descend, and a warmer portion rise, until the whole is reduced to the greatest degree of cold the ice, in melting, can communicate. If to the ¼ seer of ice be added a handful or two of culinary salt, the cooling effect will be very much increased.

As the small quantity of ice above mentioned cannot be applied all round the bottle, the above method is the only certain way of securing all the benefit of its liquefaction. If placed round the lower part of the bottle, no cold would be communicated to the upper portion of the wine; and also, if the bottle be laid on its side in an ordinary *tás*, and the ice placed over it, as soon as it begins to melt, it will flow down the sides, and the upper part of the bottle will not participate in the cooling effect. Besides, the large mass of the leaden *tás* will carry off a great portion of the cold.

It must be obvious that there would be a great waste of material if ice were employed, like saltpetre, to cool the water in the *tás*. But to those who will not take the trouble of instructing their servants, and yet are willing to pay any price for cool wine, a method may be suggested of allowing the *ábdár* to cool the wine, as usual, with saltpetre in the common *tás;* and when the water will dissolve no more saltpetre, the temperature may be further reduced to any extent, short of the freezing point, by adding ice.

To cool four or five bottles of wine at once, a common horse bucket would answer very well. The bottles might be placed in sand in the bucket; the sand coming up to half the height of the body of the bottle. The ice (and salt) at the rate of ¼ seer to each bottle, would thus be about the upper part of the bottles, the sand preventing it from falling down. Being heavier than water, the sand would remain at the bottom, even when the ice liquefied, and the melted ice would thus continue to surround the upper portion of the bottles. The bucket should have a cover, or a coarse blanket should be thrown over it.

To those who may not be aware of the effect of culinary salt in conjunction with ice, it may be useful to remark, that a thermometer, placed in melting ice, will not fall below 32; but if about half the quantity of salt be mixed up with the ice employed, the thermometer will sink from 84 or 85, the temperature of the air to 20 or 25 degrees below the freezing point above mentioned. This fact is well known to the natives who make ice creams.

Postscript.

Since writing the above, I have tried the arrangement with the sand, and though it is, upon the whole, convenient, yet as it wastes some of the cold, a better may, I think, be devised. To ascertain how much of the effect of the ice was wasted, I made the following trial:—I put 2 bottles of water into 2 tin vessels, one of which fitted tight to the lower part of the bottle, the other had a space all round, of about half an inch in breadth; this latter was filled with sand up to the small part of the neck of the bottle, and on the top of the sand was placed a quarter of a seer (½ lb.) of ice, with two *chatacks* (4 oz.) of salt. The same proportions of ice and salt were packed round the neck of the other bottle, which was enclosed in the tight fitting case, in which was no sand; the water in both bottles was at 80°, In half an hour all the ice had melted; the bottle in sand was of the temperature 62°, that without sand was 55°, so that 7° of heat was derived from the sand. Such a conclusion might indeed have been predicted; as in the one case the ice derives the heat necessary to melt it from a larger mass of heated matter than in the other. I am of opinion, then, that a more eligible plan is, to have a separate tin case made for each bottle, to fit the larger part of it as nearly as possible. The ice being then packed about the neck of the bottle, is confined by the tin case, which should reach within an inch or so of the cork; being of the same diameter throughout. These separate cases should be all placed in a large tub or bucket, in close contact one with another, but not touching the sides of the tub. A cloth being then thrown over the whole, they may be left for half an hour, at the end of which time they will be found cooled down to 25°.

Or the following arrangement, which, however, I have never tried, might be preferable even to the above. Let a circular tin plate be made, fitting the interior of the bucket a little loosely, and supported at a certain height above the bottom, by several strips of tin, bent so as to lay hold of the edge of the bucket. Let a certain number of holes, of a sufficient diameter, to allow a bottle to pass through them, be cut in this tin plate. These holes must not be too large, or the ice will slip down between the bottle and the edge of the tin. There should also be sufficient space left between the openings to place the ice upon. The ice being disposed now round the neck of each bottle, will be gradually melted by the heat abstracted from the bottle, and the water will trickle down the sides of the bottles. It will perhaps occur to the reader, however, that in this arrangement, although the melting of the ice produces its full effect in lowering the temperature, yet that as even after being converted into water, it is still sufficiently cold to absorb much heat; the arrangement which confines it round the bottle must be the preferable. But it is to be considered, that the water must trickle *very slowly* down the sides of the bottle, so that by the time it reaches the bottom of the bucket it is most probably of the temperature of the bottle; and secondly, that the tin vessel enclosing the bottle must give out a good deal of heat, the which is all got rid of in the arrangement just described. So that I think there are good theoretical grounds for preferring this second; but not having tried it, as I have the other, I cannot pronounce positively.

In the trial above noticed, I had occasion also to observe how very slowly heat was absorbed again by the cooled bottles of water. Being examined after a period of two hours, one was found to be of the temperature 65°, the other 60°; so that each had lost only 5° of the full effect in that time.

VI.—*On the Bubaline Antelope. (Nobis.)* By H. B. Hodgson, Esq.

The *Thár* of the Nipalese. Habitat Nepâl.

Specific Character.—Black and tan maned Antelope, (four teats in the female,) with short, conical, recurved, grooved, and annulated, horns.

This remarkable species is entirely devoid of the characteristic elegance of the genus to which it belongs. It is a large, coarse, heavy, animal, with bristly, thin set hair, not unlike that of the buffalo ; and, as the female is distinguished by the singular (and, as far as I know [1], unheard of) circumstance, of having four teats, I propose to name it the Bubaline Antelope. The body is short and thick, with deep chest : the neck, short and straight : the head, coarse and spiritless, though not remarkably large : the eye, poor : the limbs, (for an antelope,) thick and short: and the hoofs, short and compact. The general form, proportions, and attitudes, the style and character of the ears, the hoofs, the hair, and, more especially, of the testicles and mane, belong *rather* to the goat than to the deer kind.

So, likewise, do the manners of the animal ; which dispose it to solitude, and to mountainous situations. It is seldom found in herds, however small; and the grown males usually live entirely alone, except during the breeding season. Of all the deer or antelope genera of these hills, it is the most common. It tenants the central region, equidistant from the snows on one hand, and the plains of India on the other ; and though it be found every where within that central space, between the Sutlege, west, and the Teesta, east, it is more frequent in the eastern than in the western half of the tract so defined, or, in Nepal proper. The female is scarcely distinguishable from the male, by her somewhat inferior size, smaller horns, and rather paler colours, being in every other respect, precisely like him.

The mature male measures from the tip of the nose to the end of the tail fully five feet, and stands upwards of three feet at the shoulder. In his ordinary quiescent attitude, all the four legs are perfectly upright ; the back, horizontal ; the neck, slightly raised and straight ; and in him we look in vain for the gracefully bowed neck of the antelope and deer, or, the taper stooping hind limbs with which they seem ever ready to bound from the earth, and upon which they scarcely appear to tread at all ; yet the influential characters of this animal are decidedly those of the antelope, as will be made apparent in the sequel.

The horns, in the *fully* grown male, are annulated more than two-thirds of their whole length from the base ; and, in such males, the terminal one-third is perfectly smooth and polished. The rings are closely set, equally prominent all round, and blunt-edged ; and their continuity is broken by a numerous series of irregular longitudinal grooves, running from the base upwards, as far as the annulations which they cut, and even higher. In young animals the grooving extends nearly to the tips of the horns, whereas the annulation is confined nearly to their bases. The core of the horns reaches almost to their extremities.

The basal interval of the horns is from three-fourths of an inch to five-eighths: the divergency at the tips, very inconsiderable : the arcuation backwards, uniform and well defined. The horns are quite round, short,—as short almost as the ears, and acute.

[1] I believe the Deer and Antelopes resemble the goats and sheep in having only two teats : but I have little personal experience of the matter, and no good book to refer to. If my supposition be correct, the present species will form an interesting link between the deer and ox kinds.

The ears are very large and coarse, erect, not much opened; the insides well lined with long soft hair; the tips rather sharp, and not tufted.

The head is (as already noted) not inelegantly large, though coarse and expressionless; the tapering considerable, and uniform to the muzzle: the eye (for an antelope) poor and mean; the suborbital sinuses, quite round, small, distinct, and naked; the testes, goat-like, large and pendant, and hairy; the hoofs, short, firm, and thick; the teeth, void of characters; the hair, coarse, bristly, straight, sparely set on, and closely applied to the skin; the entire neck, and half the shoulders furnished with a semi-erect, straight mane, composed of bristles, rather longer and stouter than those covering the rest of the body, in character goat or rather hog-like; no mane on the pectoral surface of the neck; nor any semblance of beard on the chin; the tail, short, narrow, and deer-like. With regard to the colours, there is, in this species, some little variation, independent of that caused by sex and age: but the following may be relied on as an adequate description of the mature male, in this respect.

The whole *superior* parts of the animal, and the neck, below, as well as above, are pure black,—the *lateral* parts black, largely mixed with earthy brown red; the latter colour prevailing greatly over the former on the limbs above the knees: the *inferior* parts, insides of the limbs, and entire legs below the knees, as well as the insides of the ears, and the muzzle, dirty white. The outsides of the ears are black, like the rest of the superior surface, but dotted with the brown-red of the flanks: the periophthalmic region, nearly naked, and of an earthy red, mixed with grey; round the sinuses, the same: irides, brown-red: horns and hoofs, black: naked skin of the nose, the same.

In the female, the black of the superior parts is less full than in the male, and sometimes mixed with grey. In her, too, and in the young male, the parts above described as white, are sprinkled often with the red prevailing on the parts next to them; and, lastly, the belly is not immaculate white, but has a black sprinkling. The Nipalese call this animal the *Thár:* and the chase of it is a favourite diversion, with the Gooroong tribes especially, who usually kill it with poisoned arrows. It is not speedy, as might be inferred from what has been said of its make. Its flesh is very coarse and bad. But there is plenty of it, and these mountaineers, who are apt to look to the quantity, more than the quality, of such flesh, as a Hindoo Government deems licit food for them, prize the *Thár* very highly, and hunt him very eagerly. The following are the size and dimensions of a fine mature male :—

	feet.	*in.*
Length of the body, from the setting on of horn, to root of tail,	4	$1\frac{1}{2}$
Length of the head,	0	$11\frac{1}{2}$
Length of tail, (flesh only,)	0	$3\frac{1}{4}$
Ditto ditto, to end of hair,	0	$6\frac{1}{2}$
Height of animal, shoulder,	3	1
Depth of chest,	1	$3\frac{1}{2}$
Height of fore leg, to line of chest,	1	$9\frac{1}{2}$
Utmost girth of the head,	1	9
Ditto ditto, of the body,	3	2
Length of ears,	0	$7\frac{3}{4}$
Ditto of horns, (in straight line,)	0	8
Basal diameter of ditto,	0	$1\frac{3}{4}$
Basal interval of ditto,	0	$0\frac{5}{8}$

VII.—*Report on the Experimental Boring for Fresh Water in Fort William.*

[Read before the Physical Class Asiatic Society.]

During the rainy season of 1830, Messrs. Ross and Kyd, and Dr. Strong, the gentlemen entrusted with the Experimental Boring, were obliged to confine their operations, to the preliminary measures of sinking a well, constructed of earthen rings, on the native plan, to the depth of 30 feet below the surface of the ground. The earth at this depth was of so sandy a nature, that the workmen could not be induced to carry the shaft lower; and it was deemed advisable to prepare a quantity of sheet iron tube, to be forced down into the perforation, when continued thence by the auger, should the sand be found to fall in, and impede its progress downwards, according to the Report read at the meeting of the 19th August, 1830. A sum of 250 Rupees was expended upon the construction of the well, and the 55 feet of tubes, and the erection of a convenient stage over the well, fitted with a 23 feet ship's pump, which was obligingly lent by Mr. Kyd, for the purpose of keeping the upper shaft free from water.

At that meeting we were appointed a sub-committee to inspect the works, and we were satisfied that they could not be under better management.

At the meeting of the 27th October, specimens were produced of the several strata of clays, to the depth of 109 feet, which agreed in every respect with the Report of the former experiments, under Colonel Garstin. Mr. Kyd had fitted up a windlas, with tackle and pulleys, which were found highly convenient for raising the rods perpendicularly.

At the Meeting of the 15th January, it was reported that an additional depth of 37 feet had been attained, making the whole shaft 146 feet, being a few feet deeper than had hitherto been reached in the former experiments. At this depth, the borer was in yellow sand, under the thick beds of adhesive clay; and, consequently, in one of these situations whence a spring might be looked for, differing in quality from the brackish waters, of the upper or 30 feet sand: as, however, there proved to be no head or hydrostatic pressure, such as could raise the water of the lower stratum to the surface, and as the oozing above kept the shaft constantly full, it was impossible to ascertain whether any difference of quality existed, without sinking tubes; a measure postponed as long as it was possible to reach to still lower strata with the bare auger.

The instrument unfortunately broke at this period of the work, and after some ineffectual attempts to extract the fragments, it was found necessary to force it on one side into the sand.

During the delay thus caused, much sandy earth sunk into the shaft, so that each renewal of the task-work was but a repetition of the preceding day's labour.

By perseverance, however, these difficulties have been overcome, and the auger is again lodged in a light clay, under the yellow sand, at 152 feet from the surface; a specimen of this clay is now presented to the Museum.

Although the falling in of the earth still continues to counterbalance nearly all the exertions of the workmen, the superintendent in charge (a man used to such operations in Europe) feels more confident of success than ever; that is to say, he is in hopes of carrying the shaft to a still greater depth, until the present stratum of clay shall be perforated, when another chance of an overflowing spring will be afforded.

Mean time, the whole of the fund of Rupees 1000, put at the disposal of the Physical Class, has been expended; and it will be necessary to obtain a further grant, if it be deemed advisable to prosecute the undertaking.

We abstain from offering any conjectures on the ultimate success of the experiment, since conjecture must be out of place, where we have the means of submitting the point to actual trial; where there are thick strata of clays superposed on sand, and this again upon other clays or rocks of a consistent nature, and having an inclination from land of a higher level, it cannot be deemed impossible, that the infiltration of rain water from the upper levels should extend under the alluvial clays of Bengal, so as to be finally reached by our auger. The question then seems to be, whether the expense likely to be incurred will prove out of proportion to the object sought? It is an opinion, that as long as any progress downwards can be made by the rods, the work should, on no account, be given up; every foot gained, is, at any rate, a valuable acquisition to our knowledge of the stratification of the Calcutta alluvium, and that alone would be sufficient warrant for our continuance until the difficulties encountered shall become insurmountable; or until we may at length be so fortunate as to obtain the success anticipated, upon the commencement of the undertaking.

(Signed) JAMES CALDER,
J. W. FORBES,
J. KYD,
JAMES PRINSEP,
} Sub-Committee of the Physical Class.

Calcutta, 9th March, 1831. *19th August,* 1830.

VIII.—*Proceedings of Societies.*

1.—Asiatic Society.

Physical Class.

Wednesday evening, the 20th April.

The Honorable Sir Edward Ryan, President, in the Chair.

1. Specimens of the Coal from Gendah on the Neengtee, or Kuenduen River, were presented in the name of Mr. Assistant Surgeon D. Richardson, Madras Establishment, with his observations thereon; the Coal was met with in the soft sandstone district, on the boundary of the Manipur territory—the river and vallies abound with detached masses; the Coal frequently retains the form of the trees whence it was derived. The Burmans report it to be useless as a fuel, without the aid of wood to keep it ignited.

2. Specimens of the Fossil Bones discovered in the neighbourhood of Prome, in Ava, were presented by Mr. Calder, accompanied with a notice on the subject of them, by Dr. Falconer[1].

3. A large square brick was transmitted by G. Swinton, Esq. on the part of Captain Davidson. It was dug up at Goalpara, in Assam, and is supposed to indicate the existence, at an early period, of some fortress on that spot, which tradition ascribes to Man Singh.

4. A small fragment of clay sandstone, brought up by the borer in the Fort, from the depth of one hundred and sixty feet, and presented by Messrs. Ross and Strong, excited considerable interest, as it seemed to indicate that the rock had been finally reached.

5. A paper was read, on the determination of the Azimuth in Trigonometrical Surveys, by Captain Everest.

This paper embraces two objects of practical importance in Surveys, where great accuracy in the bearing of a station relatively to the meridian is requisite. The bearing is usually found by observation of the Azimuth of a circumpolar star, at its greatest elongation from the pole, to the east or west. The calculation of this Azimuth depends upon three elements: the latitude of the place; the North polar distance of the star; and the time of observation. Supposing the first or second elements to be incorrectly known, at the time of making the calculations, and to be subsequently corrected, Captain E. deduces differential formulæ for the

[1] This paper will appear in our next number; the particulars are, therefore, omitted.

introduction of the corresponding corrections requisite in the Azimuth found, so as to avoid the necessity of going through the whole operation again.

The differential formulæ for changes in N. P. D. further enables the observer to compute a set of observations for many nights in succession, by merely finding the daily variations in the other parts consequent thereto.

It has always been a desideratum to extend the observation of Azimuths to some time before or after the exact period of the maximum elongation, without resorting to the laborious formulæ of Spherical Trigonometry to work out the results. The second part of Captain E.'s paper provides a rigorous formulæ, also differential, for this object; and it points out how the process may be simplified in practice, without diminishing in an appreciable degree its practical accuracy. As an example of its application, he deduces that the polar star may be considered stationary in Azimuth for the space of four minutes and seven seconds; and that for half an hour prior and subsequent to the maximum elongation, the variation in Azimuth is only one minute of space in lat. 24°.

Tables for all these minute corrections may be computed with facility from the formulæ given.

6 Read also some observations made in a journey from Calcutta to Ghazeepoor, by the Reverend R. Everest[2].

2.—MEDICAL AND PHYSICAL SOCIETY.

At the Meeting held on the 3d April, Messrs. Key, Geddes, Keir, and Jacob, were elected Members, and Mr. Hitchcock, of Leicester, a Corresponding Member of the Society. The following communications were then laid before the Society:—An account of Lithotomy on Natives, with Calculi removed by operation, by Mr. Burnard. A case of disease of the hand requiring amputation, with a model and preparation, by Mr. Fuller. A case of tumor of the Orbit successfully removed by operation, by Mr. Egerton. A case of Pancreatic Sarcoma of the Orbit, by Mr. Twining. A case of osseous tumor of the lower jaw, successfully excised, with a drawing of the same, by Mr. Brett. Seven cases of Lithotomy on Natives, with specimens of the Calculi, by Mr. Brett, of Shajehanpore. A case of Lithotomy on an European, with analysis of Calculi removed from Natives by operation, by Mr. Twining. Part 1st, of an *Essay on the common fevers of Bengal*, by Mr. Hutchinson. A letter from the Secretary of the Rio de Janeiro Medical Society, stating the formation of the same in 1829,—having for its object the improvement of Medical Science generally; and enclosing a copy of the Regulations of the Society, and earnestly requesting the establishment of an amicable communication and co-operation with the Calcutta Medical and Physical Society, on Medical and Scientific subjects. A printed account of the Siamese Twins, presented by Mr. Strong. Dr. J. G. Vos's *Thesis De ruminatione humana;* presented by Dr. Keir. Several objects of Natural History from Pinang, were presented by Mr. Waddell. The case of Abscess of the Liver, formerly laid before the Society, and Mr. Hitchcock's account of Cholera, were then read and discussed by the meeting.

The case of Hepatitis was that of an European admitted into Hospital on the 14th August last, with the usual symptoms of acute inflammation of the liver. About the end of September, the symptoms indicated the formation of an Abscess—and in the course of the early part of the ensuing month, this was placed beyond a doubt. At length, on the 30th of October, the case terminated fatally. The man, at the commencement, had declined being bled to the extent prescribed by his medical attendant. On inspection, after death, it was found that an enormous abscess had formed in the right lobe of the liver, part of the contents of which had escaped into the chest.

Mr. Hitchcock's paper on Cholera, comprises a general account of thirty-eight cases of the disease, in its epidemic form, as it appeared on board the Hon'ble Company's Ship *Abercrombie Robinson*, in the month of August, 1828. On the morning of the 10th of August, the ship sailed from Bombay, and although there were not more than twenty on the sick list, yet, by far the greater part of the ship's company had been reduced by illness during the detention of the vessel in port. The weather was squally and wet, as is usual in the S. W. monsoon, and the ship's destination being for China, her course was continued in a direction along the Malabar Coast, at a parallel distance of about thirty miles. The 10th, 11th, and 12th, passed without any addition to the sick list—early on the morning

[2] This paper will appear in our next; the abstract of it is, therefore, omitted.

of the 13th, however, four cases of Cholera manifested themselves, and the nature of the disease being but little suspected, was not noticed by the unfortunate individuals until the stage of collapse had intervened. From the 13th to the 18th of August, the disease continued to prevail on board the ship. The symptoms need not be dwelt on here, as they were those that usually are seen in this disease. The treatment consisted of the exhibition of hot brandy and water, with laudanum, venesection, and the exhibition of scruple doses of Calomel, &c. &c. In the state of collapse, sinapisms and blisters were applied to different parts of the body. The warm bath, with flannels, was also applied, when deemed necessary. Neither on the use of the warm bath, nor of venesection, does Mr. Hitchcock give a very favourable opinion. The former seemed to increase the spasmodic affection, with a sense of suffocation; and in no one single case was the heart's action quickened or invigorated by the latter.

With reference to the primary cause we have, observes Mr. Hitchcock, three of the most important parts of the body labouring under a loss of vital and nervous power—the heart oppressed by some invisible, unknown operation, and sinking beneath a load of dark carbonaceous blood—manifested by a labouring pulse, by a deficiency of animal heat, and by the colour of the blood transmitted. The brain, chemically as well as mechanically, suffering; in part from an important interruption to the change and transmission of the blood through the lungs, as well as from some serious impression made upon the organ itself, by the morbific agent; which effects were most fully evinced by dilated pupil, giddiness, and stupor. And lastly, the lungs themselves appeared primarily affected, as was seen in the impediment offered to the free circulation of the air, occasioning a short and hurried respiration, a purple coloured lip, and, from the appearance of the blood itself, marking an imperfect decarbonisation.

All these changes, he conceives, are produced by some extraordinary change in the principles of the surrounding atmosphere; or what is perhaps equally probable, from an inhalation of some kind of malignant aëriform particles which have their rise in a *chemical* or electrical change in one part or other of the same. "I am aware," Mr. Hitchcock proceeds, "that this opinion must be subjected to objections, because it is not demonstrated, and because it may be urged;—why then should not all who breathe the same atmosphere, and so closely in contact with each other, universally suffer from the same? To this, I would reply, that it is just as probable, that the specific agent now alluded to, may be formed, or be as suddenly disengaged, as the electric spark that shoots from its original source to the nearest object of attraction;—or like miasmata producing ague, it may require a certain state of the system for a developement of its malignant effects. The latter of the two, I am inclined to think the most probable, although unable to trace, in the present instance, any signs of a predisposing cause.

"If the effective cause or causes, cannot be accounted for in this or a similar way, how much less may be credited the opinion of those who have suspected its presence in vapours arising from stagnant waters;—from rice, in a state of decomposition, as well as other vegetable matters;—or have accounted for it in the sudden change of temperature, or even traced it to errors in diet; when we, who have suffered almost beyond precedent, were far removed from the effluvia of either of the former[3], and by no means the subjects of the latter to any extent. Again, this opinion (of the primary cause) may be opposed by inquiring, if the self-same agent is always necessary for the production of cholera, why its action should not be more regular and uniform? Why in one appear under the dangerous and fatal form of congestion or collapse, and in another produce a contrary effect, by increasing the heat, and accelerating the heart's action? Here I would refer to the general causes of some forms of fever, where the same agent is producing in one a continued, and in another, an intermittent type, according (as is supposed) to the predisposition of the subject, or a concentration of morbific influence; so also it may be in epidemic cholera, and I doubt not is." In a word, Mr. Hitchcock is inclined to think that cholera, as it has been called, is a specific disease, and as such, is nowise liable to be produced by any common cause whatever; and that its action is general upon all, and occurs alike under all circumstances, and in every situation;—no predisposing cause being at present assignable. The total number of deaths from cholera, on board the *Abercrombie Robinson*, was 24—and of recoveries 14—making in all 38 cases.

[3] The maximum distance to which Malaria can travel, has not yet been determined. It has been proved, that it can produce its morbid effects at a distance of three, and even of five miles. Dr MacCulloch is even of opinion, that the poison may be wafted from the shores of Holland to those of Scotland by the East wind.—Ed. Gov. Gaz.

Meteorological Register kept at the Surveyor General's Office, Calcutta, for the Month of April, 1831.

Day of the Month.	Minimum Temperature observed at Sunrise.					Maximum Pressure observed at 9h. 40m.					Observations made at apparent Noon.					Max. Temp. and Dep. of M.B.Ther. obs. at 2h. 50m.					Minimum Pressure observed at 4h. 0m.					Observations made at Sunset.					Rain-gauge No. 1.	Rain-gauge No. 2.
	Barometer reduced to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. t° 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.		
1	29,791	74,	2,6	cm.	cis.	,862	85,2	3,8	s. w.	cis.	,803	89,7	10,3	s. w.	ci.	,745	95,	17,1	s. w.	ci.	,738	92,5	14,8	s. w.	cu.	,768	85,7	7,6	cm	cis.		
2	,817	74,5	2,1	do.	cu.	,877	81,7	10,3	do.	cu.	,840	94,	15,6	do.	cl.	,748	96,5	18,8	do.	cis.	,745	95,5	18,8	do.	cis.	,741	90,	12,9	do.	do.		
3	,78[illegible]	76,2	1,1	do.	ci.	,838	87,5	12,8	do.	do.	,820	92,3	12,9	do.	cis.	,752	96,3	14,6	do.	cu.	,716	96,	14,4	do.	ci.	,639	91,	11,6	s. w.	do.		
4	,817	76,5	0,8	s. w.	cl.	,873	88,	7,3	do.	ci.	,848	95,	13,3	w.	ci.	,758	95,3	16,9	n.	cus.	,748	89,3	12,9	w.	n.	,770	83,	5,6	w.	cus.		
5	,8[illegible]2	73,6	3,9	cm.	cu.	,861	83,4	12,4	n. e.	cl.	,818	92,8	16,1	n. e.	cl.	,742	95,6	16,5	n. e.	cu.	,719	95,3	17,3	n. e.	cu.	,717	88,	10,9	n. e.	cu.		
6	,862	67,5	0,6	n. e	cis	,907	80,6	6,2	e.	cis.	,844	85,5	12,5	e.	cis.	,806	88,	13,8	do.	do.	,775	86,6	12,4	do.	cis.	,791	82,	9,9	cm.	cis.		
7	,837	68,3	0,9	e.	ci.	,871	81,	9,	do.	ci.	,845	86,6	11,7	do.	ci.	,772	88,6	9,6	e.	do.	,739	85,	7,6	e.	cu.	,768	77,	3,1	do.	n.	1,80	1,20
8	,813	71,5	1,1	s. w.	cis.	,864	83,8	7,6	s. w.	cu.	,838	87,8	9,1	s. w.	cu.	,760	90,3	12,1	s.	cus.	,737	86,3	9,1	s.	cus.							
9						,898	80,8	7,1	e.	ci.	,852	85,	9,6	e.	do.	,779	87,3	11,9	n. e.	cu.	,760	87,5	11,8	n. c.	cu.	,745	82,3	7,9		cu.	0,37	0,35
10	,786	74,7	0,8		cu.	,879	71,7	0,3	s. w.	cu.	,776	81,3	7,9	s. w.	cus.	,729	84,3	6,9	w.	cis.	,729	82,	3,6	w.	cis.	,738	79,	1,3		do.	0,38	0,30
11	,736	70,3	0,4	s. w.	cl.	,797	81,3	9,4	n. w.	cl.	,767	86,	13,6	n. w.	ci.	,677	88,3	14,4	n. w.	cu.	,663	87,5	13,1	n. w.	cu.	,663	83,3	8,9	n. w.	do.		
12	,689	74,	0,6	n. w.	ci.	,757	88,	9,3	s. w.	do.	,736	92,3	8,6	s. w.	cis.	,648	92,8	19,1	s. w.	cl.	,525	92,5	18,8	s. w.	cl.	,642	85,	11,1	s. w.	cis.	0,30	0,28
13	,710	77,	0,3	s.	cl.	,797	88,3	7,3	s.	cu.	,788	82,3	6,9	s.	cl.	,694	89,9	15,2	s.	ci.	,686	89,5	14,5	s.	ci.							
14	,789	63,	0,6	cm.	cu.	,844	81,5	5,6	cm.	cl.	,821	88,	11,6	s. w.	do.	,724	92,3	14,9	s. w.	cl.	,723	91,5	14,6	s. w.	cu.	,740	83,5	6,1	s. w.	cus.		
15	,799	76,9	1,	s. w.	cl.	,860	84,8	4,4	s. w.	cu.	,825	89,8	7,9	s.	cus.	,753	90,6	10,9	s.	cu.	,733	89,5	10,3	do.	do.	,733	85,	5,6	cm.	cu.		
16	,815	72,	3,6	s. e.	cu.	,871	82,6	6,7	s. e.	ci.	,836	90,3	12,1	s. e.	cu.	,765	90,3	12,6	s. e.	do.	,737	89,3	11,9	s. e.	ci.	,765	83,5	4,1	s. e.	cis.		
17	,830	73,	0,6	s. w.	cis.	,881	85,3	4,9	s. w.	cu.	,850	91,	6,6	s. w.	do.	,823	76,5	2,1	s.	n.	,815	76,	2,1	s.	rn.	,835	68,9	0,5	s.	rn.		
18	,823	69,	0,6	cm.	cus.	,892	79,5	5,8	cm.	ci.	,852	83,5	7,5	cm.	cis.	,797	86,5	11,6	cm.	cis.	,780	86,	11,1	cm.	cis.	,777	81,	6,1	cm.	ci.	2,20	1,75
19	,812	72,7	1,3	do.	cis.	,867	83,5	8,1	do.	cl.	,834	86,6	8,9	s.	cu.	,760	89,9	11,7	s.	cus.	,757	86,3	9,9	s.	cus.	,756	81,5	4,4	s.	cis.		
20	,805	75,9	1,5	s.	cu.	,861	87,7	11,3	s.	cu.	,841	90,	10,6	do.	do.	,765	92,7	13,	do.	cu.	,696	92,	12,6	do.	cu.	,751	87,	9,3	do.	ci.		
21	,774	76,7	1,3	cm.	ci.	,839	85,6	7,2	cm.	do.	,806	91,3	13,	n. e.	do.	,720	93,8	16,4	n. e.	do.	,710	93,5	15,6	n. e.	do.	,719	88,3	9,9	n. e.	cu.		
22	,741	77,5	0,6	s.	cl.	,802	88,8	9,4	s.	cl.	,775	92,5	12,1	s.	do.	,794	95,3	15,4	do.	do.	,665	95,	13,6	do.	do.	,678	89,3	8,6	cm.	cl.		
23	,783	76,7	0,3	do.	do.	,873	88,	8,6	do.	do.	,825	93,5	13,6	do.	cl.	,765	94,5	16,8	s.	cis.	,751	94,3	17,3	s.	cis.	,778	88,7	12,8	s.	do.		
24	,800	76,5	1,1	s. w.	do.	,838	90,5	11,6	s. w.	cu.	,896	91,	10,6	s. w.	cu.	,732	94,5	15,6	s. w.	cu.	,731	93,5	15,1	s. w.	cu.	,747	87,3	11,9	s. w.	ci.		
25	,735	77,	0,6	s.	do.	,792	91,	12,6	s.	cl.	,754	95,6	13,9	s.	cl.	,668	98,	15,	s.	cl.	,650	96,8	13,5	s.	do.	,666	89,	9,3	s.	do.		
26	,669	78,7	0,8	s. w.	cu.	,711	91,3	10,4	s. w.	do.	,656	97,	14,3	s. w.	do.	,580	101,3	17,9	s. w.	do.	,561	96,8	11,4	s. w.	cl.	,575	88,	6,3	s. w.	cl.		
27	,571	81,5	1,4	s.	cl.	,617	91,3	7,4	s.	do.	,570	94,8	11,1	s.	do.	,513	95,6	9,2	s.	do.	,504	94,6	9,2	s.	do.	,526	89,3	4,9	s. e.	cns.		
28	,594	81,3	1,6	s. w.	ci.	,660	90,5	7,8	s. w.	cu.	,642	94,	9,6	s. w.	cu.	,617	95,8	10,9	s w.	cn.	,667	94,5	10,2	c.	do.	,582	91,	8,6	do.	ci.		
29	,627	80,4	1,	s.	cy.	,679	89,5	7,6	s.	do.	,646	94,	11,1	s.	do.	,575	95,5	11,6	s.	do.	,562	94,5	10,3	s.	cn.	,626	83,3	6,9	s. w.	cus.		
30	,669	80,5	0,4	do.	cu.	,719	89,3	7,9	s.	do.	,688	94,5	11,7	do.	do.	,603	95,6	11,9	do.	do.	,590	94,8	11,9	do.	do.	,585	88,5	6,1	s.	ci.	0,25	0,20
Mean,	29,762	74,9	1,2			,823	85,5	8,0			,787	90,2	11,1			,719	92,2	13,5			,697	90,8	12,3			,708	85,2	7,6			5,30	4,08

Abbreviations. In the column "wind," small letters have been used instead of capitals; *cm.* means *calm.* In the column "Aspect of the sky," *cy.* is *cloudy; cl. clear; rn. rain; ci. cirrus; cu. cumulus; cs. cirro-stratus; cus. cumulo-stratus; cc. cirro-cumulus; n. nimbus.* The Rain-guage No. 1, is on the ground: No. 2, is on the roof of the house, 45 feet above it.

GLEANINGS

IN

SCIENCE.

No. 29.—*May,* 1831.

1.—*Geological Observations made on a Journey from Calcutta to Ghazipur, by the Rev.* R. Everest.

[Read before the Physical Class Asiatic Society, 20th April.]

Not far beyond the fiftieth milestone, on the road from Calcutta to Benares, we begin to observe that we are gradually leaving the alluvial plain of Bengal. The soil round us is turned more or less to a red clay, and our road lies through a soft, reddish sand, such as would be occasioned by disintegrated granite, composed of grains of felspar and quartz, with some mica, and a few rare black grains, some of which look like fragments of hornblende.

A little before completing the 73rd mile, I observed a gravel intermingled with the red clay, which resembled the gravel we often see in basaltic or volcanic countries, and which is there composed of small cinders, fragments of augite, &c. covered by a coating of burnt clay. In our present case the grains are globular, or nearly so, from the size of a pea to that of a hazel nut, and when broken, show a fracture of an iron black or red colour, and are full of small cavities; but they are earthy and soft, yielding easily to the knife.

These appearances continue as we advance, and we besides see angular fragments of a coarse sandstone lying about; such a rock as might, by disintegration, form the reddish sand above mentioned.

With these changes in the soil, a change in the level has also taken place, but the rise is so barely perceptible, that we travel on it a long while without being made aware of our situation, by the existence of lower land before us.

And as we find ourselves among a succession of very gentle undulations, we pass over the beds of streams which no longer deposit mud, but fine sand and gravel. Every trace of the alluvial flat has disappeared; over such a country, and, upon the whole gradually rising, we reach Bancùreh. Here the surface presents us with the same appearances, but a well, fortunately, gave me a sight of the rock beneath. Below two or three feet of granitic sand, was a well defined straight slaty gneiss, dipping rather to the westward of the north. It is very friable, owing to the decomposition of the mica, for about 10 feet down, and then suddenly becomes solid. I had no means of knowing whether this dip is universal or no in the country around; for, except some large water-worn blocks, scattered about, the rock is scarcely any where to be seen. Once or twice I met with it exposed in a small watercourse, but much disturbed by veins of large grained quartz and felspar, which traversed it. With the granitic soil are mixed grains of the gravel we before alluded to; and we find blocks of a reddish brown slaggy looking stone here and there, from which they have evidently been derived. These pieces have, I believe, been called clay ironstone, a mineral quite different from the clay ironstone which is found in the English coal districts. It is about the sp. gr. of 2.8, and seems to have been produced by the decomposition of granite, with, perhaps, some magnetic iron. The slaggy appearance is occasioned by its numerous irregular hollows mammellated inside, and indeed some specimens shew much of a stalactitic form. Many grains of quartz are imbedded in it, and the quartz gravel of the granitic soil often has an iron black or red coating, which shows it to have had a similar origin. Those who remember the decomposing state of granite in the neighbourhood of trap rocks will not be at a loss to account for this; to those who do not, I will refer to Dr. Daubeny's work on volcanos, where he states, that in granitic countries which are or have been subject to eruptions, the felspar and mica of the rock is in a rapid state of decomposition, owing to the carbonic acid gas, which is every where forced through fissures in the rock. This is called by the French, the "maladie du granit," and we see that our granite here has, some time or other, been troubled with a "maladie," and a wide spreading one too, so that we may reasonably infer that it has suffered from the same cause. The iron-stone itself, from its mammellated and imperfect stalactitic form, seems to have been at least semifluid; and from its softness and earthiness, can only have been a deposit from water. So that if we conceive a spring to have issued from the rock, bringing with it this iron clay as a sediment, which gradually agglutinated together, and hardened, we might expect to find such appearances as we now see. I two or three times came to places where this iron-stone seems to have cut through the granitic rock as a vein; at least it formed a reddish streak or band on the surface, for some distance through the whitish grey debris of the gneiss; but there were no means of ascertaining its connection with the solid rock. About four miles to the south of Bancúreh, a pathway, in the jungle, crosses a considerable mass of it, for near a quarter of a mile. Loose blocks of it cover the surface, and in some spots we stand ankle-deep in the globular gravel; but beneath the roots of the grass and bushes, it is solid as far as could be determined. A pathway which ran parallel with the first, at the distance of 4 or 500 yards, gave another sight of it, but the soil and thick vegetation, prevented my tracing it further. We cannot, therefore, know whether it continues across the country as a dyke, or is merely here in the mass.

There is another substance which confirms our conjecture respecting the origin of this iron-stone. And that is the "Kankar" or limestone, of which pieces are every where scattered through the soil. These pieces are usually from the bigness of a walnut to three or four times that size; but they are not such pieces as would have come from the breaking up of a solid bed of carbonate of lime; they are full of irregular hollows, which are sometimes faintly mammellated inside. They are covered with a whitish or yellowish white powder, but the fresh fracture is of a brownish grey colour, and the stone compact, and somewhat harder than common chalk. The newly exposed cavities inside are lined with minute crystals. The irregular almost dendritic form of these pieces, and the hollows, which abound in them, lead us to believe that they have been deposited round other substances, either in a vein of the rock or at the surface.

Those familiar with the productions of what is called a "petrifying spring," or, in stricter language, an encrusting or calcareous spring, will hardly hesitate to believe that they are fragments of such incrustations. They too contain grains of quartz, and in these, as also in the iron-stone, some minute silvery specks are to be observed, which look like mica.

If we recollect that beds of the red clay, which have been called laterite, and I believe pieces of the accompanying iron-stone, form, as it were, a fringe to great part of the Bay of Bengal, covering the edge of the granite of either peninsula, and lying between it and the sea, we may have some idea of the causes which have formerly been in operation, from the effects we now see. Of which causes the many hot springs in different parts of the country, are probably the only remains at present. At Penang, the only other place in which I have yet seen the granite of India, the extent to which decomposition has taken place is astonishing. Auvergne has been cited as a remarkable instance of granitic decomposition; but in the former place I have seen it more remarkable and extensive than I recollect to have done in the latter.

From Bancŭreh we go in a direction about N. N. W. for 32 miles to Raniganj, on the bank of the Damŭda, where the Coal Pits are situated. We are on a gradual descent the whole of the way; though the further we leave Bancŭreh behind, the more level does the country before us become till we at last appear to have returned to the flat plains of Bengal. Before reaching Raniganj, Chatna hill, a rounded granite looking mass, that we see at Bancŭreh to the N. W. bears to the east of south from us, and from this a succession of points and ridges appear to reach to the north of the west, to the bases of which the low country extends, so that we are partly encircled by them. We see the rock appearing through the soil shortly after leaving Bancŭreh, a fine grained slaty gneiss, though for no great extent; but for several miles before reaching the Damŭda, all is hidden from us.

On the southern bank of the Damŭda, which is very little below the level of the plain, we find beds of a brownish, crumbling sandstone, and a micaceous shale, nearly horizontal; but having crossed to the opposite side, we ascend a tolerably steep slope, to the height of from 150 to 200 feet, over strata of the same crumbling sandstone; dip irregular, generally from west to S. west. There has been a small eruption on the side of the hill, probably occasioned by the spontaneous combustion of coal strata beneath.

Blocks of a porous lava, with pieces of hard slate imbedded in them, of semi-vitrified slate sticking together, of burnt shale, red and white, and scoria, are mingled in a mass not less than 130 yards across, and in some places from 12 to 14 feet thick. The whole, or nearly so, appears to have burst forth in a line of rents under the crest of the hill, and to have pushed obliquely down a hollow in the slope, till it reached the flat ground, through which a streamlet (the Hunada) runs near its junction with the Damŭda.

From the upper to the lower extremity of this long heap of veins, is about a quarter of a mile, and we see from the waterworn channels that intersect it, that it is much less than it once was. Sometime ago in the main bed of coal 75 ft. below the surface, the workmen had reached to within 30 yards of the western end of what I have described as a line of rents, when a quantity of what they called *cinders* burst in upon them, and nearly filled the gallery in which they were, and which has been abandoned in consequence. Cinders they are not, but merely burnt shale, such as would be produced by heating shale in the open air.

About 10 yards to the west of this spot the strata had shifted, so that instead of rising obliquely to the mass of heated coarse rubbish, they rise directly against it; but as these shifts are not uncommon in the strata, we cannot draw any certain inference from them.

The bed of coal at present worked is 8 or 10 feet thick, and is probably the main bed in the formation; for they have sunk to some depth beneath it, but the coal seams became thinner as they descended. The laminæ of the coal show between them an appearance of woody fibre, which I do not think is uncommon. The coal itself is in appearance much like the Staffordshire coal, and burns in the same manner, leaving a white ash. The vegetable remains in the shale are of the same kind as those in England, in so far as they may be ranked nder the general names of calamites and equiseta; one or two of them are not unfamiliar to me; but for further information on this head, I beg to refer to Dr. Falconer, who has been good enough to give his attention to them, and whose detailed account of them may shortly be expected. I have merely to observe, that the impression, of which mutilated specimens have before been sent down, and about the nature of which many conjectures were raised, appears to have been a reed. But I never recollect to have seen any similar to it, and it is peculiarly abundant, and may be said to be characteristic of this formation.

The sandstone seams which alternate with those of shale and coal, are more crumbling than I recollect them in England; yellowish, and covered with ochry stains. Two specimens which I have examined, one from the surface, the other from about 20 feet below, and which was reckoned as remarkably difficult to work, both effervesce strongly with muriatic acid. They are, however, principally composed of fine granitic sand; and probably the carbonate of lime has only acted as cement to them. We have no means at present of ascertaining the thickness of these calcareous joints; but the specimen from the other bank of the Damùda is not calcareous. With the sandstone alternates a micaceous shale, of a light ochry yellow colour, as well as the dark blue and blackish varieties.

No dykes have yet been observed to cut the coal strata; and though Mr. Jones, in his paper on them, speaks of some trap or greenstone layers, I was not fortunate enough to discover any such. But about 12 miles off appear three cones, called by the natives the Pachete hills, which, from their shape, must be trap; and it is not impossible that dykes may hereafter be traced from them, into the adjacent country. A considerable hot spring is said to rise near them, and two others are named in the neighbourhood of Raniganj, one 27 miles to the west, in the bed of the Damùda, and one about the same distance to the north, beyond the Adji river.

Of the extent of this formation little is known. To the eastward and north-eastward, its limits have not been traced. To the north we are not without evidence that it reaches, at least, to the banks of the Adji: for a quarry of sandstone is worked there, and the stone used in large slabs, for paving. We know that to the south-east it does not extend to Bancùreh; but 25 miles to the south of this latter place, at Aminagar, a stone is worked similar to that on the Adji. To the west, a coal pit is worked 20 miles distant, on the bank of the Damùda, but the strata are said to be cut off by primitive rocks not much beyond this.

I had no means of ascertaining the nature of the rock till I got near Amchatar, about 50 miles farther on, when it appeard to be the same sort of country, and of granitic soil, which we see about Bancùreh; but shortly before we reach Amchatar we see a conical hill before us, which appears, as we approach it, to vary something in shape, and become like the projecting part of a highly inclined bed, dipping to the north. It is a greenstone stratified, composed of large and distinct crystals of hornblende, predominating in a base of dark grey felspar, a sienitic greenstone, if such a term be admissible. We see in the distance, to the west, one or two cones, which, judging from the range of this, are probably connected with it; and, for a similar reason, we might suppose the three cones, I have called the Pachete hills, to be part of the same line.

Beyond Amchatar we pass over a tolerably level country, with a soil of granitic debris, in which *Kankar* occasionally abounds. I had not the opportunity of seeing the rock more than twice, exposed in two small watercourses, before reaching Chass. Once there appeared a distinct passage to sandstone; a collection of small angular grains of quartz and felspar, with parallel scales of mica sparingly interspersed, and crumbling under the hand, an appearance which I at the time rather attributed to the state of decomposition of the rock, than to any change in the formation. The dip here N. E.

To the north of Chass, we see a detached mountain[1], rising abruptly out of the low country at its base, and distant from us, perhaps, 10 or 15 miles. It can hardly reach to a less height than 3000 feet above the surrounding plain, and, from its size and appearance, is probably granite or gneiss.

As we continue to advance from Chass, we see another mountain range fronting us, and running from N. E. to S. W. perhaps rather from E. N. E. to W. S. W. Its peculiar outlines strongly mark it as being composed of granite or gneiss; and the mountain we see to the north of Chass is probably only an outline from it.

In this part of our way we begin to observe a change in the rock round us, wherever we have an opportunity of meeting with it. It has still a slaty structure, with hornblende and not mica; but before we reach the Damùda it has become more massive and rugged; the hornblende, and the rock has partly taken the appearance of trap. The dip is yet steady to the east of the north.

On crossing the Damùda we see the rock exposed on the further bank. It is thrown up at a considerable angle, and shows a passage to sandstone, similar to what I mentioned having seen before coming to Chass. But on ascending a few yards over the edges of the strata, there is no longer any doubt of its nature. Layers of a well-defined micaceous sandstone are seen alternating with a bluish and whitish shale, loose and earthy. The dip too has changed to the N. W.

From this place to Gumeah, a distance of three or four miles, we pass over the edges of such strata, mostly small grained yellowish sandstone, not differing much from that of the coal strata at Raniganj, except that in this case, shale alternates with it but sparingly.

A little before reaching Gumeah the dip gradually changes from the N. W. to the south, and beds of a purplish and blackish shale begin to predominate. In going down the last declivity, less than a quarter of a mile before reaching the bungalow at Gumeah, I turned aside down a small water course, and was lucky enough to find in the slate, some impressions of the reed of Raniganj; the coal strata themselves may probably be found not far to the south. I have been particular in naming this locality, as those who have time and inclination to stop at Goomeah will be likely to find abundance of remains there[2].

It is impossible to see this shale full, as it is, of the impressions of decayed vegetables, and then to look at the country round—widely different from a regular granitic formation, but rather as it were, detached pieces of such a formation, rising out of the low plains as islands out of a sea; it is impossible to see this, and not remember the theory which supposes the first formation of Europe to have been a number of islets composed of primitive rocks, and that in the hollows

[1] The famous Parisnath mountain.—ED.

[2] On referring to Mr. Jones's paper, I see, that though the Damùda, at 7 miles above its confluence with the Basacan, shows the primitive rocks in its bed, yet the coal formation is continued in the direction of Jeriagerh, and with this our sandstone and shale is probably united.

among them, were deposited beds composed of their debris, and subsequently of the vegetables which grew on them, of which theory we here see so beautiful an illustration in a distant land.

As we leave Gùmeah we ascend, by a regular slope, up the side of the great range, which we had observed as fronting us on leaving Chass. The rock, as far as we see of it, is here granite and gneiss; more granite than we have yet seen, and without hornblende. Once, between Chutí and Narkandy, there was a distinct passage of the rock to sandstone, similar to what I have twice before mentioned, but only for a few yards. Between Narkandy and Hazaribagh I had no means of ascertaining the nature of the rock.

At Hazaribagh we are on a granitic soil, and apparently on a level, or nearly so. In fact we stand on the back of the great ridge from which the rivers take opposite directions, and which, to judge from the maps, must reach from Rajmehal nearly to Nagpur.

We leave Hazaribagh, on a gentle descent, which becomes more apparent as we advance, and about 12 or 14 miles further on, come to a low range of hills running nearly east and west. It is the same rock we have seen at Amchatar, and on the eastern bank of the Damùda, a sienitic greenstone, passing to hornblende rock; and it has here the distinct features of trap, a rugged ridge of gneiss occasionally rising into cones, and cutting the country like thick dykes. Our ascent up it is trifling; but when we are on it, we see before us a precipitous descent of several hundred feet, at the foot of which lies a low country, intersected by others of these ridges or mountainous dykes, which, though irregular, mostly take a direction parallel to the one we are on; many of the blocks on the descent are slaty.

We have here an example of the Ghats of India, as they are called, and we may not unaptly compare it to the edge of a basin nearly full.

About 3 miles off, in the valley, we come to Katcamsandy. Here, in the bed of the rivulet, the rock is gneiss, rather inclining to a gritty gneiss (if such a term may be used), highly inclined, and dipping to the south. As its range is parallel to that of the trap ridge we have just passed, this latter has probably burst forth rather between the strata than cutting them.

Four miles further on, at Katcamsandy, the rock was porphyry; a base of greenish grey compact felspar, with blotches of a reddish and brownish colour in it, and intersected by a network of quartz veins—not quartz of such a lustre as we find in veins in granite, but a dull translucent substance, approaching to chalcedony; dip S. The hot spring gushes out in a stream, apparently as thick as a man's finger. I was prevented from making such observations on it as I could have wished, from a crowd of people, who were employed bathing themselves in it, and had made the whole a dirty puddle.

For about 25 miles further on, we pass over a country nearly flat. The rock which we see occasionally runs through those various and undefinable changes which are usual in the passage from primitive to transition strata, and which it were tedious to attempt to describe, as those who have ever seen such formations, must know; sienite, sienitic granite, sienitic gneiss, porphyritic granite, are names that will perhaps include most of the varieties; the general dip is to the south. Before reaching the 267th milestone, I met with well-defined strata of gneiss, in the bed of a rivulet dipping rather to the east of south: a little way on the other side, were layers of yellowish slate clay, similar to what may be seen in the Raniganj strata, dipping to the west, but nearly horizontal. Nearly 3 miles further on, at Dangudhy, we see the same kind of strata exposed in a rivulet; but though the base is the same, it here contains a number of pebbles of quartz, sienite, sienitic and porphyritic granite, mica slate, and perhaps flinty slate, mostly rounded, but some angular. Near the 270th milestone, the crystalline rock again protrudes above the soil. From the direction of the stream, we might believe that this bed is only the termination of a formation which is expanded in the lower ground, in the line of Bàghelpur. The notice of coal at Palamù might also lead us to conjecture its connection with that quarter.

The crystalline rock as mentioned, was a compound of hornblende and felspar, rather what we should describe as sienite than greenstone; but 7 or 8 miles farther on, we come to rugged ridges, similar to what we passed before reaching Katcamsandy, and the rock is again principally hornblende. With this we sometimes see masses of a white felspathic rock, in a state of decomposition, which sometimes contains mica or hornblende, and occasionally a large grained granite; but these are partial appearances, and probably only masses that have been lifted by the trap.

After crossing these ridges, we come by a rapid descent upon the alluvial plains of the Ganges. One or two detached masses of rock appear in the distance to the north, probably they are sienite; the main formation still appears in the distance, to the south. Between the 300th and 312th milestone, I observed two outliers from this, near the road, both principally felspathic, with mica and hornblende.

The above observations are the only data which I have had to form the accompanying section. The features of the country are probably familiar to many, and those who have studied the change of granitic and sienitic rocks, where they pass much into each other, can only know the difficulty of drawing any distinctions between them, even where the rock is uncovered, the vegetation scanty, and the climate favourable to exertion. How much more so is it likely to be, where on these points we find a lamentable difference?

Yet notwithstanding these difficulties, and the equivocal nature of the rock in many places, it sometimes takes a decided character; as for instance, at the two Ghats I have described to the west of Hazaribagh. In the two points I have noticed to the east of this place, viz. near Amchatar, and on the eastern bank of the Damùda, it is less marked; but as I see there is a Tutki Ghat between Rakinjah and Hazaribagh, it may perhaps be found there.

The gradual passage of this hornblende rock or transition greenstone through sienite to granite, and the manner in which the layers of it lie between those of gneiss, lead us to conjecture that the two rocks have remained long in contact in a state of complete fusion. On such a supposition sienite and sienitic granite may be only portions of one or both rocks, the nature of which has been partially changed.

Thus mica, with about 15 per cent. of quartz, and nearly the whole of its iron deducted, would differ little in chemical composition from felspar; the same mica again, with the addition of some lime and oxide of iron, would have a similar composition to hornblende.

The manner in which the trap has burst out on each side the ridge, and its partial appearances of stratification, which shew that it has pushed between the strata rather than cut through them, are indicative of intense and long continued pressure. The inclination of these beds or dykes (for they most likely partake of the nature of both) to a common axis, renders it probable, that they are connected beneath; and, if this be allowed, we can hardly refuse the inference that they have been the principal cause which has upheaved the intermediate mass of granite and gneiss.

Between the 325th and 330th miles we see, 6 or 7 miles to the south of us, 4 or 5 cones, in a line rising out of the alluvial soil. They were evidently once continuous, as may be seen by the long heap of ruins which yet connects them; and they are a remarkable instance of the extent to which these detached masses have suffered by degradation.

About 10 miles after crossing the Son River, at a place called Jemorah, we come to a low range of hills, whose outlines are totally different from those we have just left. An outlying mass of this was near the road, a fine grained, highly consolidated, micaceous sandstone, yellowish, and greyish, splitting into thick layers, which might be used as flag-stones, or grindstones. This detached portion of the strata was nearly horizontal, but in the main range, as far as I could observe, the dip was regularly inwards, according to the direction of the range, which extended to the south and the west; so that we had approached the formation at its N. E. corner. Some of the projecting points appeared to have been thrown up at a considerable angle. The height of this range is here inconsiderable, probably not above 400 feet; it runs parallel with the road for 3 or 4 miles, and then retires further to the south. It probably reaches to Chunar, and is the north eastern extremity of the great sandstone formation of Bundélcand.

At Ghazípur I have had an opportunity of observing the *Kankar* somewhat further. The pieces here are larger than I saw them at Bancúreh, and in their fantastic shapes, resemble very much the flints in the English chalk.

The bank of the river shows a section of a layer about 4 feet thick, formed of these pieces. This layer is gradually lost in the clay, above and below. In some places this layer or seam is double, with several feet of clay intervening. It sometimes finishes, or the lower layer branches off upwards to the higher.

It resembles the chalk flint too, in the manner in which the loose pieces are imbedded in the clay, and in the layers being all composed of detached pieces. The clay itself is yellowish, probably from calcareous mixture, near the *Kankar*; but when pure, it is a stiff clay, of a light bluish colour. Such a deposit is not now formed by the river, which at present only deposits, here, a very fine sand. It is not, therefore, improbable, that the whole country around has once been the bed of a lake, which a slight difference of level would yet make it, during the rainy season.

In confirmation of this conjecture, and also as shewing the recent origin of *Kankar*, I must state that I have found fresh-water shells, small Planorbes, and fragments of what I believe to be a Lymnæa, in the clay below a layer of *Kankar*.

These shells may be distinguished from the recent ones which are washed into the rifts of the clay, by showers, and become imbedded in it, as it consolidates in the wet weather, by their very crumbling condition, so that it is hardly possible to preserve specimens. The Lymnæa I have not yet seen recent in this part of the country.

The manner in which the *Kankar* pieces are found scattered over the whole of India, is a remarkable fact in Geology, and analogous to nothing I know of elsewhere. I see, from Mr. Hardie's paper on the country between Baroda and Udeypur, that they are equally abundant, several hundred miles to the west, and in a country similar to what I have now described, being principally composed of sienitic granite. I am happy to find that I agree with so excellent an observer in opinion as to its origin, viz. that it has been a deposit from calcareous springs.

The Huriána Chumbul.

Fig. 1.

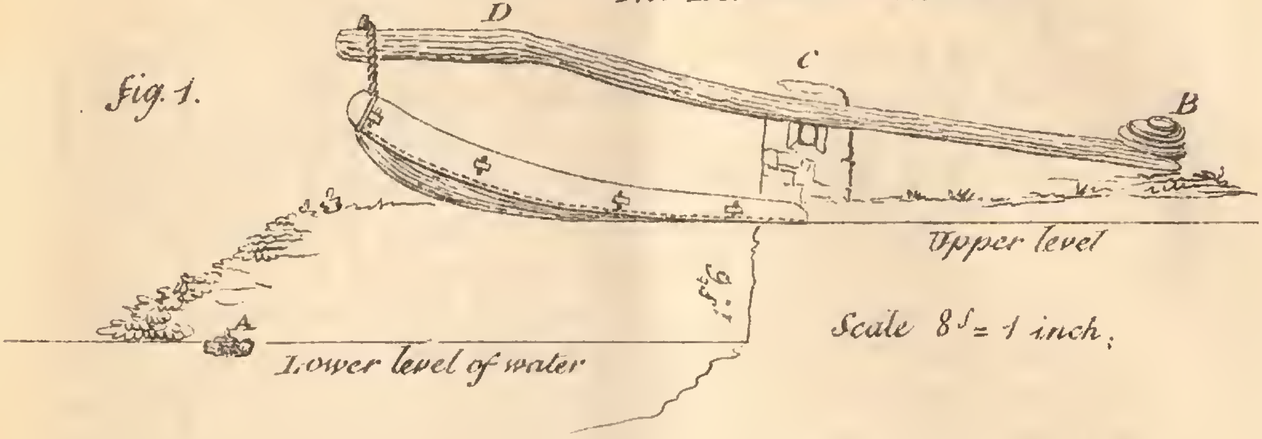
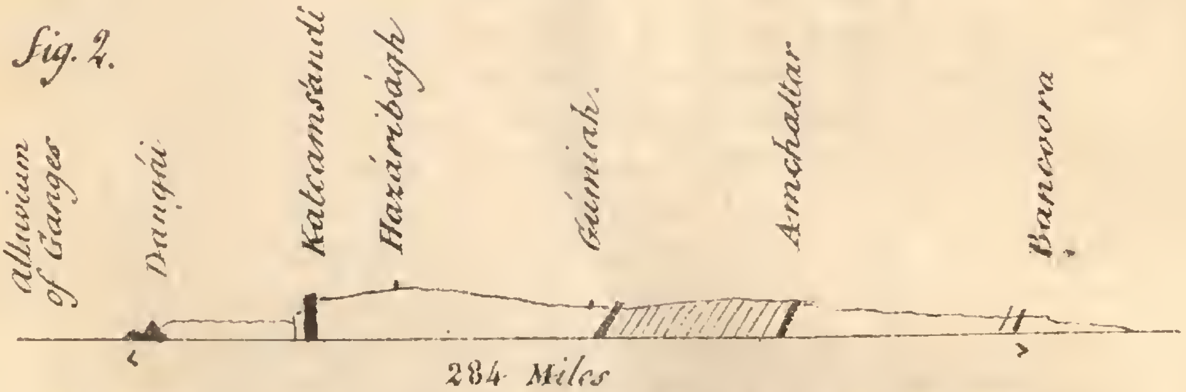


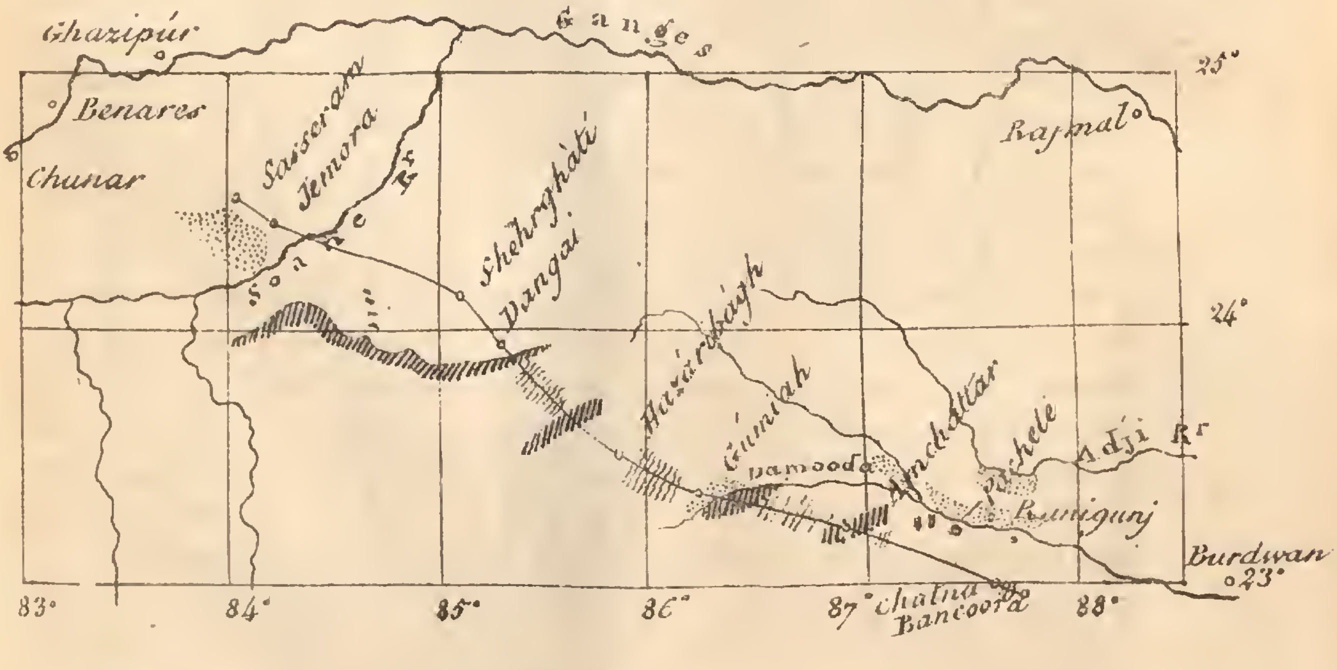
Fig. 2.



Section of Mountain land between Calcutta and Benares, shewing the trap dykes intersecting it

Revd. R. Everest.

fig 3.



Trap. Granite, Gneiss. &c. Sandstone, Coal &c.

J.B.Tassin Lith.

II.—*Classification of Animals.*

Classes.

- ANIMALS,
  - articulated,
    - internally vertebrated,
      - with mammæ; viviparous, ... 1 Mammalia.
      - without mammæ; oviparous,
        - lungs,
          - feathers; wings, ... 2 Aves.
          - neither feathers nor wings, ... 3 Reptilia.
        - no lungs: bronchiæ, ... 4 Pisces.
    - externally invertebrated
      - with articulated members, ...
        - tracheæ, ... 5 Insecta.
        - bronchiæ, ... 6 Crustacea.
      - without articulated members, ... 7 Vermes.
  - non-articulated: respiratory organs, ...
    - distinct: vessels, ... 8 Mollusca.
    - none: nor vessels, ... 9 Zoophyta.

Class 1st.—Mammalia.

Sub-classes.

- Toes......
  - furnished with claws or nails, ... 1 Unguiculata.
  - enveloped in hoofs, ... 2 Ungulata.
  - joined together so as to form fins, ... 3 Nectopoda.

Unguiculata.—1st Sub-class of Mammalia.

Families.

- Teeth ....
  - of three kinds: members
    - distinct: thumbs,
      - separate on ....
        - the hands,
          - only, ... 1 Bimana.
          - and feet, ... 2 Quadrumana.
        - the feet, without a nail, ... 6 Pedimana.
      - not separate; walk on ....
        - the toes, ... 4 Digitigrada.
        - the sole of the foot, ... 5 Plantigrada.
    - united by a membrane, in the form of a wing, ... 3 Cheiroptera.
  - of less than three kinds; want........
    - the canine only, ... 7 Rodentia.
    - the incisors ....
      - and canine, ... 8 Edentata.
      - only, ... 9 Tardigrada.

Family 1st.—Bimana.

Genus.

Power of walking erect—lower incisor teeth erect, chin prominent, ... Homo, ... Man.

Family 2d.—Quadrumana.

Incisor teeth		Genera.	
	4 in each jaw, without any interval, posterior index nail not pointed; form anthropomorphous,	Simia,	Ape.
	more or less than 4, and with an interval, or when 4 exist, their direction differs from that of the Simiæ—nail of the posterior index pointed; form quadrupedal,	Lemur,	Maki.

Sub-division—Genus Simia.

Septum of the nostrils				Sub-genera.	
	Old World. very narrow: 10 molar teeth bluntly tubercular; muzzle	short; head, rounded: no tail: f. a.	65°	Pithecus,	Orang.
		short; head, flattened; tail, short,	45°	Cynocephalus,	Macaque.
		short; head, flattened; tail, long,	60°	Cercopithecus,	Guenon.
		extremely elongated; tail short,	50°	Papio,	Baboon.
	New World. very broad, 12 molar teeth, bluntly tubercular, or 10 acutely tubercular; tail long, often prehensile: muzzle	long: head pyramidal,		Cebus,	Alonate.
		short: head flattened,	60°	Callithrix,	Sapajon.

Sub-division—Genus Lemur.

Incisor teeth,			Sub-genera.	
	four in the upper jaw, and	six in the lower, long tail,	Lemur,	Maki.
		six in the lower, no tail,	Loris,	Loris.
		four in the lower tail, sometimes long, sometimes short,	Indris,	Indris.
		two in the lower, hind legs very much elongated,	Tarsius,	Tarsier.
	two in the upper jaw, and six in the lower posterior, kirse very long, tail long and tufted,		Galago,	Galago.

Family 3d.—Cheiroptera.

Digits of the hand			Genera.	
	not longer than those of the feet—furnished with sharp hooked claws,		Galeopithecus,	Flying Lemur.
	very long: nose	furnished with a membrane: canine teeth, far apart,	Rhinolphus,	Rhinolphus.
		furnished with a membrane: canine teeth, not far separated,	Phyllostoma,	Phyllostome.
		simple: interfemoral membrane very small, or none,	Pteropus,	Roussette.
		simple: interfemoral membrane large: tail, unconnected above the membrane,	Noctilio,	Noctilio.
		simple: interfemoral membrane large: tail, comprized in the membrane,	Vespertilio,	Common Bat.

Family 4th.—Plantigrada.

				Genera.	
Body ..	covered with spines : canines nearly as long as the incisors,			Erinaceus,	Hedge-hog.
	without spines : canine teeth	shorter than the incisors : muzzle very long,		Sorex,	Shrew.
		longer than the incisors ; fore-feet..	much broader than the hind,	Talpa,	Mole.
			similar to the hind,	Ursus,	Bear.

Sub-division—Genus Ursus.

					Genera.	
Teeth ..	presenting a small canine behind the large one, and an empty space between the former and the molar teeth,				Ursus,	Bear.
	forming an uninterrupted series: tail..	much shorter than the body, which is broad behind,			Taxus,	Badger.
		nearly as long as the body,	prehensile ; muzzle short,		Potos,	Kinkajoo.
			not prehensile ; toes	free, muzzle short,	Procyon,	Procyon.
				semi-palmate ; muzzle very long,	Nasica,	Nasica.

Family 5th.—Digitigrada.

				Genera.	
Muzzle	short and rounded, claws retractile,			Felis,	Cat.
	pointed ; nails	semi-retractile, legs short, body very long,		Viverra,	Civet.
		not retractile, ...	very long, very low on the legs,	Mustela,	Weasel.
			short and thick, high on the legs,	Canis,	Dog.

Sub-division—Genus Mustela.

			Sub-genera.	
Hind feet	palmate, legs short, tail thick at its base, muzzle rounded, head flattened,		Lutra,	Otter.
	free: nails	short, neck and body long, back arched,	Mustela,	Weasel.
		very long ; and fitted for digging, body wide behind,	Mephitis,	Mouffette.

Family 6th.—Pedimana.

Tail	prehensile, and without hair on one side at least,		Didelphis,	Sarigue.
	not prehensile, ..	very bushy,	Dasyurus,	Dasyuri.
		with a tuft at the extremity, hind legs long and slender,	Phalangista,	Phalanger.

FAMILY 7TH.—RODENTIA.

Characters				Sub-genera.	
Incisors of the upper jaw	six, lower two; fore legs very short, and of little service in walking; tail long and strong,			Kangurus,	Kangaroo.
	two; body	covered with sharp spines,		Hystrix,	Porcupine.
		hairy: upper incisors	double,	Lepus,	Hare.
			single: tail flat and scaly,	Castor,	Beaver.
			single: tail short or none,	Cavia,	Cavy.
			single: tail long and bushy throughout,	Sciurus,	Squirrel.
			single: tail long and not bushy throughout,	Mus,	Mouse.

SUB-DIVISION.—GENUS MUS.

Characters				Sub-genera.	
Molar teeth..	nearly flat, tuberculous, body thick and heavy, tail very short,			Arctomys,	Marmot.
	furrowed: tail	scaly and compressed—hind feet palmate,		Fiber,	Oudrata.
		hairy, and nearly as long as the body,		Lemnus,	Campagnol.
	notched; tail	very short, or none,	with cheek-pouches,	Cricetus,	Hamster.
			no external eyes—incisors exposed,	Aspalax,	Rat-mole.
		very long and	scaly,	Mus,	Mouse.
			villose, with a tuft at the end—legs equal,	Myoxus,	Myoxus.
			villose, hind legs disproportionately long,	Dipus,	Serboa.

FAMILY 8TH.—EDENTATA.

Characters			Sub-genera.	
Mouth furnished with	no teeth: body covered	with corneous imbricated scales, capable of rolling into a ball,	Manis,	Pangolin.
		with spines, capable of assuming a spherical form,	Echidna*,	Porcupine, Ant-eater.
		with hair,	Myrmecophega,	Ant-eater.
	Molar teeth only: body covered	with a soft skin, muzzle like a duck's bill,	Ornithorynchus*.	
		with hair; nails flat,	Orycteropus,	Cape Ant-eater.
		with an osseous shell, divided into compartments,	Dasypus,	Armadillo.

* Geoffroy Saint-Hilaire has formed a class for the reception of these genera, as he believes that mammæ do not exist in any of the animals belonging to them. Meckel, on the other hand, contends that he has discovered mammæ in the Ornithorynchus Rufus. Are these animals oviparous? if so, in the event

of Meckel's opinion being confirmed, we shall be forced to allow the existence of oviparous mammalia. Meckel thinks that the presence of a teat is not an essential character of a mammary gland, any more than the presence of external organs of generation is essentially characteristic of the glands of the sexual system; he, moreover, considers that the very great sensibility of the broad mouth of the Ornithorynchus may render it capable of sucking where there is no teat. These animals have little analogy with birds, but approach much nearer to the Mammalia, and reptiles. Their resemblance to the latter, in particular, was pointed out long since by Dumeril.

FAMILY 9TH.—TARDIGRADA.

	Genus.
Digits united as far as the nails, which are very long and hooked—fore feet shorter than the hind,	Bradypus, ... Sloth.

UNGULATA—SECOND SUB-CLASS OF MAMMALIA.

		Families.
Hoofs to the number of	more than two,	10 Pachydermata.
	two,	11 Ruminantia.
	one only,	12 Solipeda.

FAMILY 10TH.—PACHYDERMATA.

			Genera.
Hoofs,	five on all the feet, muzzle prolonged into a proboscis, 2 large tusks,		Elephas, ... Elephant.
	four on all the feet,	all applied to the ground,	Hippopotamus, River Horse.
		two only touching the ground,	Sus, ... Hog.
	four on the fore feet, and three on the hind,		Tapirus, ... Tapir.
	three on all the feet, muzzle furnished with one or two horns,		Rhinoceros, ... Rhinoceros.

FAMILY 11TH.—RUMINANTIA.

Have	horns,	bony and	deciduous, proper to the males, and to a small number of females,		Cervus, ... Deer.
			persisting, hind legs much shorter than the fore,		Camelopardalis, Giraffe.
		hollow; with the base	compressed; chin	furnished with a beard,	Capra, ... Goat.
				not bearded,	Ovis, ... Sheep.
			rounded: skin under the neck	not forming a dewlap,	Antelope, ... Antelope.
				forming a dewlap,	Bos, ... Ox.
	no horns: canine teeth	long in the upper jaw, none in the lower,			Moschus, ... Musk.
		short in both jaws,			Camelus, ... Camel.

Family 12th.—Solipeda.

Teeth of three kinds, with an interval between tke Canine and Molars—tail with long hair or tufted,.................. Equus,........ Horse.

Nectopoda—Third Sub-class of Mammalia.

Members .... { four, ... 13 Amphibia.
{ two,...................................... 14 Cetacea.

Family 13th.—Amphibia.

Teeth .. { of three sorts, body terminating like the tail of fishes, muzzle rounded like that of cats, ... Phoca,.. .... Seal.
{ less than 3 sorts, want { the incisors only, canines very large, and longer than the head, ... Trichecus, ... Morse.
{ the incisors and canines; hind feet concealed in the tail, ... Manatus, ... Lamantia.

Family 14th.—Cetacea.

Have { no teeth: upper jaw furnished with transverse corneous laminæ, with fringes; edged-spiracles near the middle of the head, and separate,.. } Balæna,...... Whale.
{ teeth .... { in one jaw only, i. e. { the upper; common blowholes on the back part of the head, 2 long projecting tusks, ... } Monodon, ... Narwhal.
{ the lower; head very large, blowholes united near the front of the muzzle, Physiter, ... Cachelot.
{ in both jaws, two blowholes on the summit of the head, ... Delphinus,.. .. Dolphin.

III.—*Of the Enrichment consequent on the Division of Production and Commerce.*

If we now suppose, that from the earliest time, men had devoted a part of their own labour to the acquisition, not only of the articles of the primary, but also of the secondary description of wealth, which they required, we may readily conceive how great an advance may be made in obtaining both the wrought and raw necessaries of existence, and consequently in increasing the incomes of all, when those enjoying particularly favorable situations, or peculiar genius, for conducting certain kinds of production, take upon themselves such occupations alone, as they can prosecute with advantage.

When the husbandman, besides the labour of his field to attend to, has the fabrication also on his hands, of his agricultural instruments, household utensils and clothes; then, as a part only of his labour can be given to agriculture, the plot of ground he occupies, must, on this account, be fitted in an inferior degree for being peculiarly the matrix of that reproduction whence his primary wealth is obtained; and hence a comparatively small income of this description of necessaries: again, as there can be expected but little dexterity in any business, and a great loss of time in changing occupations, when, upon every occasion of a person's requiring wrought commodities, he has to leave his cultivation; as he must, besides, in preparing many of these commodities, labour under great disadvantages, and be subjected to the inconvenience of long search for what he requires, before he can proceed, the raw materials of his wares, and the tools for preparing them not being all obtainable on the very spot he occupies; so we may readily imagine, how great an increase of power is obtained, when production comes to be divided amongst distinct classes of labourers; and the incomes upon which men are supported, comprising articles both of primary and secondary wealth, being thus vastly increased, we may also see how an extension of population must follow the introduction of such a system.

But under the supposition, that man does not now labour in the preparation of what he himself is ultimately to consume, the advantages attending the division of production having been perceived and felt; the consumption, which is the end of all production, must now be preceded by interchanges of the peculiar products of each individual; and hence we see at once the necessity for that bartering and trading which prevails in all advanced countries of the world; and we see, at the same time, the source of the gain which each obtains, on every commercial transaction. If two individuals, one peculiarly expert in the fabrication of cloth, and living where looms and his raw materials were readily obtainable, but ignorant of the arts of agriculture,—and the other ignorant of the modes of working adopted by spinners and weavers, and settled in a comparatively fertile tract,—were each to quit their own peculiar occupation, and become, in their own persons, both weavers aud husbandmen, to the extent of their individual wants, it is manifest that the quantity of food, and the quantity and quality of clothing, realized by both, would be inferior to what, through the division of production, had been obtained. Now the difference between the quantity of food obtainable when the husbandman labours in raising the supply for both, and in the quantity of cloth obtainable, when the weaver labours in fabricating cloth for both, is the fund which forms the gain on the commercial interchange.

This principle is in constant operation wherever commerce can have being whether between man and man, or between nation and nation; and it is vain to look for any commercial intercourse, except where there is mutual gain. Thus, for instance, if the weaver should be so happily circumstanced, that besides the cloth for his own use, in fabricating which he enjoyed advantages, he lived in a country so fertile, that he obtained a sufficiency of food, with less labour than was required in preparing a quantity of cloth equal to a second man's consumption; he would doubtless have no dealings with the husbandman, with whom we have just supposed him to be in commercial intercourse :—it would matter not to him, that the husbandman wanted cloth, and that he had food to offer in exchange for it; if it was a less quantity of food than he himself could raise, or if it was an equal quantity, but obtainable only through the greater labour of fabricating more cloth, there could be no gain; there would, in fact, be loss experienced by him, if he listened to the proposal of exchange made by the husbandman. Just so it is with nations; if one produces corn alone, and the other produces both cloth and corn, it matters not whether cloth can be obtained much more readily in the one than in the other; there can be no commercial intercourse, unless both nations gain on the transaction.

We have just seen, how an increased income comes to be obtainable by the ultimate consumers of goods, when these have become the subject of commercial interchange. We must now proceed to trace the formation of the income which it falls, in the process of time, to be the peculiar lot of a commercial class to enjoy; and incidentally to shew, that it is not between primary and secondary wealth alone, that advantageous commercial interchange can take place; we shall trace this progress under the supposition, that primary wealth alone exists.

Supposing men to labour under a necessity, not only for one description of vegetable or animal products, but for several; and supposing that one individual occupies a tract peculiarly adapted for one description of production, while another occupies a tract peculiarly fitted for reproduction of a different nature; if each endeavours to raise a proportion of both products, they will both have to labour at a disadvantage; and the joint reproductions of both will, on the whole, be less, than if each devoted his time and land to the production for which the soils were peculiarly fitted. The incomes of both will, therefore, be increased, by each appropriating their lands to their proper purpose, and by their subsequently exchanging the produce. Now let us suppose, that each producer, carrying his goods to his neighbour, is, in personally affecting this exchange, so taken off from attention to his peculiar business, that the utmost possible reproduction is not made available by his labour. If then an arrangement can be effected, by which this interruption is avoided, it follows, that a greater produce than before will be rendered available for human consumption; that an increased income will be given off periodically; and the means created of supporting an increased population.. Suppose, then, a carrier to step between these two producers; if the superior reproduction, consequent on these persons being allowed to devote their undivided labour to their peculiar business, be more than sufficient for the supply of his wants, it will be manifessly advantageous for both parties to employ him: and this is the origin of the income which, in later times, it comes to be the peculiar lot of the mercantile class to enjoy; as also of that greater general enrichment which takes place amongst those nations, where merchants are found in employment. When countries, like men, devote themselves peculiarly to that description of production for which, by nature, they are best adapted; and when they establish, in consequence, commercial intercourse with each other; then, not only will a class of merchants realize a newly evolved income, but the general income of the two countries will also experience a corresponding increase; for we have seen, that it never can be to the advantage of producers to give a commercial class employment, unless they also are enriched, at the same time, by employing them.

It has been usual to say, that commerce enriches individuals and nations, by giving each what is required more for what is required less. But this explanation does not appear to me to go to the bottom of the subject; it shows only how people will be better accommodated after the exchange of their products, than they were before; and not how they will be enriched; not only by obtaining what is better suited to their ultimate consumption, but by their obtaining also, in a quantity greatly increased, that which they respectively want; and it gives no insight whatever into the nature of the new income which supports the additional class in society, through whose means commercial interchanges are effected; and this appears to be a most weighty charge to bring against the theories of Political Economy which are now current; for they all profess to give explanations of the nature of that enrichment which is consequent on commerce.

When a class of merchants has come into being, and when, in consequence, production is accommodated to this new order of things; these merchants, in place of being the mere hired carriers in which they have their origin, will, in time, take upon themselves the risk of disposing of what each producer yields, in excess to that which satisfies his own proper consumption, of his own peculiar commodities. They will, then, like the manufacturers, have it in their power, with reference to their own peculiar enrichment, to fix the prices at which they will sell to the ultimate consumers; and like the manufacturers, they will find their markets extended in proportion as they lower the prices demanded, and they will find themselves enriched, only so long as the increasing number of sales, effected at a lower price, suffices more than to compensate, in the aggregate of gains, the reduction of price on each article sold. Indeed, as we shall now suppose, that no considerable commercial interchange is effected by the direct agency of the producers of the commodities bartered, we must look upon the determining of the price at which products can be sold, as depending not on how the classes of producers alone are most enriched, but on how these can obtain, together with this intermediate class, through whose instrumentality so much has been gained in productive power, the greatest aggregate of gain on the whole transaction. As, in the former case, there was no loss, but, on the contrary, a great gain to the community, by manufacturers permanently selling their wares at that price only which insured them the greatest aggregate of gain; so, in the present case, the same principles will insure the greatest possible enrichment to all other classes, when the merchants also come into the receipt of the greatest possible aggregate of gain. The necessity for giving an income to a new class, has not rendered a greater payment necessary by the community, on each of their consumable commodities: on the contrary, if this new class failed, not only to create a saving, or an increase equal to their own consumption, and equal to the enrichment of the classes of producers themselves; it, like the carrier between the two agriculturalists of our former illustration, could never have been in employment.

The obvious principle here elucidated does not, as I have said, appear to be known; else it would not be laid down, as it is in the works of the popular writers of the day, that the only reason why gain should be obtainable by merchants, when these come between producers and ultimate consumers, is merely because these merchants have bestowed, in their business, a quantity of labour in the ordinary proportion to the gains they realize. If this were, indeed, the cause of the gains of merchants, then the same rule would hold good in favor of every person whatsoever, who, whether advantageously or not for the society, continued to interpose himself between the original preparers of goods, and those by whom they are ultimately consumed. It is because through a saving of time, or labour, an increased power of production has been obtained, which yields a return not only equal, but superior to the gain of the merchants, that their business becomes a source of general advantage, or one, indeed, which can exist at all: and not merely because they have contrived to thrust themselves between consumers and producers. If there should be no depôts in which the products of different descriptions of industry could be obtained by little and little, to meet the immediate wants of consumers, the division of production would necessarily be incomplete: the principles which prove the enriching consequences of the division of production, establish also the enriching consequences of every thing which tends further to facilitate this division: and it will readily be seen, that, when different classes of producers devote themselves exclusively to the wholesale production, each of one description of wares, while the consumption effected by each individual in the society, is that of a small quantity of a vast number of different products, there must be in existence the means of obtaining products in retail, before the division of production can be looked on as complete. The gains of the retail dealers, and of the society which employs them, proceed, in this case, from the superior productiveness of that industry, which is thus enabled to devote itself, exclusively, to wholesale commerce and production. In the case of the retail trade, if the members of the community ultimately consuming goods, could obtain from one another, through the means of wholesale dealers, as great a quantity of products as they do when a class of retailers is established, they never would employ the retail dealers; and the reason of the above is precisely the same as that which would deter the two agriculturalists, whose case we formerly considered, from employing the carrier between them.

It it not, any more than in wholesale business, merely because labour happens to be employed in the retail trade, that men consent to give a remuneration to those who carry on this trade; but, as in the case of the employment of all other merchants, and mere dealers in commodities, it is because the society is enriched by employing them, that they are enabled to make their gains.

In what has been written, I have endeavoured to establish, and to keep constantly before the mind, the ultimate connexion with, and absolute dependence of, all wealth and all revenue, whether of a primary or secondary nature; whether proceeding from actual reproduction, from manufactures, or from commerce, on the reproductive and incremental principle: for although we have seen society enriched by the addition of all the wrought wares which were produced; by the increased net produce evolved, when men were, through the means of the division of production, enabled to devote themselves exclusively to one peculiar business; and although we have marked the further enrichment, and evolvement of general and peculiar income, which follows the establishment of the mercantile class; still we cannot forget, that it is this paramount principle of reproduction and increase, which yields, in the first instance to the cultivator, that which forms his income; and which affords support, not only to him and his, but of which the excess, passing from his hands, in exchange for wrought products, yields periodically the support, and forms the basis of the income of the manufacturer; and which, besides, when proper arrangements have been carried into effect, for insuring the proper division of production, suffices to yield support to, and to form the basis of the income of those classes also who devote themselves to commerce.

The manufacturer, by giving desirable artificial qualities to native products, which they did not before possess, added, doubtless, to the number of useful products of which the income of the society is composed; and the merchant, by securing the other producers from interruption, enabled all, more efficiently, to devote themselves to their peculiar labours; and although the manipulation of the manufacturer, and the intervention of the merchant, thus increase the wealth of the society, we must grant, that without the periodical exhibition, and continual co-operation of the reproductive and incremental energy, there could have been no periodical return or increase whatever, on which to superadd the wealth which springs from the simple manipulation of the manufacturer, or to support the classes engaged in commerce.

IV.—*Proceedings of Societies.*

1.—Medical and Physical Society.

At the Meeting of the Society held on the 7th May, Dr. Brydon, of the Bombay Medical Service, and Messrs. Boswell, Ginders, and Blackwood, of the Bengal Establishment, were elected Members. The following communications received since last Meeting, were then presented to the Society—first, second, and third parts of Mr. Hutchinson's Essay on Fever; a Catalogue of one hundred and twenty specimens of Burmese Materia Medica from the vegetable kingdom, and a sample of amylaceous fecula, prepared from the root of the *Jatropa Manhiota*, cultivated at Moulmien, by Mr. W. S. Anderson, Staff Surgeon.

A letter from Dr. R. Tytler, with a drawing representing a diseased condition of barley, during the growth of the grain; a case in which the Ergot was administered with much benefit, by Dr. Warrand, presented by Dr. Mouat; a case of successful operation for strangulated Hernia, by Mr. J. B. Preston, Cuddalore; a successful case of ligature of the right common Carotid Artery, by ditto; two copies of Marshall's Popular Summary of Vaccination were presented by Dr. Jackson; Mr. Brett's case of exostosis of the lower jaw, and notes of cases of Lithotomy on Natives, and Mr. Burnard's paper on the same subject, were then read and discussed by the Meeting.

2.—Agricultural and Horticultural Society.

At the Meeting of the Society, held in the Town Hall, on the 11th instant, Sir Edward Ryan, President, in the Chair;

The following Gentlemen were elected Members of the Society: Messrs. John Carr, John Brightman, John Swinhoe, and James Napier Lyall.

On the motion of Mr. Robison, Mr. Carr was appointed Assistant General Secretary.

Read a letter from Mr. H. Piddington, dated Nimtullah, 11th ultimo, presenting a paper entitled "*Description of the Hydraulic Heart for Irrigation and Draining*," and translated by him from the 25th No. of the Spanish Annals of Agriculture of the Havannah, together with the No. which contains the plate referred to in the paper.

Read a letter from Mr. Maingy, Commissioner at Moulmien, dated 4th March last, sending a sample of Tobacco, the produce of Virginia Seed sent to him by the Society, and enclosing a memorandum, by Dr. Anderson, descriptive of the method pursued by him in cultivating it.

Read a letter from Mr. G. J. Gordon, dated 2d ultimo, presenting two bottles of Carracas Indigo Seed, received from America, by Mr. Palmer, and believed to be a species different from, and more valuable than the Bengal plant. The Secretary informed the Meeting that those bottles of seed had already been handed to the Akra Committee for experiment.

Read a second letter from Mr. Maingy, dated Moulmien, 7th ultimo, sending two bags of uncleaned Tenasserim Cotton, and another sample of Tobacco grown from the Society's Seed: also one from Sir Robt. Colquhoun, dated 7th ultimo, presenting, in the name of Mr. Swinton, specimens of Arracan Rice, and enclosing Mr. S.'s communication to him; one from Mr. W. C. Hurry, dated 7th inst. to whom these specimens had been submitted, giving his opinion on the same The Secretary was requested to communicate Mr. H.'s opinion to Mr. Swinton.

Read a letter from Mr. J. C. Marshman, dated 20th ultimo, sending three hundred copies of the Bengalee Version of the first Volume of the Society's Transactions. The most grateful thanks of the Society were voted to Dr. Carey for the great labour he had bestowed on this translation, with no other assistance from the Society than a common native copyist. The Secretary was requested to send a proper number of copies to the Government here, as well as to the Court of Directors, and also to distribute them among the Members of the Society.

Read a letter from Sergeant Major Watson, dated Durbungah, 22d ultimo, submitting the Plan of an *Improved Hungarian Machine,* for drawing and raising water: also one from Colonel Coombs, dated Palaveram, 26th ultimo, regretting the want of an Agricultural Society at Madras, and requesting to be supplied with American Sea Island Cotton, Havannah Tobacco, Grass, and other Seeds. The Secretary was requested to reply to Colonel Coombs, and afford him such assistance as the Society's present stock enabled him, consistently with local demands upon him.

Read a letter from Mr. M. Larruleta, dated Atchipore, 27th ultimo, enclosing a letter to his address, from Mr. Ryan, dated Philadelphia, 8th November last, who promises to send Cotton Seeds and Plants commissioned by Mr. Larruleta for the Society, by the first vessel that should leave that place in the ensuing spring: also one from Mr. H. Turnbull, dated 28th ultimo, submitting samples of Tobacco grown by him from the Virginia and Maryland Tobacco Seed, presented to him by the Society: and two from Mr. W. Prinsep, dated 29th ultimo and 11th instant, reporting on two specimens of Poonah and Salsette Island Silk, presented by Sir Edward Ryan, in the name of the Lord Bishop, at the Meeting of the Agricultural Committee, on the 7th ultimo, and which the Secretary was requested to submit to Mr. Prinsep for his opinion thereon. The Secretary was requested to communicate the substance of Mr. Prinsep's report to His Lordship.

A letter was read from Mr. W. Smith, presenting two bottles of a superior kind of Bean, produced from a plant received by him from the Isle of France; and communicating several particulars as to the time of sowing, &c. One also from Mr. DeVerine, dated this day, submitting a statement and plan of work done at Akra, from the 17th November last to the end of last month, together with an Abstract of Expenditure, and also samples of Virginia, Maryland, and Persian Tobacco, and of Sea Island and Bourbon Cotton, the growth of the Farm: and a paper by Mr. John Brightman, on a mode of cultivating Artichokes here, which he had found very successful.

Sir Edward Ryan submitted a letter from Dr. Robert Tytler, to Sir Robert Colquhoun, dated Gorruckpore, 2d ultimo, enclosing two Drawings, by Ensign Kewney, of the 50th Regiment Native Infantry, of the diseases affecting Grain alluded to in the Doctor's letters read at the last Meeting; and communicating additional particulars.

Dr. Strong presented about a maund and a half of Coffee, the produce of plants grown by him at Russapugla, and which had not been shaded.

The Secretary having submitted a recommendation of the Agricultural Committee, (at its last Meeting, on Thursday the 5th current,) that twenty beegahs of the Akra Farm should be set apart for the cultivation of Grasses, Turnips, &c., with a view to the improvement of cattle, &c,, the expenses whereof should be defrayed out of the general Fund of the Society;—it was.

Resolved, that this Fund could not bear this expense; and that as these could not be defrayed out of the Akra Fund, furnished by Government for the cultivation of Cotton, Tobacco, Silk, Sugar, and other exportable articles of Raw produce, the measure must be delayed till a future period.

The Hydraulic Heart, communicated by Mr. Piddington, consists of a horizontal cylinder, part of the circumference of which is cut out, and upon this part is fixed a chest, and in the sides and covers of which, are valves for the admission and expulsion of the water. The interior of this apparatus is divided into two parts, by a partition fixed to the cover, and which at its lower edges, terminates in a moveable flap, turning on an axis in the centre of the cylinder. On the upper part of the chest is a head, terminating in a pipe, for carrying the water raised. This apparatus, as described in a plate, is fitted into a simple frame-work, to keep it upright, and is wrought by the oscillating motion of a lever, with chains and pullies, giving motion to the flap. The moveable flap, reducing alternately the capacity of one side of the cylinder, drives out the water through the expulsion valves on the one side; while that on the other is driven in by its own weight, and this, reversed immediately by the oscillating motion, produces the same effect on the other side, which thus gives a considerable stream of water.

Mr. Maingy states that the Natives about Moulmien prize extremely the Virginia Tobacco, which yields much larger and finer leaves than the Tobacco of that country.

Dr. Anderson, in his memorandum, thus describes the mode followed by Mr. Maingy in cultivating the Virginia Tobacco.

"The seeds were sown in a bed, and when their leaves were about three inches long they were transplanted; the ground being prepared by hoeing deep; manure was laid down in small heaps, and the soil was drawn up to cover it, forming small hillocks, at the distance of from four or five feet from each other. One young Tobacco plant was planted on the top of each of these hillocks, watered and shaded, until it took root. The lower leaves were removed from time to time, being small and worm eaten. When the plant was about a cubit high, the top was pinched off, leaving six or seven leaves on each plant. Shoots which struck out from the axillæ of the leaves were pinched off, and the plants were mulsed every eight or ten days with the drainings of a stable. When the leaves began to change colour and assume a yellow marbled appearance, they were considered ripe, and at this time shoots left, had thrown out blossoms. The leaves when cut were heaped together for three days in a house, when they became yellow. They were then spread in the shade to dry for eight days, after which they were tied together in bundles of three, and hung upon the rafters of a shed to dry thoroughly.

On the specimens of Rice sent by Mr. Swinton, Mr. Hurry reports that he is at a loss how to value them, as they are of kinds totally unsaleable either here or in England. Two that he had marked with red ink, would answer for the Isle of France or Eastern markets, if better cleaned. That when Major Burney was here, he (Mr. H.) had caused a quantity to be prepared in the Bengal manner, in Major Burney's presence, that he might initiate the Arracan and Tavoy people. That the black kind is much valued by the Malays, and that the red is used here by our boatmen on account of its cheapness, being the common produce of Ballasore and Cuttack, and brought here daily in boats, at prices which he thinks would effectually prevent the Arracan Rice finding its way so far.

The improved Hungarian Water-raising Machine, described in Mr. Watson's letter, which is accompanied by a sketch, is only so far claimed by him as he has invented the method of making it work, without being dependant on a spring of water from a hill, which is a great advantage in this country.

At a late Meeting of the Agricultural Committee, Sir Edward Ryan had presented, in the name of the Lord Bishop, two specimens of Silk, the first fruits of the labour and attention lately applied to this production in Bombay. One specimen was from Poona, and had been raised by an Italian lately settled there, through the influence and encouragement of the Collector, Mr. Gisborne. The other specimen was from the Estate of Framjee Cowasjee, in Salsette, who has lately brought some worms, and two skilful managers, from China. Mr. W. Prinsep, to whom these specimens were submitted, and whose great skill in such matters is well known, made the following report upon them.

"No. 1. *The Poonah Skein.* Letter A. No. 1, of four to six cocoons, would be the denomination here of a thread of this size; harsh and dull, has very much the appearance of China Silk; the thread is very uneven, fleecy and endy; these terms apply to the want of equal compactness in the thread; the fault arising, most probably, from some defect in bringing the different cocoon threads together: it is obviated here by a wheel, which crosses the two threads as they rise wet from the basin, and serves to bind them firmly before they run into the skein on the reel. It would be a defect seriously felt by manufacturers of Silk of this size."

"No. 2. *The Salsette Skein*—rather finer, but would be ranked under the same class of A. No. 1, four to six cocoons. It is bright, soft and mellow, the colour not quite so pure as the Poonah Silk, but quality generally superior, and the reeling decidedly so; this thread is round, even, and strong, but it should be less endy in the skein; it is difficult to judge of this defect unless the skein has escaped handling by others; this silk is superior to any that is exported from Bengal, although single skeins are occasionally seen of equal value.

"In both the above Factories, the reeling might be much improved, by adopting the Bengal size of skein, instead of imitating that which comes from China; it is more easily handled in the making and putting up here, as well as being more conveniently applied to general purposes in the Silk Mills of England."

Mr. Smith describes the Bean, furnished by him to the Society, as an excellent vegetable, and usually eaten in the same manner as Windsor Beans when young, and also very good in a dried state, with the skins taken off. He recommends their being put into the ground either at the commencement of the rains or the beginning of the cold weather; they grow like a runner ,and require support, as they spread very much, (three having covered a space of fifty feet,) giving two crops during the season; the time for gathering them being when the pods begin to turn white.

The following is Mr. Brightman's mode of cultivating Artichokes.

"The seed ought to be sown in the month of October, in a rich soil. When the plant is about a foot high it should be transplanted, say three or four times, every fifteen or sixteen days, before it is placed in the spot in which it is intended that it should bear. When the plant is put into the ground for the last time, the root ought to be well covered with old manure, and the earth heaped up in a mound round the plant, of a pretty good circumference, and about a foot high, or in proportion to the height of the plant. A small ditch should be made round the mound to hold water, which must be given very plentifully every morning and evening. By the above means, Mr. Brightman has had Artichokes in his garden, since the middle of March every four or five days, a dozen or sixteen, up to the beginning of May."

Dr. Tytler's letter is in continuation of his last communication, and is accompanied by two beautiful drawings, executed by Ensign Kewney, of the 50th Regiment Native Infantry. He states that the disease of Barley and Oats, which those drawings represent, had not (after a minute search over many miles of ground along the banks of the Ganges,) been detected by him even in a single ear of Wheat—that in instances where Wheat and Barley were intermingled in the same field, he found the disease affecting the Barley but not the Wheat; and that in his opinion the distemper does not owe its origin to moisture, because in a Jeel, in the neighbourhood of Patharghàta, he found sound Barley growing in the water, and diseased Barley on dry gound above the Jhìl, from which he infers that, in this particular, the disease differs from that called Smut.

There were submitted to the Society statements embracing the whole operations at Akra, since Mr. DeVerine became Superintendent of the Farm. The Committee of Management had, at first, difficulties to overcome, both in the condition of the land and unwillingness of the natives to work for the Society; patience and perseverance had however overcome all these, and in the short space of six months, the Farm exhibits a most interesting appearance, ninety-seven bígahs being already covered with Cotton plants, partly in bearing; six bígahs being under Tobacco; three bígahs under Sugar Cane; two and a half bígahs under Indigo, raised from the Seed of Bengal, Hindoostan and the Caracas; and four bígahs under the West India Arrow-Root plant; while two hundred and two more bígahs were cleared of jungle, ploughed, harrowed, and ready to receive Cotton and Tobacco Seed, so soon as a fresh supply shall arrive from America, of which the Society is in daily expectation; the greater part of the Seed sent out by the Court of Directors, if not the whole, having failed.

The specimens of Tobacco produced from the Farm, appear to be of a quality much superior to any hitherto raised in this country; and the Cotton appears to offer the same promise of success.

One specimen of Cotton raised at Akra, from Sea Island Seed, presented by Mr. Palmer, and planted in November last, was carefully compared with some Sea Island Cotton sent to Mr. Henley, a Member of the Society: (Cotton of the same description as this sample, in July 1830, was selling in the Liverpool market at the rate of 14½d. per lb.) The Gentlemen who compared these specimens, having themselves much experience in the value of Cotton of different descriptions in the markets of Europe, were of opinion, notwithstanding the strong prejudice which exists against all Cotton grown in this country, that the Cotton grown at Akra would, at the very lowest, fetch from 9d. to 10d. per lb., which is a higher price than the second best Cotton sent to the Liverpool market from America.

The Meeting adjourned.

V.—*Analyses of Books.*

An Account of Steam Vessels, and of Proceedings connected with Steam Navigation in British India. By G. A. Prinsep, *Esq. Calcutta Government Press,* 1830.

In our first volume we gave a short notice on the then recent experiments made with a view of introducing steam navigation on the river Ganges, This, with the exception of a few paragraphs in the news-papers, is all that until lately we possessed in the shape of documents bearing on the history of the introduction of steam navigation into India. Many who have felt interested in the progress of this great improvement have lamented the want of an accessible and connected account, which should exhibit as well what has been done, as what still remains to be accomplished. It was, therefore, with considerable satisfaction, we noticed the publication, at the Government Press, of the work, the title of which we have given above. For the copy obligingly sent us by the author, we return our best acknowledgments, and we shall avail ourselves of it to give to our readers some idea of the contents of the work.

It is a compilation, as we learn in the preface, from every source which could throw light on the subject. The several official documents bearing on the question, were placed at the author's disposal, by order of Government. To these he has added what could be gleaned from the news-papers, or private correspondence. He has, besides, consulted the various officers, builders, and others connected with the introduction of steam vessels in India, and he has thus, at the expense, we can easily conceive, of no small labour, collected a body of information, which by those interested in the history of public improvements will be duly appreciated. And although the dry nature of such a work will, in a measure, preclude it from very general perusal, the Author will still obtain his reward in the satisfactory assurance, that his volume must always remain a Manual of Steam Boat History, or, to use his own words, "a record of easy reference" for all who may be interested commercially, professionally, or officially, in a subject, the importance of which is every day increasing throughout the civilized world.

Our Author treats, in succession, of private speculations :—of government sea and river steamers ;—of experimental voyages on the Ganges :—and on the question of river tugs ;—concluding with a comparison of the navigation of the American and Indian rivers; he has added plans and sections of several of the steamers, and etchings of most of the native boats in use on this side of India ; as the latter will prove interesting to the generality of our readers, who may, like ourselves, have been frequently perplexed in distinguishing the *Oolakh* from the *Patella,* or the *Panswuee* from the *Pulwar,* we have obtained permission from the gentleman who sketched them, to make use of his plates, in striking off the set which adorns the present number of the *Gleanings.*

Our notice of them will naturally take precedence of our general description of the steamers themselves.

"Whoever has lived upon the banks of the great Ganges, and of the Hoogly above Calcutta, must have been struck with the rapid succession of boats, moving up and down at all seasons, and penetrating the country in all directions. All the large streams which rise in the northern hills, are navigable, more or less, throughout the year, nearly to the foot of the first range. The Ramgunga and Gurra, in Rohilcund, though comparatively small, are open above half the year. The Goomtee, Chowka, and Dewa or Gogra, in Oude; the Raptee, Gunduck, and Bhaguruttee, in Goruckpore and Behar; the Koosee, Muhanuddee and Teesta, (the Attri of the plains,) in Purneah and Dinajpoor; and on the side of Assam and Sylhet, the

Burhampootur, with some of its tributaries, and the Soorma and Megna, admit of navigation at all seasons. The streams which flow into the Ganges and Jumna, from the south, have a different character; mere hill and upland torrents, dry most part of the year: even the Soane, the largest of them, is not navigable above Daoodungur, situated only twenty miles from its entrance into the Ganges. The rivers of Bundelkund and Malwa have rocky beds, and frequent falls and rapids, which render even the largest of them, the Chumbul, scarcely fit for navigation at a short distance from its confluence with the Jumna.

The boats used in this extensive commerce, are of various forms and construction, influenced by local circumstances. Those depicted in the present work may be classed and explained in the following order: the plates unfortunately bear no figured references.

The *Pinnace* is, as its name denotes, of European introduction, and is used chiefly for the personal accommodation of officers in the service, travelling into the interior. It has sometimes two, and sometimes one mast; two spacious cabins; the crew consists of a serang and 12 to 20 clashees, and costs from 12 to 20 rupees per diem.

The *Budgerow* has a hull and rudder of native construction, with one mast, square rigged:—two roomy cabins; a crew of manjee and dandees, and from 10 to 18 oars. It is principally adapted for tracking, and draws very little water.

The *Bhauleah* is essentially a row boat, with cabin accommodation, for short trips; chiefly used in the neighbourhood of Calcutta, and throughout the Delta.

The *Mor Punkhee*, (peacock feathered,) is a native pleasure boat, moved with paddles and skull; its peculiarity consists in the canopy, or state cabin, being in the fore part of the vessel.

The *Sona Mookhee*, (golden faced,) is an English adaptation of the ornamented native state boat, for the Governors General of India. It is represented in the sketch as rigged for the late expedition in tow of the *Hooghly* Steamer.

The *Patela* and *Kutora*, are the baggage boats of Hindoostan; of saul timber, flat bottomed, with rather slanting outsides, not so manageable as a punt or London barge; their great breadth gives them a very little draught of water, and renders them fittest for the cotton and up-country products, which require only a dry and secure raft to float them down the stream: these are the only clinker-built boats in use.

The *Oolakh*, or common baggage boat of the Hoogly and central Bengal, has a sharp bow and smooth rounded side: this boat is the best for tracking and sailing before the wind, and is tolerably manageable with the oar in smooth water.

The Dacca *Pulwar* is more weatherly, although, like the rest, without keel; and the fastest and most handy boat in use for general traffic.

The *Panswuee* and *Dingee* differ only in size: they dip in the bow, and run upwards to a peak astern:—the name of the former seems to import that it should carry 500 maunds, but in practice this boat varies much in size; it is of light draught, and outstrips a Pinnace before the wind.

The Calcutta *Bhur* is the cargo boat or lighter of the port. It has an open hold for baggage, and a small matted cabin astern for the crew.

The *Hola* has a circular bow and stern, and great proportionate beam:—it is suited for heavy freight, such as coals, bricks, kunkur, &c.

The Soondurbun *Budra Khoolea*, has a burthen from 100 to 6,000 maunds; it brings fire-wood for the Calcutta market. There are various other boats for lime, rice, mats, &c. trafficking through the eastern creeks, which may be classed under this head: it is a most unweildy boat, and is navigated merely by the tides, guided by a tow boat.

The *Mug Boat* or *Balum*, has a floor of a single hollowed piece of timber, and raised sides, neatly attached by rattan sewing, with strips of bamboo over the seams:

A Pinnace

A MOR PUNKHEE or Native pleasure boat

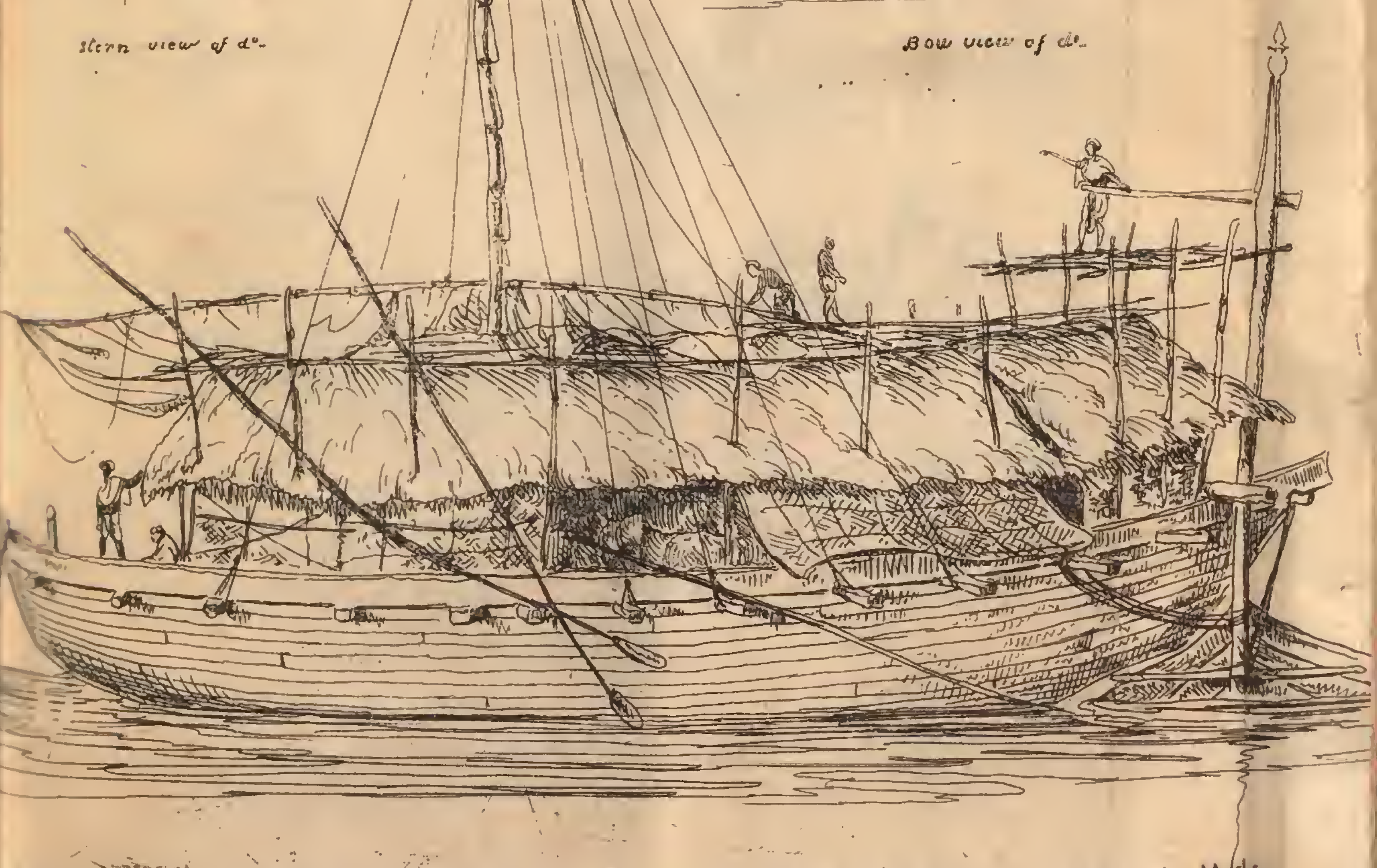
THE SONA MOOKEE or GOVr GENERAL's pinnace


A Ferry Dinghee
A common Calcutta Dinghee
Calcutta Panswai under Sail
A BUDGEROW
A Fishing Dinghee
A Native Bhauleah
A Calcutta Bhauleah

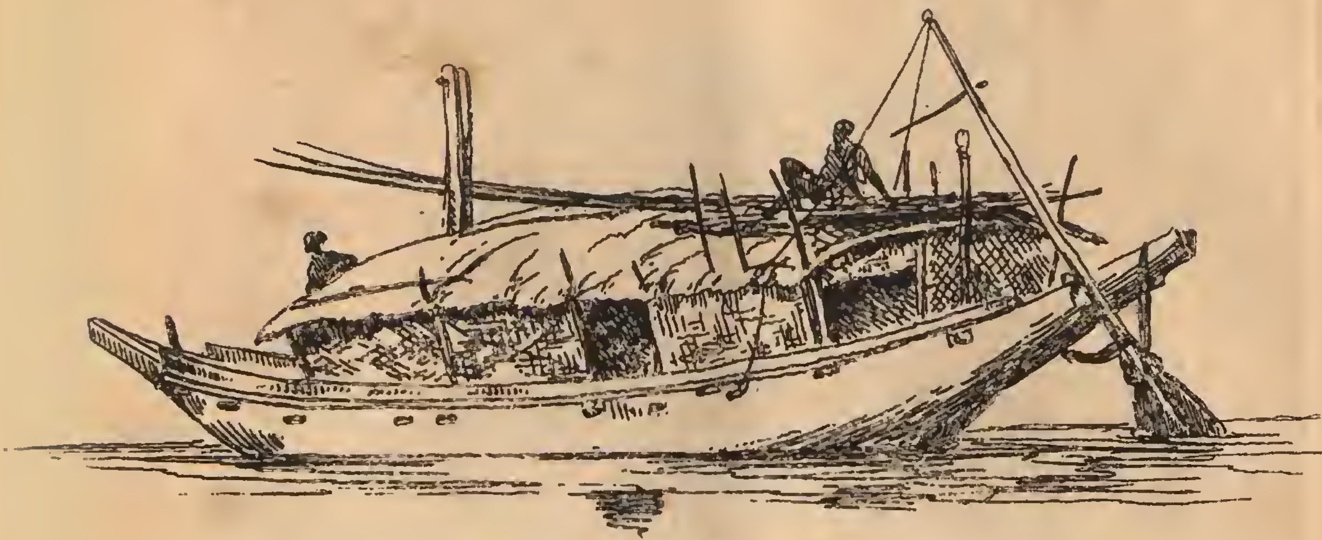
A CHUPRAH OOLAK of 1000 Mds

Stern view of do.

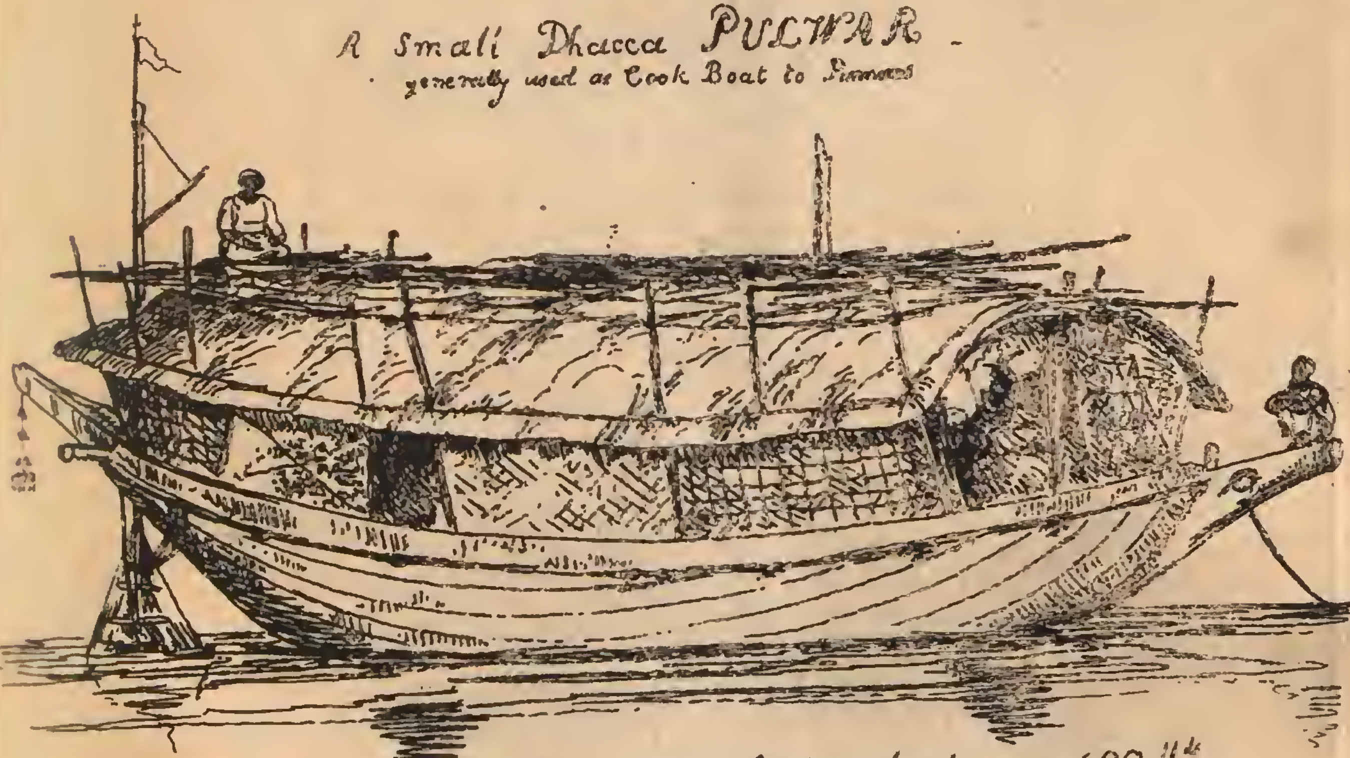
Bow view of do.



A MIRZAPORE Cotton PATELA of 1000 Mds



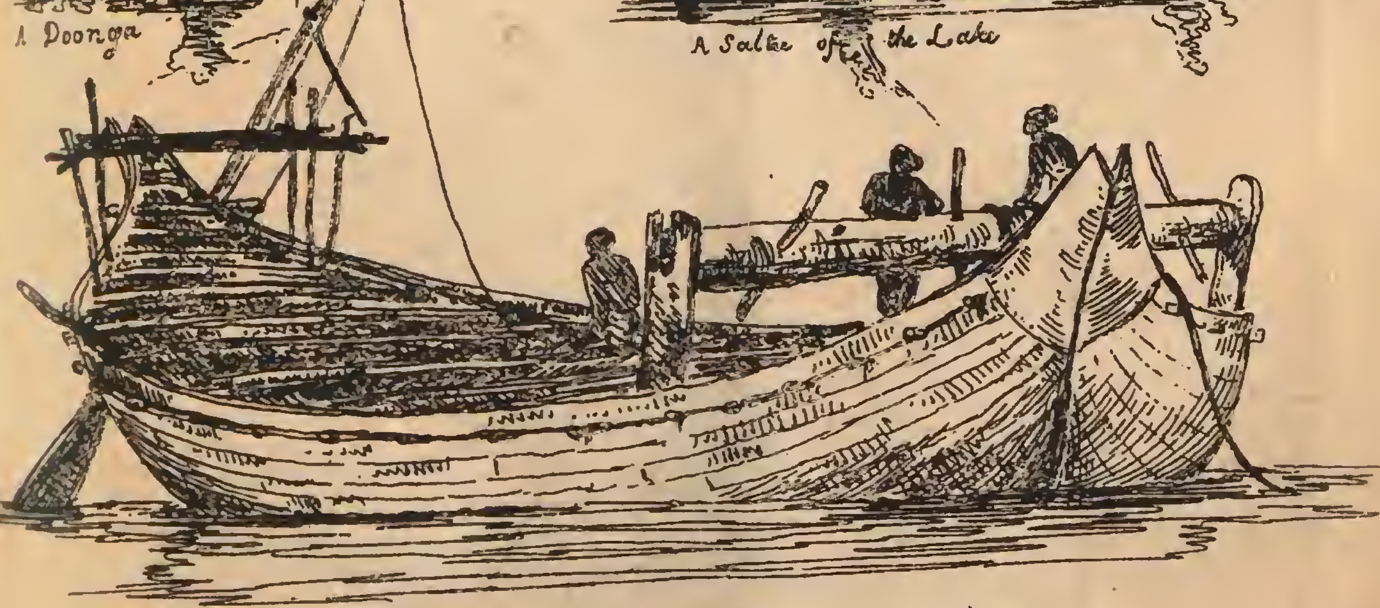
A Small Dhacca PULWAR – generally used as Cook Boat to Pinnaces



An OOLAK from Azimabad of 400 Md.

A Doonga

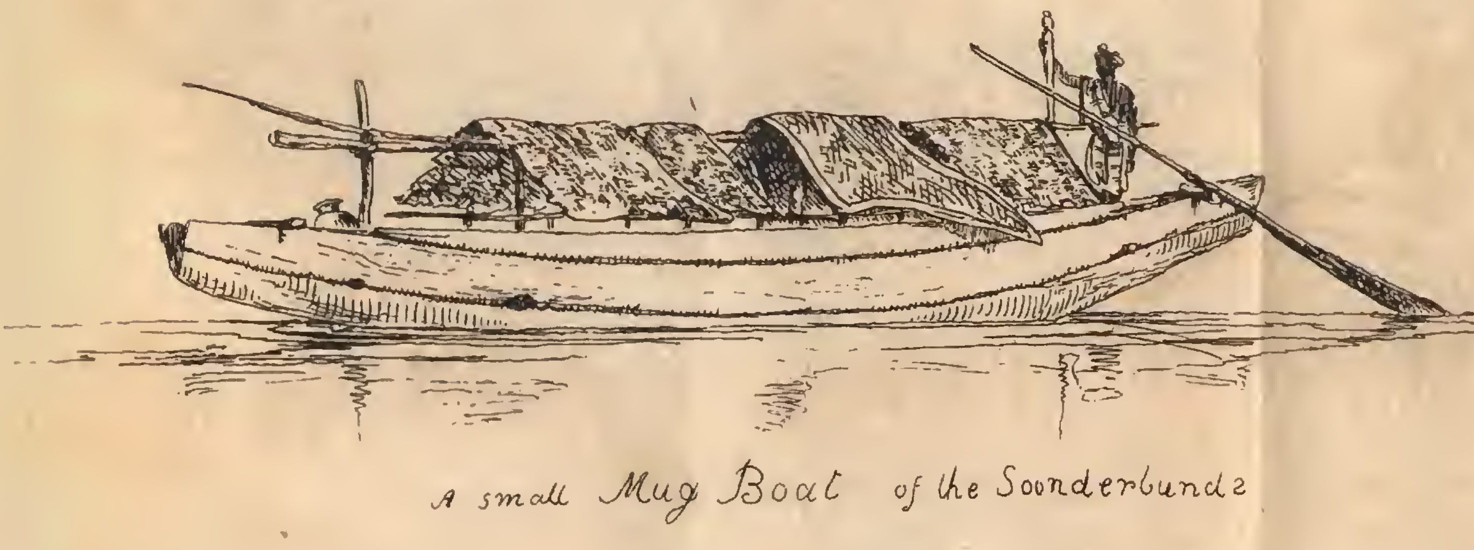
A Saltee of the Lake



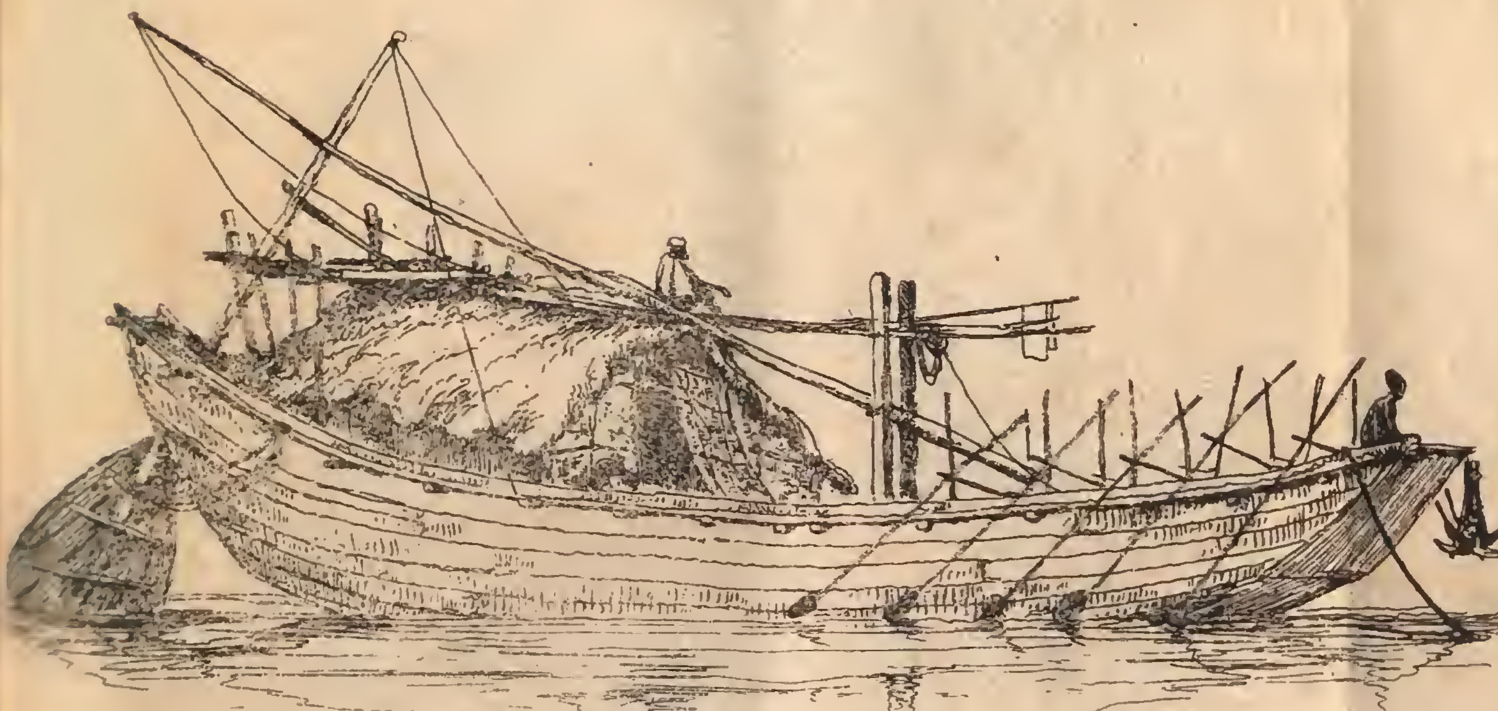
A Budra Khoolea or Wood boat of the Soonderbunds

del.

A Dacca Pulwar of 500 maunds

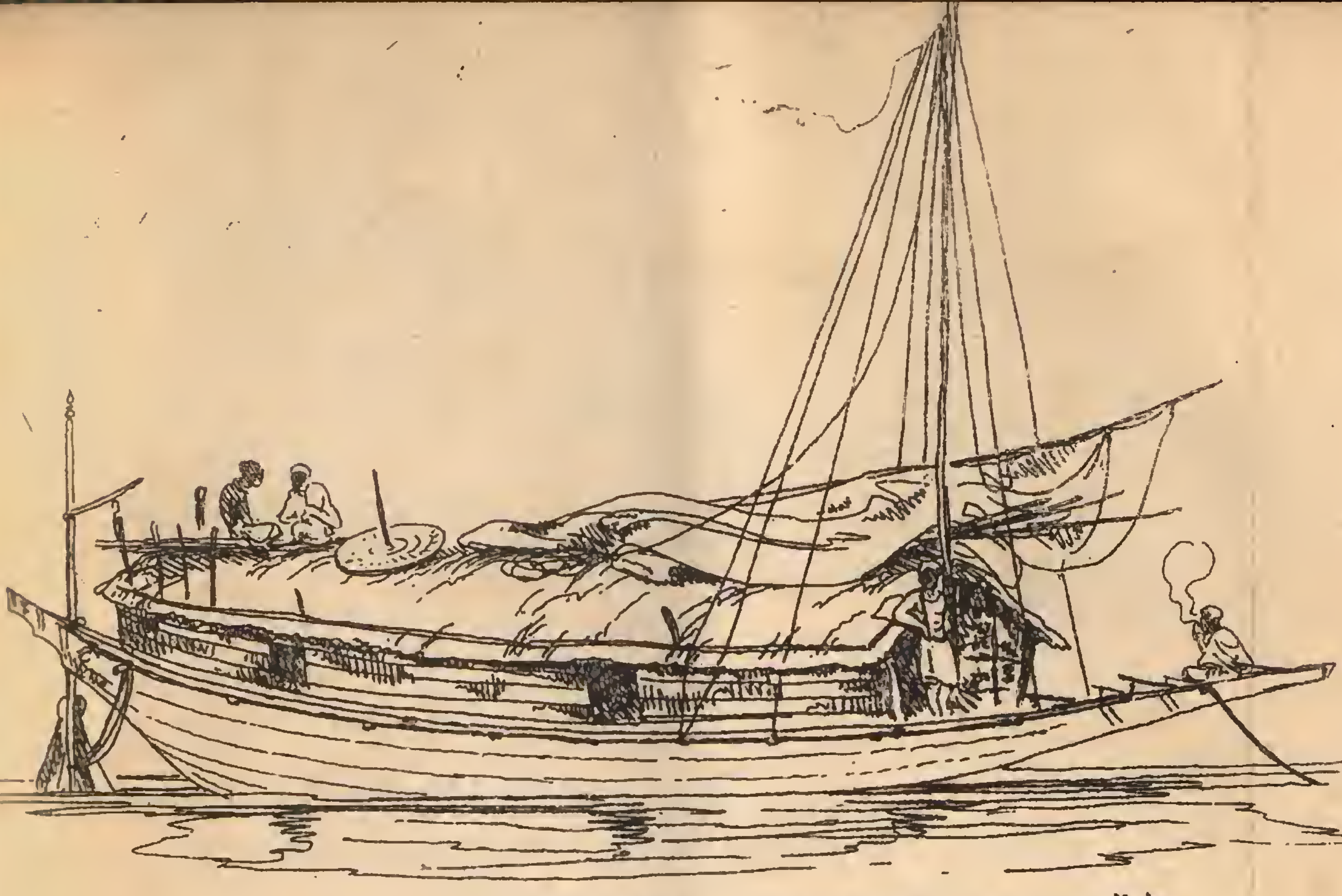


A small Mug Boat of the Soonderbunds



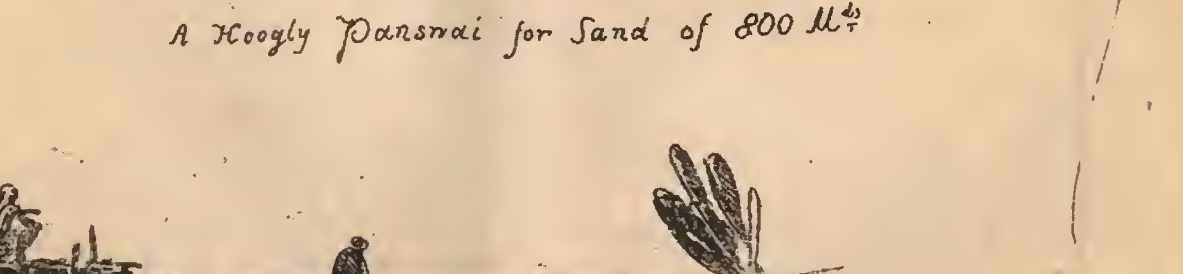
A Tumlook Salt Boat of 800 Mds

J. F. del.

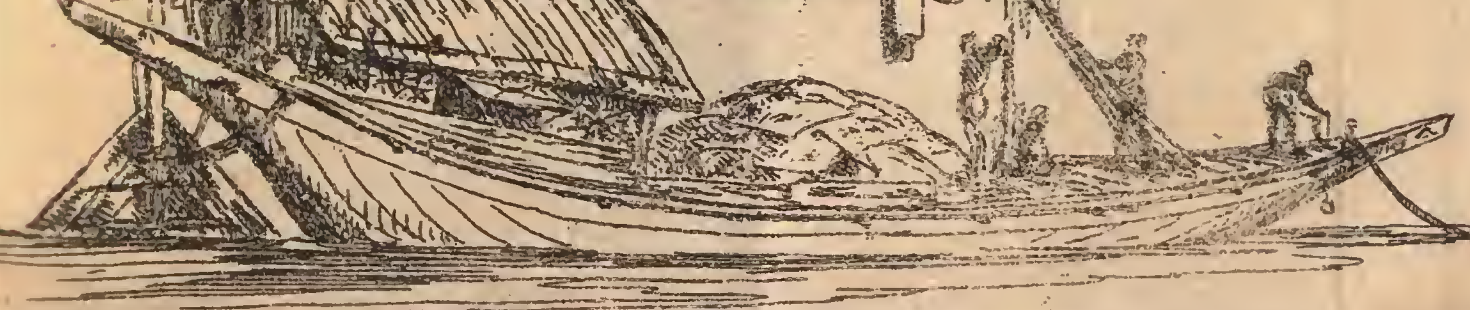


A KUTWA Panswai of 900 Mds

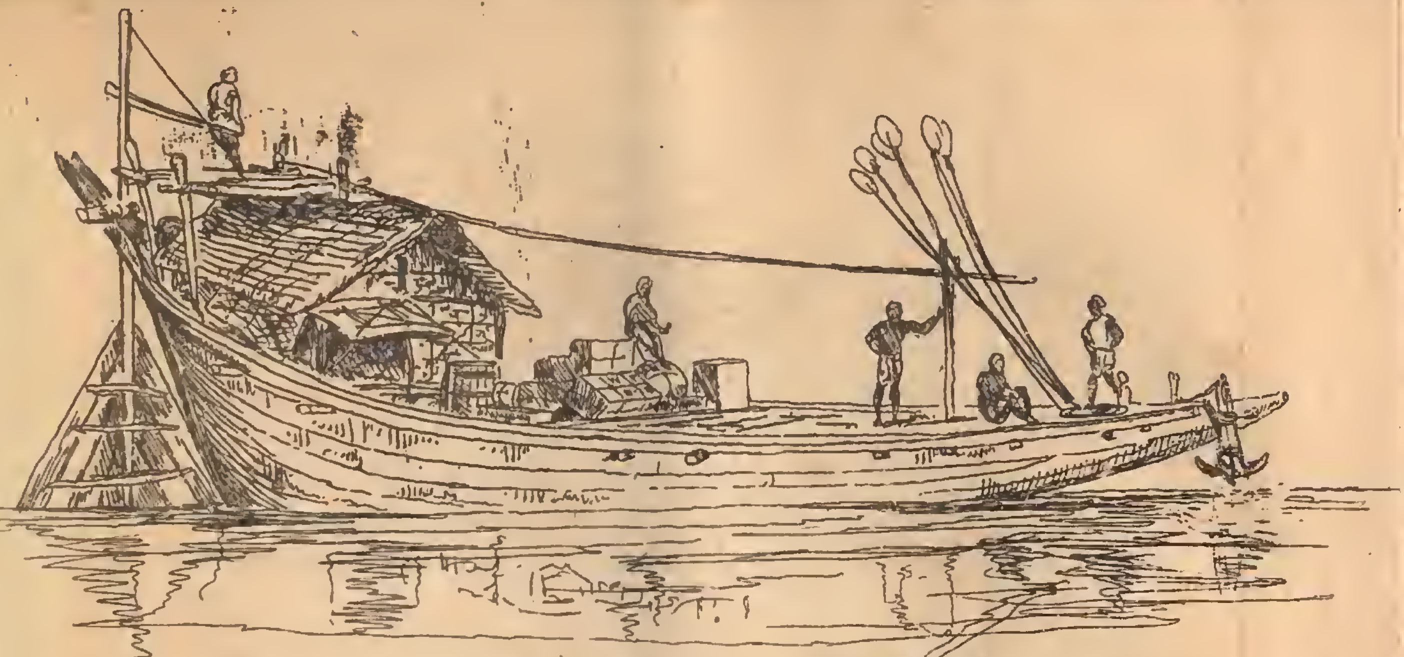
A CALCUTTA Panswai of 200 Mds



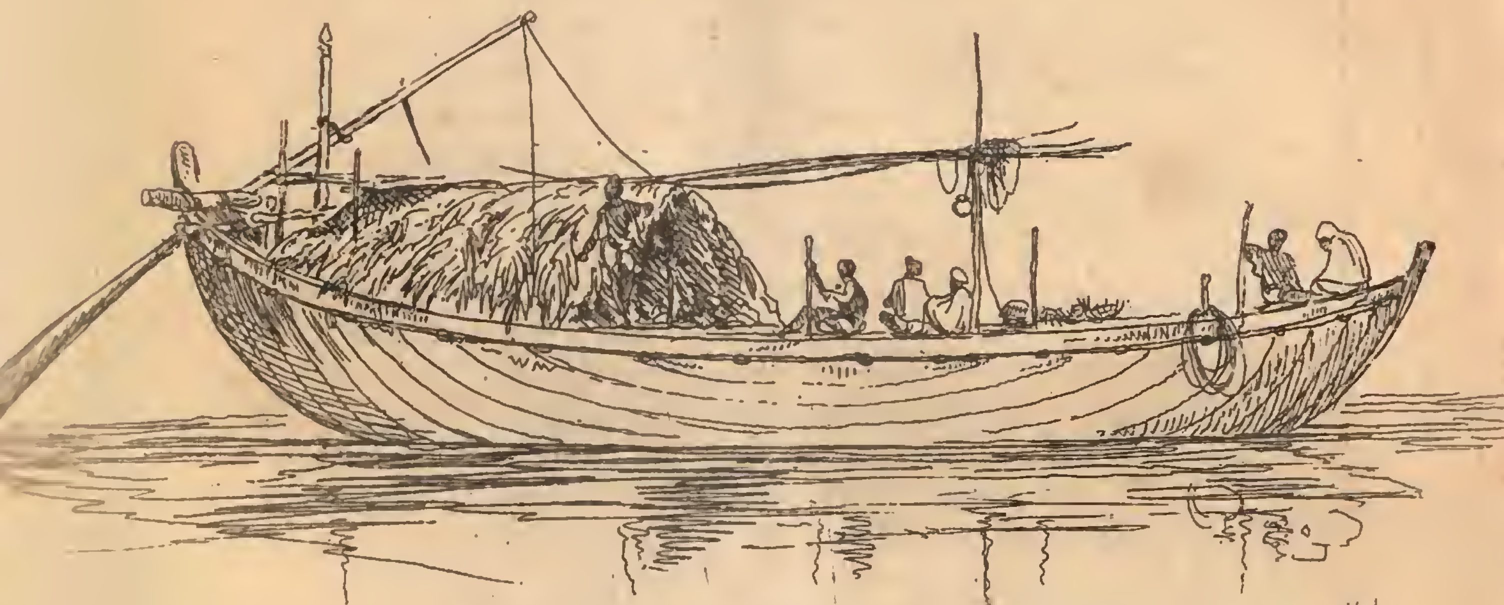
A Hoogly Panswai for Sand of 800 Mds



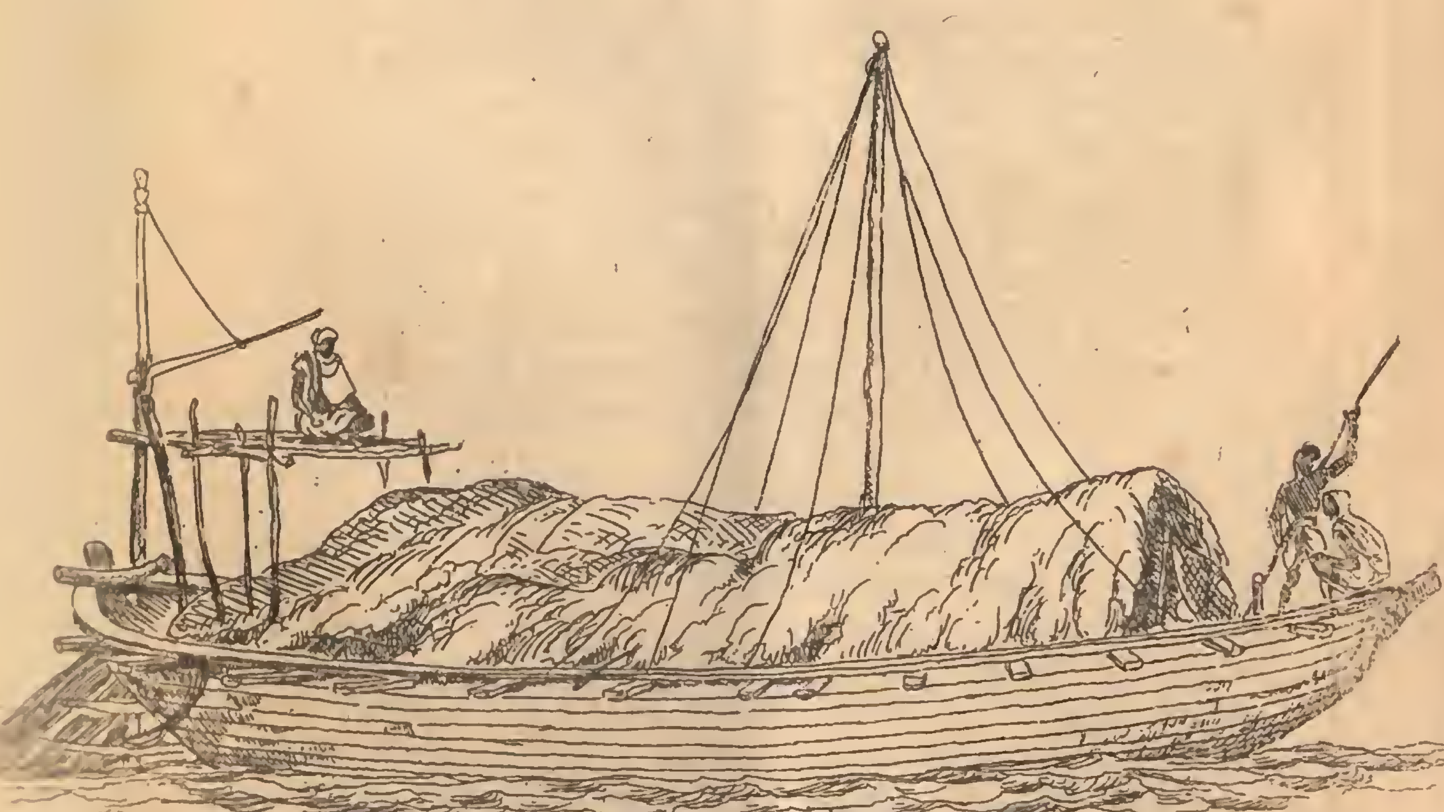
A NUDDEA Panswai for Grain of 1000 Mds



A Calcutta Cargo BHUR



A Saltee or Hola – for Coals – of 600 Mds



A FURUKHABAD KUTORA of 800 Mds

The *Tumlook Salt Boat* has a flat bottom, brought up at an angle to the prow and stern: it is of strong build, and constructed especially for the salt trade.

The *Saltee* is a kind of long canoe, cut out of a solid trunk of saul timber: the bottom is flat and thick, which renders it, although narrow, difficult to overturn.

The *Doonga* is, in like manner, made of the hollow butt end of the Taree Palm tree. It is used by the fishermen to punt about the Salt-water Lake.

An almost endless variety of other native boats might be enumerated: some will be found in the accompanying plates, whence they will be more easily understood than by description.

So precarious is the navigation of the Ganges, from eddies, gusts of wind, shifting sands, sunken trees, and falling banks, that the premium of insurance on a voyage to Cawnpoor (3½ per cent.) is absolutely as high as on one to England: the time required to mount against the stream is also well nigh as great; while the expense to a traveller, carrying his baggage, provisions, and servants, is upon the same scale. These circumstances, combined with the extraordinary success of steam navigation on other rivers, were sufficient to draw the attention of speculators, and lead them to look for equal advantages from its introduction on the Ganges, which began to draw attention about 10 years ago.

"The boat built at Lucknow, by Mr. W. Trickett, in 1819, for the Nuwab, was the first vessel in India propelled by steam." It was furnished with an excellent little single engine of 8 horse power, from the Butterley works. We believe she is still used as a pleasure boat of passage to the palace gardens, although her repairs may be, as Mr. Prinsep says, totally neglected.

The next application of steam power was made by the late Major Schalch, to a Dredging boat, in 1822: its power was found insufficient; and the *Pluto* was converted into a floating battery in the Arracan expedition. She was afterwards sold, and dismantled, and her hull finally sunk in a gale, in May, 1830.

The engines and frame of the *Diana* were carried out by Mr. Robarts, to China, on speculation, in 1822; thence transferred to Calcutta, they were purchased by the agency houses, and fitted into a new vessel, in 1823. She was first employed as a passage boat; then sold to Government for the Rangoon expedition, where she proved very useful. The vessel has been principally used in the Tenasserim provinces.

The attention of the Indian community was, by this time, fully alive to the advantages of steam navigation; and many schemes were canvassed for shortening the voyage to and from England, by establishing steam communication, either round the Cape, or through the Mediterranean and Red Sea. A general meeting, in London, in 1822, concurred with Mr. Joliffe, in adopting the former route:—but Captain Johnstone, who was sanguine in preferring the latter, proceeded to Calcutta with a proposal to this effect; after several public meetings, in 1823-4, a large subscription fund was raised, for the encouragement of any attempt by either route, made before the expiration of 1826; with limitations, as to time, of 140 days, for the double voyage.

As a candidate for the prize thus held out, the *Enterprise* was the first vessel put in hand; she was intended for the Cape voyage, and was already in progress when Captain Johnston reached England, and was entrusted with her command. She was launched in February, 1825, and arrived in the Hoogly, in December, after a very fatiguing voyage of 113 days, 63 under steam, and 40 under sail, entirely disappointing the exaggerated expectations of the share-holders and the public. It was a fortunate circumstance for the speculators, that the Burmese war was then at its height, and that the Government, having proof of the utility of steamers in the services of the *Diana*, were willing to take her off their hands at prime cost, retaining also Captain Johnston in command.

"Government had no reason to regret the purchase, although the war was so near its close. The certainty of her passage to and from Rangoon was so great, at a season when the north winds protracted the arrival of sailing vessels, that she was constantly employed in carrying despatches, and in no instance failed to outrun every other vessel. She made two entire voyages within the first month. Her accommodations, too, proved highly useful to sick officers and others re-joining their regiments, or returning from the campaign. She has also been used as a transport, and has sometimes mustered three hundred men on board.

On one occasion, having brought the news of the first cessation of hostilities, many days before Captain Snodgrass arrived with the despatches in His Majesty's ship *Champion*, although the *Champion* had sailed before the *Enterprise* even reached Rangoon, she saved the Treasury above six lakhs, by preventing the transmission of stores, fresh contracts for transports, and other expenses, which a delay of twenty-four hours would have incurred. Again, the final news of the peace, despatched under similar circumstances, by His Majesty's ship *Alligator*, was anticipated by the *Enterprise*. Such a vessel, at the commencement of the war, would have avoided much of the severe suffering of the troops at Rangoon, which aggravated the mortality among the Europeans, while their distress was unknown and unsuspected in Calcutta."

A memorandum of her services is given in the Appendix, whence it appears, that from January, 1826, to February, 1828, she made 25 voyages, in all 14,000 miles, at an average rate of 5.1 miles per hour. In April, 1829, she was made over to the Bombay Goverment, but failing to satisfy their expectations of her speed, was lately transferred back to Calcutta.

Mr. Taylor, who had seceded from the London Association, was meantime zealously pursuing the Suez scheme, and had launched the first of a series of steam tugs, intended for the Red Sea, in October, 1825. The *Emulous* was a model of a smooth water tug, but was totally unfit to contend with a heavy sea; and it was a work of no small danger to bring her round the Cape, although dismantled of her paddles. She reached Calcutta only in September, 1826, a month after the *Juliana*, a vessel of 521 tons, leaden with coals, intended as her consort.

Nothing could be more unfortunate than the result of Mr. Taylor's projects. The *Juliana* was sent home under heavy mortgages for repairs, &c. The *Emulous* was forfeited through involvements here, and in England. She was too late for the Calcutta steam fund, and the whole train of steamers intended to be connected with her was necessarily abandoned.

The *Emulous* herself was converted into a ship-tug, and while she had the river to herself, was very successful:—a joint-stock company purchased her, cut down her paddles, (no doubt duly calculated by the engineers at home to give her a maximum speed,) injured her rate, increased her consumption of coal, and after making a losing concern of her for several years, have recently sold her for one-third of her prime cost.

The counter claims of Captain Johnston and Mr. Taylor to remuneration from the Indian subscription fund, have so frequently been the theme of discussion here, that it is needless to revive the topic. Thus much, however, must be conceded by all parties: the former, commanding a ship originally planned by his rival,—pursuing the route disapproved of by himself,—embarking none of his own capital, and failing in all the advantages contemplated, was yet rewarded handsomely and permanently; while the latter, assuming the line which, if any, must eventually be successful, staking his own means, and all that his credit could command, producing also the best vessel, was denied a share of the premium; was irrecoverably ruined; and, still bent upon carrying his projects through, has at last perished miserably in the cause; having been massacred on his journey overland from Bagdad, in Oct. 1830!

The *Falcon*, formerly Lord Yarborough's yacht, had been sent out on speculation, during the Burmese war. She arrived under canvas, in March, 1826, but not finding a purchaser, was dismantled of her machinery, and converted into an opium Bark.

The *Telica* met with no better success as a steam speculation. She first tried Chili, where her supercargo, in a fit of madness, fired a pistol into her magazine, and destroyed the after part of the vessel, with himself and several passengers.—She was then consigned to Calcutta, (April 1827,) exhibited great capabilities as a tug, was purchased by Government, at Rs. 61,000, and was transferred to Bombay. Once more, however, our friends in the west, who seem to expect impossibilities from steamers, were dissatisfied, and the *Telica* was converted into a pleasure yacht for the Governor !

In 1826, the Engineer of the *Diana*, Mr. Anderson, planned and built, at Calcutta, two sister steamers, the *Comet* and *Firefly*, which deserve mention, in proof of the difficulty of ensuring success, under every care, in the introduction of any novelty in the conduct of ordinary affairs : built economically by native carpenters ; under his own personal charge, as pilot, commander, and engineer ; traversing between Chinsurah and Calcutta, and plying for passengers in a port always crowded with shipping ; moderate also in their charges ; still the utmost effected by these boats has been to repay merely the expenses of the day, without any return of the capital invested.

The *Forbes* is the last of the steamers as yet built on private speculation : she was launched at the new Howrah Dock, on the 21st January, 1829, designed as a tug for the shipping of the port, for which she certainly combines all desirable qualities, more than any vessel so employed. She has two 60 horse engines, with a copper boiler : her loaded draught is 12 feet, with eleven days coal on board : she has the speed of the *Emulous*, and considerable advantage over her in rough water. By way of experiment she was sent to China, by her owners, Messrs. Mackintosh and Co., in March last, towing the *Jamesina* opium trader, and acquitted herself well, as far as regards velocity, making the passage in 38 days, while the *Red Rover*, a fast sailer, was reckoned fortunate to arrive in 43 days. On the whole, however, the sea tug system would not seem conducive either to expedition or economy. The necessity of cleaning the boilers every 3 or 4 days, is a serious defect; we believe this is obviated in the *Enterprise*, by a discharge pipe at the foot of the boiler. Tredgold's work on the Steam Engine, gives the calculation of the quantity of water to be ejected to preserve the bulk of a constant specific gravity.

The Bengal Government had paid highly for their two steamers, but yet the benefits derived from their acquisition, during the Burmese war, were such as to induce a strong recommendation to the Court of Directors to send out engines fitted for two armed vessels. The Court approving the measure, obtained a transfer of two pair of 40 horse engines, then in store at Deptford, and shipped them to India, in 1826. In a separate department a reference home had also been sanctioned upon the suggestion of Mr. Scott, the commissioner in Assam, for two pair of boat engines, adapted to the navigation of the rapid rivers of that district : hostilities had terminated ere any of the four arrived, but the plan was prosecuted to completion, and early in 1827 were launched four Government steamers, the *Ganges* and *Irrawaddy*, and the *Hoogly* and *Burhampootur*.

The *Ganges* and *Irrawaddy* were built upon an English model, as 10 gun brigs of war, by Messrs. Kyd and Co. upon a contract of Rupees 125,000 for each.

"To sum up the qualities of these vessels, it must be admitted that they draw rather too much water, with reference to their power, and the situation of their paddle shafts, and have not the speed which was anticipated ; and that they are capable of but little progress against a strong head wind. But as with these defects they have always made good passages, their general efficiency cannot be denied. At a much less charge than the *Enterprise*, they are better adapted, as safe and comfortable sea-boats, to keep up the communication with our new possessions on the eastern side of the Bay, which, without them, would be at once more difficult of protection, and productive of large uncertain expense for the transport of troops and supplies. They facilitate the collection of the revenue from the maritime provinces, and enable the Commissioner to make his circuits of controul, at seasons when it would otherwise be impossible to proceed; and they abridge greatly the term of their duration at all times. By means of one of them (the *Ganges* towing the *Nereid* yacht) the Commander in Chief made his tour of inspection to Chittagong, and the stations on the Arracan Coast, in March, 1829, which could not have been effected in double the time by a sailing vessel. They carry treasure to that coast, and fetch it from Cuttack or Chittagong, and more than once have been usefully employed in making remittances to and from Madras or Masulipatam. They are able, at all times, to bring up troops from the China ships, when the weather is too rough for the river steamers, and can proceed with them to the depôt at Chinsurah, if required. Although not comparable with vessels built expressly for tugging, they are competent to that service in ordinary cases, and are especially useful in this way, when the regular tugs (such as have hitherto been employed on the Hoogly) could render no assistance whatever. They can steam at one stretch, in all seasons, to Penang, Madras, or Ceylon; and were it desirable to devote them to such purpose, they might undoubtedly be very useful as steamers on the Pilot Establishment."

The *Hooghly* and *Burhampootur* were also built by contract, the latter by Messrs. Kyd, the former at the Howrah Dock. They were of equal draught, size, and velocity, though differing in construction and shape: "They have been declared to be equally well executed, as regards materials and workmanship, and in accordance with their respective contracts." Notwithstanding these parallelisms, however, there is an anomaly of 20,000 Rupees in their cost, which we confess ourselves unable fully to comprehend; it is, no doubt, partly attributable to the costly knee-timbers of the latter vessel. Another discrepancy between the sister vessels, is in the consumption of coals; the Hooghly burning half as much again as the Burhampootur: this fact deserves to be fully investigated, as it can arise from more than one cause; either the engine may be badly fitted, which seems unlikely; its paddles may be too small, or the boat may be too light for the steam power: in the latter case, the Hooghly would be the better vessel for a tug.

According to the original design, one of these boats was preparing for a voyage to Assam, and the coal depôts had already been established, when the arrival of our present Governor General gave a new impulse to the subject of river steamers, and led to the more decisive and interesting experiment of ascending the great Ganges itself, a task hitherto unattempted, if we except a partial trip by the *Comet*, in 1826, as high as Malda, beyond which she was unable to stem the strength of the current.

After the usual routine of minutes and reports, (the necessary preliminaries of a change in the councils of a state, which is bound to furnish reasons, or as it is technically called, "to make out a case," for the higher authorities at home,) the *Hooghly* was dispatched to Allahabad on two successive experimental voyages: the first in the height of the freshes of September, 1828; the second in the hottest and driest months, April and May, of the following year.

To render the expedition as effective as possible, Captain Johnston, and Captain T. Prinsep, Engineers, were ordered to accompany it, and collect every information regarding the river, and the difficulties of navigation, &c. We must refer our readers to the work for a full account of both expeditions.

The upward voyage of September occupied 24 days, and the return 14, including 2 days detention at Benares. The whole passage, up and down, 1613 miles, took 360 hours under steam, being an average rate of 4½ miles per hour. The steamer was drawing 3 feet 8 inches, with 806 maunds of Burdwan coal on board. The quantity of fuel consumed was 2245 maunds of coal, and 408 of wood: her motion through the water was seven miles per hour, whence deducting the mean velocity of the stream, 4 miles, leaves a net progress of three miles. On descending from Allahabad, the *Hooghly* grounded on a sand bank, and was only saved from spending the whole of the dry season there, (as was the fate of the *Comet* in the Moorshedabad river last year,) by the fortuitous effect of anchoring her, head and stern, athwart the current, which, forming an eddy round her, by degrees cleared away so much of the sand as to shear off the vessel at right angles to the cables, by which she was retained: when once clear, the force of water upon her broad side enabled her to drag her anchors, until she again ran into the sand, and this process continued insensibly all night, until she extricated herself.

Her second expedition was attended with infinite fatigue, from the necessity of seeking for channels through the numerous shoals of the dry season: an alteration in her rudder had rendered her more manageable, but her new poop accommodation, though better adapted to the fierce heat her crew had to encounter, (104° in the cabin,) was an impediment to her steering against a strong westerly wind. She found an average current of only 1 mile per hour, but this advantage was lost to her on account of her heavy draught. She got to Benares with difficulty in twenty-one days, and could not arech Mirzapoor for want of water. Her voyage up and down, 1938 miles, occupied 410 hours, which even, after deducting the detour through the Sundurbuns, exceeded her former trial, both in time and in distance traversed, from the winding of the low water channels.

Among other useful results of these experiments, which satisfactorily proved that there existed no insurmountable obstacle to the establishment of a river steam navigation, we cannot omit to notice the revised charts of the Ganges and Delta channels, published by that able and lamented officer Captain T. Prinsep. Valuable information was also contributed in Captain Johnston's and Mr. Warden's reports, and especially in a memoir by Captain Smith, of Engineers, on the navigation of the Jumna, and its confluence with the Ganges. It is gratifying to see the opinions and researches of well informed and practical officers, laid open for general edification, instead of being consigned to oblivion the moment after their ephemeral notice in a Secretary's budget.

The same remark will apply to the numerous questions officially brought under discussion in the Marine Board, or in special Committees, on subjects connected with Steam Navigation, such as, the substitution of steamers in the Company's Pilot service; the tug system, and form of tugs and barges best adapted for the Ganges. We have in the volume before us an abstract of the opinions of the persons best qualified to judge on such points, frequently followed by an experiment to verify them; thanks to the resolution and spirit of inquiry which have lately characterized the Bengal Government.

The most essential point of lessening the draught of the steamer, without weakening her section for the support of the boiler and machinery, has been accomplished by Captain Forbes[1], in a boat launched in September last, which drew only 10 inches empty, and 2 feet when loaded with the weight of a 40 horse engine, and 5 days' coal;

[1] The plan of Capt. Forbes' Steam tug does not accord with the specification in App. A. 3. which refers to a boat with a *double* truss; but the principle is the same in both.

thus loaded she was towed by the *Burhampootur*, at the rate of 5¾ miles, only ¼ mile less than the steamer's own velocity.

A subsequent experiment which we witnessed, gave a more decided advantage; indeed the result was quite paradoxical at the first view, seeming to prove that one could be equal to two! The steamer's maximum velocity alone was stated to be 7 miles, her engines making 30 strokes per minute: with the float astern, laden with 68 tons of kentledge, the maximum velocity attained was 6½ miles, the piston making 28 strokes:—Now these numbers are very nearly in the same ratio; and as the consumption of coals is as the strokes of the piston, the same quantity of fuel as would have conveyed the empty steamer to a given distance, sufficed to carry her thither with the tug astern; here was a clear gain of more than 2 to 1 in the work done, with a sacrifice of one-fourteenth only in the *time* occupied by the passage.

The advantages of keeping the accommodation boats detached, has been more fully proved in the recent voyage of the Governor General up the country; on this occasion, both of the river steamers having vessels in tow, reached Benares in 24 days, or rather in 202 hours of steaming. The comforts of the passengers were greatly increased, while the steam boats had more room for their fuel, and were more obedient to the helm: the native pilots had also become more skilful in pointing out the channel to be followed.

On the other side of India, at the suggestion of Sir C. Malcolm, R. N. the steam communication with England viâ the Red Sea, has been at last made a Government object, and a vessel of 411 tons, the *Hugh Lindsay*, furnished with powerful engines, was launched in the beginning of the present year. We have always thought that the only hope of accomplishing this desirable object was by its adoption as a public measure. In the onset, no doubt, it would be a source of expense without return; but how many hundred objects of less utility command a national outlay of greater annual amount? Surely the speedy conveyance of despatches and public officers, to say nothing of the early receipt of political and commercial intelligence, is worthy of a pecuniary sacrifice greater than is here demanded.

The *Hugh Lindsay*, deeply laden with 11 days' coals, started on the 20th March, and reached Aden, her next coal depôt, on the 7th April. Her voyage to Suez occupied 21 days of actual steaming, and 11 in various detentions, which may hereafter be avoided. She encountered contrary winds and head seas, and an intricate navigation up the Red Sea. The distance was 5872 miles, making a daily average of 140 on her log.

"This trial voyage has by some been considered as a failure, because it was less successful than it might have been." The fault seems to lie in the adoption of a vessel depending on intermediate depôts, in place of a powerful steamer, of burthen like the *Enterprise*, which can make the whole run at once. Captain Johnston had indeed shewn by a statement (Appendix E.) that when constantly employed, the latter vessel becomes more economical than the *Ganges* or *Irrawady*, because the transport of coals is obviated.

The *Hugh Lindsay* has just now departed on her second voyage to Suez, with Post Office packets, and we heartily wish her success, anticipating that she will reach her destination to the isthmus, in less than a month, whence another month will easily take the letters on to London*.

We must conclude our present extracts from Mr. G. A. Prinsep's work, with his general table of Indian Steamers, reserving, for a future occasion, his observations on the river Ganges, which being of a scientific character, have an additional claim to our notice.

* This was written some months since: the return voyage of the *Hugh Lindsay* proved most tedious; and she was unable to cope with the prevailing spring monsoon.

General Description of STEAMERS *in British India.*

	Names.	Builder, and date of launch.	Cost ready for steaming.	Length between perpendiculars.	Breadth extreme.	Tonnage as sailing vessel.	Tonnage as a steamer.	Engineer.	No. of Engines.	Total Horse power.	Diameter of paddle wheels.	Paddle boards. Length.	Paddle boards. Breadth.	Paddle boards. Number.	Revolutions pr. minute. Light.	Revolutions pr. minute. Loaded.	Length of Piston stroke.	Proprietors' names, and employment.	Draft of water, loaded.	Consumption of Burdwan Coal pr. hour. 30mds. 1 ton.	Days of coal carried (of 24 hours).	Average velocity under steam, per hour.
			Rs.	Ft. in.	Ft. in	Tons.	Tons.				Ft.	Ft.	Ft.				Ft.		Ft.	mds.	days	knots
Private Steamers.	COMET & FIREFLY,	J. Anderson, Kidderpoor, 1826.	92,013 2 the two.	80 4	13 3½	76.5	54.9	H. Maudeslay......	2	20	9 0	4 0	1 0	8	36	30	....	Messrs. Alexander & Co. river accommodation boats,	5 0	6	2½	7
Private Steamers.	EMULOUS,	Evans, London, Oct. 1825.	170,000	126 9	19 2	226.7	127.8	Horsley Company, ...	2	100	12 6	8 0	1 8	12	28	24	3 4	Joint stock Company, river ship tug, ...	8 0	18.0	10	8½
Private Steamers.	FORBES,..	Howrah Dock, Calcutta, January 1829.	310,000	126 0	22 6	302.2	162.0	Bolton and Watt, ...	2	120	15 0	8 0	2 0	14	25	23	4 0	Messrs. Mackintosh and Co. ship tug, sea and river, ...	12 0	16.	11	8½, av. 5½ at sea.
Government Steamers.	DIANA, ..	Kyd & Co. Calcutta, July 1823.	70,000	100 0	16 8	133.0	89.4	H. Maudeslay, ...	2	32	12 0	5 0	1 4	6	..	..	....	Government, rivers of Ava, ...	6 0	172 ft. of tk. wood.	..	
Government Steamers.	ENTERPRISE,..	Gordon, Deptford, Feb. 1825.	400,000	14 6	27 8	164.0	275.5	Ditto, ...	2	120	15 0	7 0	1 5	12	25	19	4 0	General service at sea, ...	16 0	18.	24	max. 7 av. 5¾
Government Steamers.	IRRAWADDY and GANGES,	Kyd and Co. Calcutta, 1826-7.	200,000 each.	110 5	24 6	305.6	170.5	Ditto, ...	2	80	12 0	7 0	1 8	12	30	19	3 8	Transport of troops, towing vessels, &c...	11 0	11.3	9	5
Government Steamers.	TELICA,..	Humble & Hurry, Liverpool, 1824.	65,000	92 10	17 6	134.0	81.4	Fawcett & Co. Liverpool	2	50	....	....	..	..	30	25	....	Dismantled at Bombay, ...	9 6	10.	4½	8½
Government Steamers.	BURHAMPOOTUR.	Kyd & Co. Calcutta, Jan. 1828.	144,000	99 0	18 0	152.0	86.3	H. Maudeslay, ...	2	50	13 0	5 0	1 4	12	30	26	2 8	Built for river navigation, ...	4 0 3 0	7.0	2½	7
Government Steamers.	HOOGLY,	Howrah Dock Company, March, 1828.	124,000	102 8	18 0	158.9	89.5	Ditto, ...	2	50	13 0	5 0	1 4	12	30	26	2 8	Ditto, ...	4 0 3 0	9.5	3	7
Government Steamers.	HUGH LINDSAY,	H.C Dock Yard, Bombay, 1829. ..	......	140 4	24 10	411.0	..	Ditto, ...	2	160	....	....	..	.	..	..	....	Packet to the Red Sea, ...	..	..	..	5¾

The above measurements are according to Act of Parliament, as regards length and breadth; the length from fore part of stem, under the bowsprit, to aft part of stern post, along the rabbit of keel; the breadth, at the broadest part above or below the main wales.

Meteorological Register kept at the Surveyor General's Office, Calcutta, for the Month of May, 1831.

Day of the Month.	Minimum Temperature observed at Sunrise.					Maximum Pressure observed at 9h. 40m.				
	Barometer reduced to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.
1	29,652	81,	0,6	s. w.	cu.	,678	91,	8,3	s.	cl.
2	,650	83,	2,6	do.	cl.	,684	93,	9,1	s. w.	do.
3	,588	81,7	1,3	s. e.	ci.	,633	90,3	6,4	s.	cu.
4						,619	90,5	10,1	do.	do.
5	,751	72,7	1,6	n. e	cy.	,763	82,3	5,9	n. e.	ci.
6	,722	76,7	0,8	cm.	cus.	,786	88,8	7,6	do.	cu.
7						,730	88,3	6,6	s. w.	cus.
8	,676	79,5	1,1	s. w.	cus.	,715	89,	7,1	s.	cu.
9	,608	79,	1,6	s.	cu.	,643	91,3	7,4	do.	cl.
10	,524	81,5	1,1	do.	cl.	,565	92,	8,1	do.	do.
11	,489	82,	1,3	s. w.	do.	,542	92,3	8,9	s. w.	do.
12	,540	83,	1,3	s. e.	do.	,585	93,	6,9	s. e.	do.
13	,623	83,	0,9	s. w.	cis.	,632	93,5	8,5	s. w.	ci.
14	,620	84,	2,1	s.	cl.	,680	92,8	8,9	s.	cu.
15	,615	83,3	1,4	s. e.	ci.	,677	92,	6,6	s. e.	do.
16	,655	83,5	1,1	do.	cu.	,693	92,5	7,8	do.	do.
17	,624	84,3	1,6	s.	do.	,675	91,5	6,6	s.	do.
18	,591	83,	1,1	s. e.	cis.	,612	91,7	6,	s. e.	cl.
19	,501	83,3	1,4	s.	cl.	,563	91,5	5,8	s.	do.
20	,495	83,7	1,3	n. e.	cis.	,574	91,5	6,3	n. e.	do.
21	,544	83,5	1,1	do.	ci.	,615	91,6	6,9	do.	do.
22	,605	77,2	0,8	s.	cus.	,647	91,	7,1	s.	ci.
23	,638	79,3	1,4	s. e.	do.	,701	88,6	5,4	s. e.	cl.
24	,641	81,7	1,3	do.	cus.	,706	91,5	9,3	do.	do.
25	,658	83,5	1,8	s.	cis.	,716	93,5	10,3	do.	ci.
26	,664	80,8	0,9	s. e.	cu.	,743	89,7	7,8	do.	cu.
27	,694	81,	0,9	s.	ci.	,731	91,5	6,8	s.	do.
28	,649	82,3	1,9	s. e.	cl.	,669	93,8	7,9	do.	do.
29	,597	82,	1,6	do.	cu.	,656	91,5	6,6	s. e.	do.
30	,590	82,3	0,4	s.	do.	,638	93,8	10,8	s.	cis.
31	,548	83,	0,6	do.	ci.	,616	94,5	10,8	do.	cu.
Mean,	29,613	81,5	1,3			,661	91,3	7,7		

Day of the Month.	Observations made at apparent Noon.					Max. Temp. and Dep. of M.B.Ther. obs. at 2h. 50m.				
	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.
1	,662	93,	8,6	s.	ci.	,591	94,	8,6	s.	cu.
2	,665	96,3	12,2	s. w.	cl.	,589	97,7	12,6	s. w.	cl.
3	,602	93,8	8,4	s.	cu.	,546	95,5	9,8	s. e.	cu.
4	,586	91,3	10,6	do.	do.	,535	92,5	10,8	s.	cus.
5	,746	85,5	9,5	n. e.	do.	,695	89,8	12,4	n. e.	cl.
6	,730	92,3	10,6	do.	do.	,653	94,5	13,8	e.	cu.
7	,707	89,8	10,4	s. w.	cus.	,626	92,5	12,8	s. e.	cl.
8	,692	89,5	10,1	s.	cis.	,635	88,7	6,3	s.	cus.
9	,600	94,3	9,6	do.	cl.	,534	97,	11,3	do.	cl.
10	,525	96,3	10,1	do.	do.	,442	96,	12,1	do.	ci.
11	,520	97,	11,8	s. w.	do.	,475	97,8	12,4	s. w.	cl.
12	,572	95,	7,6	s. e.	do.	,537	95,7	8,8	do.	cu.
13	,609	96,	11,6	s. w.	ci.	,565	95,3	10,4	do.	cl.
14	,650	95,3	11,9	s.	cu.	,605	95,3	12,4	s.	cu.
15	,633	93,	7,9	s. e.	do.	,617	95,	9,1	s. e.	do.
16	,679	92,8	7,9	do.	do.	,632	94,7	10,	do.	do.
17	,636	94,5	9,1	s.	do.	,593	95,8	10,9	s.	do.
18	,582	92,	7,1	do.	do.	,528	92,7	7,5	s. e.	do.
19	,531	95,8	7,8	do.	cl.	,480	96,9	8,5	s.	cl.
20	,541	97,3	10,9	n. e.	do.	,485	101,2	13,8	n. e.	do.
21	,592	97,	11,3	do.	cu.	,550	101,3	12,6	do.	cu.
22	,613	97,5	10,4	s.	do.	,551	98,	11,1	s.	do.
23	,672	95,8	10,1	s. e.	cl.	,598	98,5	13,6	s. e.	cl.
24	,679	96,6	12,9	do.	do.	,607	100,	13,	do.	cu.
25	,688	94,5	12,6	do.	ci.	,621	97,3	14,9	do.	ci.
26	,699	95,5	12,1	do.	cu.	,639	97,	12,3	s.	cu.
27	,687	97,3	13,1	s.	do.	,633	96,8	13,6	do.	cus.
28	,634	96,8	13,1	do.	do.	,592	88,6	7,7	do.	n.
29	,612	96,	10,9	s. e.	do.	,573	96,7	11,3	s. e.	cu.
30	,606	94,3	11,9	cm.	cus.	,519	98,	15,	s. w.	do.
31	,541	97,8	13,1	s.	cu.	,475	97,5	12,3	s.	do.
Mean,	,629	94,5	10,5			,572	95,8	11,3		

Day of the Month.	Minimum Pressure observed at 4h. 0m.					Observations made at Sunset.					Rain-gauge No. 1.	Rain-gauge No. 2.
	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.		
1	,575	92,5	8,6	s.	cu.	,585	88,	5,1	s.	cu.		
2	,575	94,5	10,4	s. w.	cl.	,480	86,7	5,	s. w	cl.		
3	,515	92,8	8,6	s. e.	cu.							
4	,517	89,3	9,	s.	do.	,531	87,	7,6	s. w.	cus.	0,06	0,04
5	,680	89,5	11,3	cm.	cl.	,688	84,7	7,3	cm	do.	0,65	0,55
6	,625	91,1	11,4	e.	cu.	,631	86,3	7,6	c.	cis.		
7	,623	91,6	11,9	s. c.	cl.	,617	85,5	7,1	s. e.	cu.		
8	,607	84,5	3,1	s.	cis.	,635	84,	2,9	s.	cis.	0,18	0,15
9	,508	96,	10,9	do.	cu.	,525	88,	6,3	do.	cu.		
10	,419	95,3	10,4	do.	ci.	,424	89,	5,1	do.	ci.		
11	,462	95,7	9,8	s. w.	cl.	,470	89,	5,6	s. w.	cl.		
12	,506	94,5	9,1	do.	cu.	,507	88,	6,6	do.	do.		
13	,622	94,	9,8	do.	cl.	,541	88,5	4,6	s. e.	cu.		
14	,587	93,8	10,1	s.	cu.	,580	88,	3,6	s.	cis.		
15	,584	92,	7,6	s. e.	do.	,637	89,	5,6	s. e.	cu.		
16	,605	92,3	7,9	do.	do.	,606	88,	3,6	do.	cus.		
17	,550	95,	10,3	s.	do.	,583	90,	4,6	do.	cis.		
18	,496	92,5	7,3	s. e.	cl.	,482	87,3	2,9	do.	ci.	1,42	1,40
19	,427	96,7	8,	s.	do.	,431	89,3	2,9	do.	cl.		
20	,462	100,8	13,6	n. e.	do.	,470	92,3	4,9	n. e.	cis.		
21	,530	99,3	10,6	do.	cu.	,534	92,	5,1	s. e.	do.		
22	,535	96,5	11,8	s.	do.	,541	89,5	5,1	cm.	cl.	0,25	0,20
23	,572	98,3	14,4	s. e.	cl.							
24	,578	99,8	11,1	do.	cu.	,607	90,3	4,9	s. w.	cu.		
25	,583	96,6	13,9	do.	ci.	,590	90,7	6,3	s. e.	ci.		
26	,626	95,	13,	do.	cis.	,643	88,3	5,9	s.	do.		
27	,607	95,5	13,3	s.	cus.	,629	87,3	5,9	s. e.	do.		
28	,553	88,	6,6	cm.	do.	,585	86,3	3,2	s.	cis.		
29	,532	93,	7,9	s. e.	cis.	,573	90,	7,6	s. e.	do.		
30	,506	96,3	14,1	s. w.	cus.	,548	91,	7,3	s. w.	do.		
31	,469	95,	10,6	s.	cu.							
Mean,	,550	94,1	10,2			,560	88,4	5,4			2,56	2,[illegible]4

Abbreviations. In the column "Wind," small letters have been used instead of capitals; *cm.* means *calm*. In the column "Aspect of the sky," *cy.* is *cloudy*; *cl. clear*; *rn. rain*; *ci. cirrus*; *cu. cumulus*; *cs. cirro-stratus*; *cus. cumulo-stratus*; *cc. cirro-cumulus*; *n. nimbus*. The Rain-gauge No. 1, is on the ground: No. 2, is on the roof of the house, [illegible] feet above it.

Fig. 1

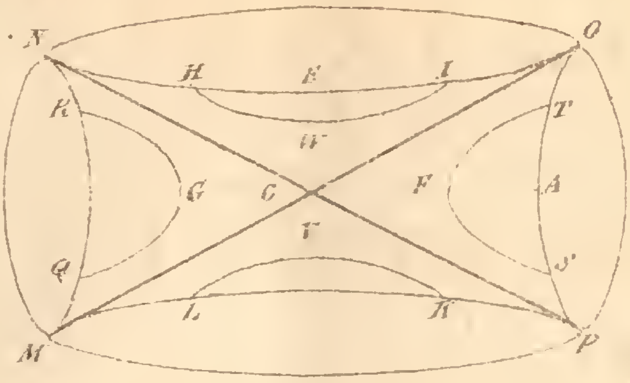


Fig. 2.

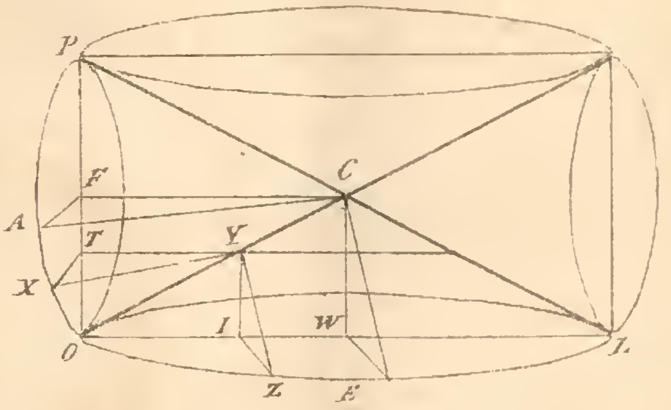


Fig. 3.

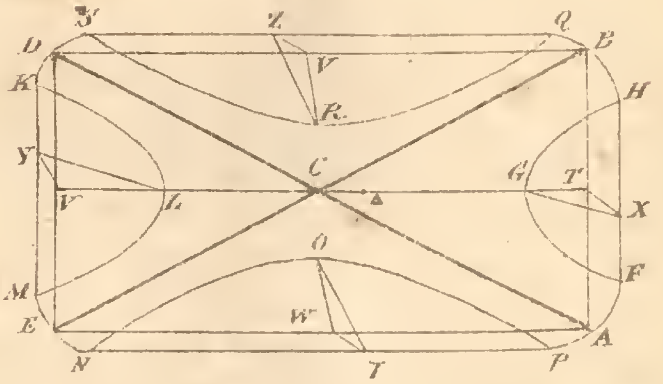


Fig. 4

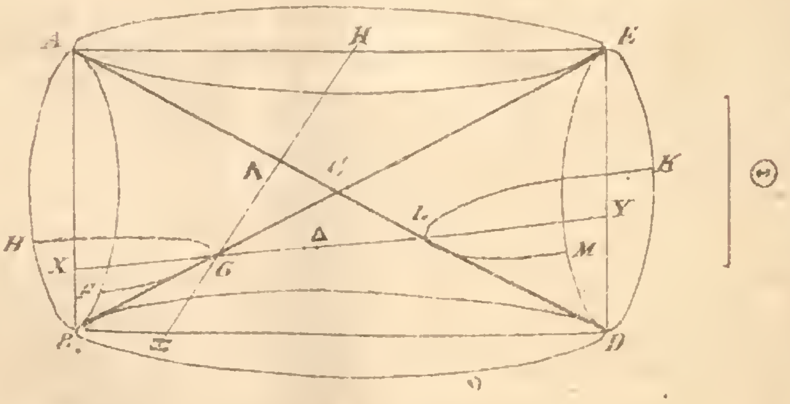
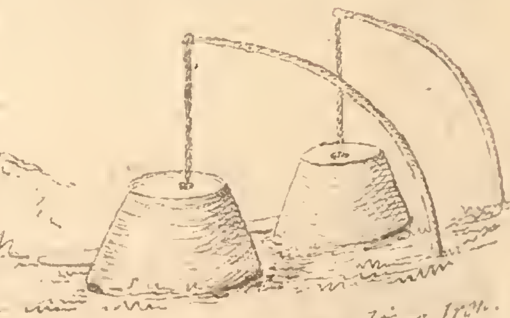


Fig. 6

Hill Cemetery.

Fig. 5.



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GLEANINGS

IN

SCIENCE

No. 30.—*June*, 1831.

I.—*On Conjugate Hyperbolas.*

To the Editor of Gleanings in Science.

SIR,

It is an old remark, that scientific men are fonder of extending the boundaries of the department to which they are attached, than of examining its principles; and that, in consequence, oversights are occasionally found to exist in the very outset of those sciences which have been most laboriously cultivated.

What I am about to lay before you, will afford a striking illustration of the above observation. Few branches of science have been more assiduously cultivated than that of Conic Sections. They have been treated, as it should seem, in every variety of way, both with and without reference to the cone; and yet it is a singular circumstance, that in all the treatises which I have had an opportunity of examining, there is either no direction given for such an elementary proposition as that of cutting a pair of Conjugate Hyperbolas from Conjugate Cones, or the directions, if given, are erroneous.

The books which I have consulted, are Robert Simson's five books; the treatise on Conics contained in the Scholia to the 8th Prop. book I. of Newton's Principia, by Le Seur and Jacquier; the articles in Rees' Encyclopædia; Abram Robertson's (of Oxford) four books; and the very recent work of H. P. Hamilton, of Cambridge, 1828. To these I may add, the little treatises of Vince and Peacock. Though all these Authors are diffuse in explaining the properties of conjugate hyperbolas, not one of them gives the least hint as to how conjugate hyperbolas can be cut from conjugate cones.

The only author within my reach, who speaks expressly on this subject, is Dr. Hutton; and the following is his definition of conjugate hyperbolas, as given among the definitions to the chapter on Conic Sections, in the 2d volume of his course of Mathematics. "And further, if there be four cones, (Pl. XIII. fig. 1.) CMN, COP, CMP, CNO, having all the same vertex C, and all their axes in the same plane, and their sides touching or coinciding in the common intersecting lines MCO, NCP; then if these four cones be all cut by one plane, parallel to the common plane of their axis, there will be formed the four hyperbolas, GQR, FST, VKL, WHI, of which each two opposites are equal, and the other two are conjugates to them; as here, in figure 1." To be sure of not misapprehending the meaning of the above definition, I have consulted all the mathematicians of my acquaintance, and they, withont exception, agreed, that their ideas of the formation of conjugate hyperbolas, by the intersection of the cone, was precisely what Hutton has here laid down.

And yet, notwithstanding such high authority, it is certain that Hutton's definition is wrong; and that conjugate hyperbolas will not be produced in the manner he describes, unless the four cones are all equal. To prove the truth of this, it is necessary to consider two cases. One, wherein the planes of the hyperbolas are perpendicular to the plane of the base of the cone, which is Hutton's supposition; the other, wherein they are inclined to it. I shall content myself with examining the first case for the present, leaving the second to a future opportunity. Let us take the two conjugate cones as given by Hutton, PCO, OCN, (Fig 1.) and suppose that the plane of the hyperbola SFT, IWH, is perpendicular to the base of the cone; and since the angle between the side and the base of the cone PCO, is COP, so that between the side and base of the other cone OCN, is CON, and these angles are the complements of each other. Then let the radius of the base of PCO, that is, the altitude of OCN, be r, and let the tangent of the angle COP, that is the cotangent of the angle CON, be τ, then the altitude of PCO = radius of base of OCN $= r\ \tau$; now let the distance of the centre of the base of each cone, respectively, from the plane of the hyperbolas SFT, IWH, that is, the line joining the centre of the base of each cone, and the points A and E, or the lines BA and YE which, by Hutton's hypothesis, are equal, be b, and this is evidently equal to the perpendiculars drawn from the points F and W, respectively, to the lines joining the apex and centre of the cone PCO, and OCN; let the point of the intersection of these perpendiculars, and the joining lines, (which cannot well be represented in the figures, but may easily be supplied by the imagination,) be X and Z, then the Δ's FXC, WZC, respectively, are similar to half the vertical Δ's of their respective cones; and since $FX = b = WZ$ by hypothesis, so XC, that is, the distance of F, the vertex of the hyperbola SFT, from its centre $= b\ \tau$ and ZC, the distance of W from the centre of IWH $= b \times \dfrac{1}{\tau}$; that is, the semi-transverse axis of SFT, is $b\ \tau$ and of IWH is $\dfrac{b}{\tau}$. The question, therefore, resolves itself into this; having given the hyperbola SFT, whose semi-transverse is XC, whose absciss is FA, and whose ordinate is the perpendicular AT, to find its semi-conjugate. If that be equal to ZC, or $\dfrac{b}{\tau}$, then is IWH the conjugate hyperbola equal to SFT, but not otherwise.

Now, for this purpose, to avoid confusions in characters, let us express the equations to the hyperbola, by Sanscrit letters, thus $\text{य} = \dfrac{\text{व}}{\text{ञ}} \sqrt{2\ \text{ञच} + \text{च}^2}$ in which, as usual, य is the ordinate, ञ the semi-transverse axis, व the semi-conjugate, and च the absciss; and then $\text{व} = \dfrac{\text{ञय}}{\sqrt{2\ \text{ञच} \times \text{च}^2}}$ now here, as above, $\text{ञ} = b\ \tau$, य by the nature of the circle $= \sqrt{(r+b) \times (r-b)} = \sqrt{r^2-b^2}$ and $\text{च} = \tau\ (r-b)\ \therefore\ \text{व} = \dfrac{b\ \tau \sqrt{r^2-b^2}}{\sqrt{2\ b\ \tau^2\ (r-b) + \tau^2\ (r-b)^2}} = \dfrac{b\ \tau \sqrt{r^2-b^2}}{\tau \sqrt{r^2-b^2}} = b.$

It follows, therefore, that the true semi-conjugate axis to the hyperbola SFT, is b; that is, the distance of the plane of the hyperbola from the vertical triangle of the cone, but the semi-transverse of IWH is $\dfrac{b}{\tau}$; that is, the said distance divided by the tangent of COP, or multiplied by the tangent of CON. These hyperbolas, therefore, cannot be conjugate, except in one case, that is, when the conjugate cones are both equal; or, in other words, when the angles COP, CON are each 45°. In that case $\tau = 1 = \frac{1}{\tau}$ and $\frac{b}{\tau} = b$.

To get the true conjugate hyperbolas, the cones must be cut in a different manner. The planes of the hyperbolas, instead of being the same, must be at right angles to each other; that is, in figure 2, pl. XIII. let CFA, CWE be the planes of the vertical triangles of the cones, and let YTX, YIZ be two planes parallel to them, cutting the cones at right angles to each other, and to the bases of the cones, viz. PAO, OZL, then the hyperbolas formed by the intersection of YTX with the cone PCO and YIZ with OCL, are conjugate to each other.

The truth of this is obvious, since it is plain, that TF, the distance of the plane of the hyperbola YXT, from the plane of the vertical triangle CFA, is equal to the semi-transverse axis of the hyperbola YZI; and similarly IW, the distance of the plane of the hyperbola YZI, from the plane of the vertical triangle CWE, is equal to the semi-transverse axis of the hyperbola YXT. It follows, therefore, that to produce *opposite* hyperbolas, the cones must be cut by the same plane in the manner commonly directed; but to produce *conjugate* hyperbolas, the conjugate cones must be cut by planes perpendicular to each other.

I shall forbear considering the second case, that in which the planes of the hyperbolæ are inclined to the plane of the base, as it would extend this letter too much; and my chief object is attained by having pointed out the error of the common idea of Conjugate Hyperbolas. I may, perhaps, address you on it at a future time.

In Rees' Encyclopædia, art. Hyperbola, it is stated. "It may be remarked, that while opposite hyperbolas must be regarded as two different branches of the same curve, conjugate hyperbolas are two different curves, possessing, indeed, some analogous properties, but really unconnected by the law of continuity. For in the first place, when a plane cuts two opposite conic surfaces, it produces no more than two opposite hyperbolas, without the smallest trace of the conjugate hyperbola; and in the next place, if we consider the hyperbola as it is determined by an algebraic equation, no such equation can be found, that preserving the same system of the co-ordinates, will comprehend all the four conjugate hyperbolas."

It may be observed, that although the hyperbolæ so cut from conjugate cones in the common way, are not conjugate to each, yet they are *similar* to these conjugates. This is noticed in the new edition of Hutton's Course of Mathematics, edited by Olinthus Gregory, 1828, of which a few copies are just come out to India, and which contains many valuable additions to the original work. In Vol. II. page 105, the last sentence of the quotation, which I have already given from the old edition, is altered to the following: "There will be formed the four hyperbolas GQR, FST, VKL, WHI, of which each two opposites are equal; and each pair resembles the conjugates to the other two, as here in the annexed figure; but they are not accurately the conjugates, except only when the four cones are all equal; and then, the hyperbolic sections, are all equal also." No directions, however, are given how to cut the accurate conjugates. It may also be remarked, that the expression, "each pair *resembles* the conjugates of the other two," is not correct mathematical language. It should be "each pair is similar to the conjugates of the other two," as may easily be proved; for they are between the same asymptotes, and hyperbolas that have the same asymptotes, are similar to each other. This may also be shewn thus; the transverse axis of the hyperbola cut from the cone PCO is $b\tau$, and its conjugate axis is b. Hence the transverse axis of the hyperbola conjugate to that, is b, and its conjugate axis $b\ \tau$. Now the transverse axis of the hyperbola cut, by Hutton's method, from the cone OCN, is $\frac{b}{\tau}$; and its conjugate, (by reasoning in the same manner with the cone OCN, as with PCO,) is b. Then $b : b\tau :: \frac{b}{\tau} : b$; that is, the proportion of the transverse to the conjugate axis in these two last hyperbolas, is the same; and hence they are similar.

T.

II.—*On Irrigation and Inland Navigation, as applicable to the Dek,han; by* Captain George Twemlow, *Artillery.*

The numerous reservoirs and irrigating tracts which may be traced all over the Dek,han (and which, it is believed, were made chiefly previous to the devastating wars carried on by the Brahmans and solar races, against the Budhist and lunar tribes), evince that the country had attained a high state of cultivation and prosperity; and it is believed that their revival would renew such.

The Mahrattas, who lately held the country, were a nation of plunderers, who forced the lands into cultivation, by external aids; each *Potail,* or head man of a village, being a robber, as well as cultivator, who foraged in neighbouring countries, for cash and cattle, to enable him to cultivate the arid tracts, on the rocky plains of his retreat, where no precautions were then taken to husband the periodical rains, as was usual under former and more settled governments.

The British received the lands from the Mahrattas; and since they neither admit of the external aids obtained by the cultivators of Mahratta governments, nor have put in order the reservoirs and irrigating canals of the Budhist and Deo governments, it is probable that the country will not repay its expenses.

It is believed that, by a due attention to three points, the Dek,han might again become (what it once undoubtedly was), a populous and rich country, abounding in large cities and marts.

1st.—Irrigation, by means of weirs or dams, with side channels from the rocky falls of all the streams.

2nd.—Inland transport of surplus produce at a cheap rate, and exempted from vexatious transit duties.

3rd.—Full employment for the present plundering tribes, by causing to be expended, on public works, a portion of the cash now dissipated in keeping them in subjection, and in outlawry or idleness.

Remarks on Irrigation.

The periodical rains fall in the Dek,han chiefly during the months of June, July, August, and September, and then in such abundance, as would be ample for the whole year, if the supply were husbanded.

Again, towards the end of the year, and also in March or April, there are generally heavy showers, which seem naturally and beneficially purposed to replenish the reservoirs and tanks.

It would be sufficient, at first, to repair all the ancient reservoirs and dams or weirs, and search for all such streams as have rocky falls, making the waters retain the upper level, and flow along the banks, (or intermediately between the bank and bed,) until they can be passed over ground fit for cultivation, or to fill such natural or artificial tanks and reservoirs, as may be formed, or be available within their course.

The rocky falls are the places from which the side irrigating canals should branch off; their mouths being cut in the solid rock, so that there would be no danger of the stream enlarging the aperture.

In some cases, where a waterfall is far distant from lower ground, and that high banks intervene, intersected by ravines, it might be adviseable to put down *nal* (pipe) or pipework, (embedded in the solid rock of the bed of the stream,) sufficiently large for the stream required, so as to convey it from the waterfall heighth to the part of the river, or *nala*, opposite the lower ground requiring to be irrigated; then by raising a pillar, with pipework within it, the water will rise to its original level, and pass over the bank to the lower ground.

Nor would this be so expensive as might at first be imagined; the natives of the Dek,han are particularly expert in excavating rocks; they do not, (as might be supposed,) confine themselves to small tools, but on the contrary, when they have extensive works on hand, they use large sledge hammers, in which sets of steel pointed chisels may be fixed; and they cover their legs with thick leathern covers, whilst working with them.

About twelve thousand Rupees per mile, might be calculated for *nal* or pipework, imbedded, air-tight, in solid rock, to admit a stream, twelve inches in diameter, allowing that chunam could be obtained near the spot.

For this method of conveying a stream, it matters not what dips or inequalities are passed over; the confined water will always attain its original level, or nearly so, when a pillar (with a continuation of the air-tight pipes,) is made for it to rise in.

Particular localities would determine the mode of conveyance; what is particularly advocated in this paper, is, that the streams of the Deck,han, instead of being allowed, as at present, to run waste to the ocean, should at every rocky fall, be retained at their then existing level, and be turned off to the right and left, to irrigate all lands, and to fill and replenish all the artificial or natural tanks or reservoirs, that the stream will run to.

The beds of every broad *nala* offer ready-made reservoirs; they should be bunded off by successive weirs at all the rocky waterfalls, as well to retain a supply of water as to turn the surplus stream over the country lower down.

Remarks on Navigation.

Now, with regard to the larger rivers of the Dek,han, such as the Godavery, the Kistnah, and the Nerbudda, it is believed that the time approaches, when if capitalists of respectable character and funds are permitted to speculate extensively in the interior of India, such rivers may be made navigable.

The benefits which would accrue to the Government and country, therefrom, are too evident to require elucidation.

The obstacles to the navigation of the larger rivers appear to be,

1st. Want of available capital, population, and produce.

2nd. The unsettled state of the tribes who occupy some parts of the banks.

3rd. The rocky falls in the rivers.

It is hoped, that the two first objections will, in time, be removed by the wise measures which appear to be in contemplation, regarding the influx of capitalists of a respectable class.

With regard to the third objection, the writer of this paper would be glad to have the opportunity of practically proving, that these very falls afford the means of irrigating, on an extensive scale, the surrounding country lower down the stream, so as to produce articles for transport; and that they by no means offer insurmountable obstructions to navigation in the present advanced state of the sciences.

Locks of a cheap and very durable nature, may be formed in the rock at each fall, by a few lbs. of gunpowder, properly applied to form cavities for locks when procuring stones for building the weirs or dams.

I am prepared to prove, that these sunken locks may be made at a cheaper rate than raised locks, (calculated to resist Indian torrents,) possibly could; and I believe that their adoption would, (provided there were produce and population sufficient,) render both the Nerbuddah and Godavery, (the Godavery as high as the junction with the Dùdna, and the Nerbudda up to the confluence of the Tewat with it,) navigable, if carried into effect on a comprehensive scale, combining the formation of weirs or bunds, for irrigation, with the means of transport for surplus produce without the former the latter would be of no use.

The tribes of plunderers at present infesting the banks of the larger rivers, and the hills near them, might be formed into bands of work-people; in the first instance to construct the works; then to cut down the forests, and to work the boats and rafts; eventually they might be settled as cultivators and boatmen; a portion being retained as organized guards.

If the Nerbudda, or any one of the larger rivers, were bunded off for irrigation, and supplied with rock-locks for navigation, as an experiment; it would, I conceive, be found, that from every bund or dam, branching off from each waterfall, there would be a subordinate canal which would irrigate the surrounding lower country, and serve, in many instances, to convey the produce into the larger stream.

These small canals might be made to fill all the small *nalas* which dry up during the warm months, and would replenish all tanks near at hand.

Sugar might be made; cotton, silk; iron be produced, and be smelted; in short, the resources of the country are ample; and vast tracts of rich land are unoccupied: but to give the impetus, it is absolutely necessary that respectable Europeans or Parsees, (or what would be still better, the two together,) should be permitted, and be encouraged, to employ their cash in speculations of the sort adverted to.

Retired servants of the Honorable Company, who would be willing to devote their time and capital to this end, might be encouraged so to do.

Many hill tracts are almost wholly unexplored; their resources may be great; and it is well known that some of them abound in mineral wealth; and that the lands on the sides of hills, near springs or streams which admit of irrigation, are by far the most productive, though at present overgrown with luxuriant woods or grass, which evinces their richness.

It is believed that coal and iron abound near the sources of the Nerbuddah, amongst the Maha Deo hills; and coal has been found in detached pieces brought down by the Towah river; which runs into the Nerbuddah, near Hussinabad.

III.—*Note on certain Specimens of Animal Remains from Ava, presented by* James Calder, Esq. *V. P. to the Museum of the Asiatic Society, by* Hugh Falconer, Esq. A. M. *and* M. D.

[Read at the Meeting of the Physical Class As. Soc. 20th April, 1831.]

These specimens of Ava fossils were procured, with some difficulty, from the neighbourhood of Prome, where the collection, by Dr. Crawfurd, had been previously made: we may hope ere long, to have a richer assortment, through the exertions of Major Burney; but in the meantime, it may be interesting to the Society to know what individual fossils of the number have been identified with those taken hence, by Dr. Crawfurd.

It must be premised, that the following attempt at discriminating the animals to which the fossil bones belonged, is submitted to the Society with great diffidence, and is confessedly imperfect. Had the means of comparison been more extensive, an accurate list might have been made out: but no recourse could be had to the skeletons of any *analogues;* and the only available sources of information, were Cuvier's Ossemens Fossiles, and Memoirs in the Geological Transactions, by Buckland and Clift.

Further, this note does not profess to contain any thing original, or to make any addition to the list of fossils from Ava, already discovered.

The remains are confined to quadrupeds. There are no marine nor fresh-water shells, nor any specimen of the deposit in which the remains are found; but it is believed to be the same diluvial formation in which the remains of mammalia are found in Europe and America.

The specimens consist of fragmented portions of bone; many of them coloured with iron. The fragments mostly angular, and few of them bearing marks of attrition.

Of the *Pachydermata*, there are bones belonging to two genera, the rhinoceros and mastodon.

No. 1. A. Is a fragment consisting of a longitudinal and vertical section, of a molar tooth of a mastodon, with a portion of the attached jaw, and a nearly entire fang. The characters are not sufficiently marked to determine the species, but it seems to approach most nearly the *mastodon lasidens* of Mr. Clift. (Geol. Trans. vol. ii. p. 11.)

No. 1. B. Is a portion of the middle of the femur of a mastodon.

No. 2. A. Is a portion of the lower jaw of the left side of a rhinoceros, containing a perfect tooth, which has been accidentally divided. It has belonged to an animal now extinct, and of larger size than the *rhinoceros monoceros* of this country. The form of the tooth is different from that found by Mr. Crawfurd, but as the characters vary, from wearing, with the age of the animal, it is no easy matter to determine whether or not it belongs to a different species. It resembles very closely in form the *rhinoceros Eriques* of the Ossemens Fossiles of Cuvier.

No. 3. *a, b,* & *c.* Are vertebræ from different parts of the spinal column of *Crocodiledæ.* Some of the bones carried to Europe, were found to belong to the *leptorhynchus* of the Ganges, or a species very nearly allied.

No. 4. *a, b, c,* & *e.* Are osseous fragments of two large genera of turtle, the *emys* and *tryonyx.* The remains of these animals bear a large proportion to the other bones.

There are several specimens, comprising the greater part of the collection, to which no names have been attempted to be given. Some of them are well marked, and the individuals to which they belonged might be hazarded with a tolerable degree of confidence; but when the evidence fell short of certainty, it appeared better to present the bones without attempting to name them, than run the risk of giving misnomers, and misleading others.

A correspondence has been discovered between a specimen from the Himalaya, and those of the *trionyx* or *emys*, from Ava; there can be little doubt that when we have an opportunity of making a comparison of the fossil bones from both places, further coincidences will be brought to light.

To the above description we take the opportunity of subjoining the following extract from the Journal of a Mission, deputed by Major H. Burney, Resident at Ava, to Yenangyong, in hopes of procuring a larger collection of the fossil remains. The expedition was unsuccessful, but we cannot help surmising, that it was only so from a misconception of the object to be sought; for Mr. Bedford says, in two places, that the ground was every where strewed with fragments of "petrified bones and trees."—He seems to have looked for skeletons in a more perfect state, and to have imagined that such had been collected by Dr. Crawfurd, which is far from being the case.

Extract from the Journal of Apothecary H. Bedford, *deputed to Yenangyoung, in Ava, in search of Fossil Remains.*

Thursday, 13th January, 1831.—Arrived at Yenangyoung at 3 P. M. I waited upon the *Myo-ouk*, and showed him the order which I had received from the *Lhwot-tau*. He said that he did not know the place where the fossil remains were procurable, as he had only resided at Yenangyoung for a few weeks; but that he would send for people to guide me to the spot early to-morrow morning, and that he himself would accompany me.

He further added, that the inhabitants of the village were in a state of extreme insubordination, in consequence of having been compelled, by the *Myo-thoogyee*, (who is at present in Ava,) to contribute 2,500 viss of silver towards the payment of the 4th instalment; the greater part of which they assert has been peculated by the *Myo-thoogyee* himself. They have pulled down his house, and his family have fled to an adjacent village for protection. They have desisted from drawing oil from the wells, and are determined, if the *Myo-thoogyee* returns again, to abandon the place altogether. On this account the *Myo-ouk* possesses little or no influence over the people, and I am afraid that it will not be in his power to render me much assistance.

Friday, 14th. Set out at day-break, accompanied by Mr. Abreu, the *Myo-ouk*, and 26 coolies. We proceeded about 4 miles to the southward, when we arrived at the hill of *Meng-leng*, or as they pronounced it *Main-lain*. I could not perceive the slightest vestige on that hill, or on the surrounding ones, of former excavations, but a few *miles*[1] beneath the surface, in every direction, we saw fragments of petrified bones and trees. We commenced digging in different places, to the depth of 10 and 14 feet. The soil was sand, unmixed with loam or clay, and very close aggregated sandstone. After 10 hours' unremitting labour, we left off, having met with nothing to reward our trouble. The *Myo-ouk* said that this place did not belong to the district of *Yenangyoung*, but was in the jaghire of *Menza-gyee*, and was under the *Myo-ouk* of the village of *Nyoung-la*. And that he would

[1] *Quære* feet?

send for that person to meet me at my boat early to-morrow morning, who, (he said,) could doubtless guide me to the exact spot where Mr. Crawford procured his collection, as it was from that village, and not from *Yenangyoung*, that Mr. C. obtained his coolies.

15th. Finding at 10 P. M. that the messengers who had been dispatched last night to *Nyoung-la*, had not returned, I was on the eve of waiting upon the *Myo-ouk*, when the *Akhau-woon* of the Petroleum wells called upon me, and said, that not long ago he had found the petrified head of an Elephant, at a place called *Phoungyoung Kyoung-bat*, and he had, no doubt, but that more could be got by digging. He said that the *Myo-ouk* and he were ready to conduct me to the place, with the same complement of coolies as I had yesterday. We accordingly set out, and after a walk of 3 miles, arrived there. It is situated due north-east from *Yenang-young*, between the villages of *Twun-gyoung* and *Thoung-say-chouk*, about half a mile from each. The latter village is situated very agreeably on the east bank of the *Pyun-gyoung* river, which is there, at this season, about 50 feet broad. The village contains about 350 inhabitants, who are principally employed in rearing cattle for the adjacent oil wells. The place supposed to contain fossil remains is a small hill, about 110 feet high, like the hill of the *Main-lain;* the surface is strewn with fragments of bones and petrified wood. We dug in different places to the depth of 11 and 12 feet, but found nothing worth the trouble of carrying away. On our road home I told the *Myo-ouk* that I heard that the hill of *Ponpai-doung*, (which is visible from this place, but is much nearer the town of *Tsa-le* than *Yenangyoung*,) contained fossils ; at this they all laughed heartily, and the *Myo-ouk* replied, that the highest peak of *Ponpai-doung* is inaccessible, and that it was a popular belief that whoever succeeded in attaining its summit, would infallibly obtain whatever he wished for. On this account, when any person makes an unreasonable request, it is customary for them to tell him to go to *Ponpai-doung*. When we had reached the *Myo-ouk's* house, I asked him, why other people had been able to procure fossils, and why I could not meet with the same success : especially as I had brought such a positive order from the *Lhwot-tan*. The *Akhaw-woon* replied, that when the British Resident was on his way to Ava, that gentleman and the Rangoon *Tsare-dangyee* desired him to collect as many fossil remains as possible; and when a sufficient quantity was collected, that a proper person would be sent from Ava to take them away. In compliance with this request, he had daily sent out people to collect them, up to the period of Sub-overseer Richardson's arrival. Mr. Richardson told him that he came by order of Major Burney, and in consequence of this he had given him the whole collection, after having received a douceur of 4 bottles of brandy and 4 handkerchiefs. He also added, that Major Burney had taken down his (the *Akhau-woon's*) name, and a memorandum of a peculiar scar on his forehead, occasioned by a fracture of his skull. I told the *Myo-ouk*, that as Mr. Abreu was anxious to return, and as I had received positive injunctions from Major Burney and the *Lhwot-tau* not to leave *Yenangyoung* until I succeeded in getting the bones ; that I should be under the necessity of writing immediately to Ava to inform him of my ill success; and that, if he wished to avoid the severe displeasure of his Government, he had better strain every effort to assist me. This appeared to alarm him very much, and he immediately sent for all the head-men, and consulted with them apart. A short time afterwards he entreated me to defer writing to Ava until the day after to-morrow; and added, that as the head-man of *Nyoung-la* had not thought proper to come to us, although he had promised to do so, that we would go to him to-morrow morning, and try once more what could be done

16th. Set out along with the *Myo-ouk* for *Nyoung-la,* in a large boat. We arrived there about half past 6 a. m., and sent for the head-man of the village. He said, that previous to Mr. Crawfurd's arrival there, the village had been attacked by banditti, and all the inhabitants had fled into the jungle; and that when the Steam-boat run aground nearly opposite, the village was occupied by a *Bho,* and detachment of soldiers stationed there to protect the village, and induce the villagers to return. And that, at present, there was not a single inhabitant in the place, who was present, when Mr. C. made his collection. He, however, professed his readiness to assist me in my researches. We spent the rest of the day in traversing the country between *Nyoung-la* and *Yenangyoung,* but unfortunately fell in with nothing worthy of notice.

Finding that I could not succeed unless I remained, at least, a fortnight at this place, I requested the *Myo-ouk* to furnish me with a boat in order that I might return to Ava; after having exacted a promise from him, and the *Akhou-woon,* that they would leave no means untried to collect as many petrified bones as possible. He would, on no account, consent to my returning overland.

20th. Overtook the Row-boat at *Pagahm-myo,* and took a small packet for Major Burney.

IV.—*On observing Azimuths by means of the Pole-star.*

To the Editor of Gleanings in Science.

Sir,

A friend having brought to my notice the facility of obtaining Azimuths from the Pole-star, and believing that it would be very useful, in low northern latitudes, to seafaring people, I have drawn up a table of Azimuths suitable for purposes of moderate accuracy, which I beg to offer for publication in your *Gleanings.*

I am, Sir,

Camp, near Meerut, Dec. 1830. Your most obedient Servant,

B.

Example. January 18, 1830, in North Lat. 28°, and East Long. 77°, at 18 h. 21 m. 30 s. the angle between the pole star and a station was observed, 116° 47′; altitude of the star 26° 39′, while its magnetic bearing was N. 49′ W. Required the true bearing at the station, and the magnetic deviation.

Rule. Add together the sine of the hour angle, the sine of the north polar distance of the star, and the cosine on at the altitude, deducting 10 from the index; the remainder will be the sine of the elongations in Azimuth, which, if east, must be added to the observed angle, or substracted, if west, for the magnetic deviation; the difference between the observed and the computed elongation, if at the same name (east or west of the meridian), or sum, if at a contrary denomination, will be the deviation, which will be east or west, according as the observed Azimuth is to the left or right of the elongation.

By Logarithms for the true bearing of the station.

	h m s		h m s
E. Longitude, ... 77° =	5 08 00	Sun's AR. 18th Jan. 1830, ..	20 0 18
Time at place of Observation,	18 21 30		+ 2 21
m s 2 · 21 = Corn. in AR. for, ..	13 13 30	Sun's AR. Corrected =	20 02 39

	h	m	s
Sun's AR. Corrected, ...	20	02	39
Time of Observation, ...	18	21	30
AR. of Meridian, ...	14	24	09
AR. of Polaris, ...	0	59	44
Hour Angle, ...	13	24	25
Or in space, ...	201°	06′	15″

Hour ∠	21°06′ 15′′	Sin.	9,5564
N. P. D.	1 35 34	Sin.	8,4437
Altitude, ...	26 39 0	Sec.	0,0488
Polaris E, ..	0°38′ 29″	Sin.	8,0489

Observed Angle, ...	186° 47′ 00′′
Polaris East, ...	0 38 29
True bearing of Station,..	187° 25′ 29″

Or the Logarithm of the star's N. P. D. may be used; the resulting logarithm will be the logarithm of the Azimuth, instead of the Log. Sine: Thus,

Hour angle, ..	21° 6′ 15″	Sin.	9,5564
N. P. D.	1 35 34	Sin.	3,7585
Altitude, ...	26 39 0	Sec.	0,0488
	Log. of 2310″	=	3,3637

And 2310″ = 0° 38′ 30″ as before.

Table of the Azimuths of the Pole-star, for every 10 *minutes of the Horary Angle, or distance from the meridian in time;* 1*st January,* 1830.

	Hours.	Minutes.						Correction for Altitude for elongation in Azimuth.					
		0	10	20	30	40	50	5°	10°	15°	20°	25°	30°
		° ′	° ′	° ′	° ′	° ′	° ′	′	′	′	′	′	′
Elongation West,	0	0 0	0 04	0 08	0 13	0 16	0 20	+ 0	+ 0	+ 1	+ 2	+ 3	+ 4
	1	0 25	0 28	0 32	0 36	0 40	0 44	0	1	2	3	3	4
	2	0 48	0 51	0 55	0 58	1 01	1 04	0	1	2	4	5	7
	3	1 08	1 10	1 13	1 16	1 18	1 21	0	1	3	5	7	10
	4	1 23	1 25	1 27	1 29	1 30	1 32	0	1	3	6	9	13
	5	1 33	1 34	1 34	1 35	1 35	1 36	0	1	3	6	9	14
	6	1 36	1 36	1 35	1 35	1 34	1 34	0	1	3	6	10	15
	7	1 33	1 32	1 30	1 29	1 27	1 25	0	1	3	5	10	14
	8	1 23	1 21	1 18	1 16	1 13	1 11	0	1	3	4	9	13
	9	1 08	1 05	1 01	0 58	0 55	0 51	0	1	2	3	7	10
	10	0 48	0 44	0 40	0 36	0 32	0 28	0	1	2	2	5	7
	11	0 25	0 20	0 16	0 13	0 08	0 04	0	0	1	2	3	4
Elongation East,	12	0 0	0 04	0 08	0 13	0 16	0 20	0	0	1	2	3	4
	13	0 25	0 28	0 32	0 36	0 40	0 44	0	1	2	3	3	4
	14	0 48	0 51	0 55	0 58	1 01	1 04	0	1	2	3	5	7
	15	1 08	1 10	1 13	1 16	1 18	1 21	0	1	2	4	7	10
	16	1 23	1 25	1 27	1 29	1 30	1 32	0	1	3	5	9	13
	17	1 33	1 34	1 34	1 35	1 35	1 36	0	1	3	6	10	14
	18	1 36	1 36	1 35	1 35	1 34	1 34	0	1	3	6	10	15
	19	1 33	1 32	1 30	1 29	1 27	1 25	0	1	3	6	10	14
	20	1 23	1 21	1 18	1 16	1 13	1 11	0	1	3	5	9	13
	21	1 08	1 05	1 01	0 58	0 55	0 51	0	1	2	4	7	10
	22	0 48	0 44	0 40	0 36	0 32	0 28	0	1	2	3	5	7
	23	0 25	0 20	0 16	0 13	0 08	0 04	0	0	1	2	3	4

By the Table for the Deviation.

Hour angle, 13h. 24m. 25s.

Table,	13 20	—32′	
Diff. per	5m.	—+ 2	
Correction for Altitude,		+ 4	
Elongation East,		38′	
Magnetic bearing N.		49	W.
Deviation East,		1° 27′	

For the mariner's purpose, the latitude may be taken as the altitude of the star.

The pole-star being visible till sun-rise with the telescope of a common theodolite, affords a good opportunity of observing the bearings at the peaks, up the Himalaya, which are oftenest seen at that time.

It may be remarked, that the most favorable time for making these observations, will be, when the star is about its greatest elongation, or 6 hours from the meridian.

V.—*Excursion to the Chirra Púnjí Hills.*

We arrived at Chatak at about 5 P. M. of the third day, after leaving Dacca, and might have done it in 3 or 4 hours less, had our navigator known the route as well as he does now: there we slept, and next morning started in a Bhaulia for Company-Ganj, whence, with the assistance of ponies and elephants, we reached Pandua, about noon. At this place there is a mountain torrent, which is accessible to very small boats at most seasons, by being dragged up rapids in several places.

Our servants, with our baggage and provisions, came on from Company-Ganj to Bourdeaux, which is nearer Pandua than Company-Ganj. At Pandua, the party halted till evening, when it began to rain; but being all in high spirits, this little inconvenience was disregarded by many of the party, who moved on to Teriah-Ghât, the very foot of the mountain, and got wet through, arriving about dark: the rest slept in a guard house, and started at four the next morning; thus avoiding the rain. A great part of this road is on the border of the *nála* which runs past Pandua, the bed of which is covered with pebbles of all sizes and sorts, granites of various colours, amygdaloidal sandstone, and limestone. At Teriah Point a bund is being constructed, I believe with a view of obtaining a great depth of water, and enabling boats to approach within the range of hills; but as far as I could learn, success was very problematical, and I think the labor would be better bestowed in improving the ascent of the pass. I saw nothing but sandstone and nodules of iron ore, containing loose quartz sand all the way up. The groves of oranges, betel nut, and the wild pine apples, give a very different character to the ascent, from that at Masúri; as well as the absence of the fir, oak, and rhododendron. Near the summit, at the village of Musmai, we came suddenly on a platform of rock, with a tremendous perpendicular precipice, whence we enjoyed the glorious view of a lovely valley, about two miles broad, and perhaps 1500 feet deep; into this, various waterfalls and cascades tumble, and in every direction add to the splendour and richness of the scene; little villages and patches of cultivation, with orange groves, appear at the bottom. I think it probable, that a road may be brought into this valley below, and that the ascent to Chirra may be made here, by a much shorter route than the present; after passing Musmai there is a descent; then a small plain, the rise after which brought us in full view of the Chirrah station, at a distance of two miles. The Chirrah Sanatarium is bounded on the west by a rocky *nála*, which rises in some small hills; one part of it runs north, and soon falls into a deep valley, over a precipice: this valley forms the northern or eastern boundary of the station. It is much larger than the Musmai valley, but neither so deep, nor so picturesque, and has several cascades of various dimensions, some at least 300 feet in fall; and the view across extends to the Jentia and Manepúr mountains, of which we had one transient glimpse. They are very distant, and must be from 9 to 10000 feet in altitude; to the south there are fine downs, and the Musmai valley, into which the rocky *nála* discharges its waters over precipices. The climate of Chirra-Púnjí appears to be delightful; while we were there, the thermometer, in the house, ranged from 58° to 72° Far.; and, excepting some transient fogs, or rather clouds flitting past us, the weather was very pleasant.

I was so little fatigued with ascending the hills, that I took two long walks the same evening, which I attribute entirely to the climate; for in the plains, a walk upstairs was fatiguing to me. The next day, we visited the *Púnjí*, or village of Chirra, which is evidently thriving; all the people seem employed and cheerful, and new houses are springing up in various places. A striking feature in these hills is found in the cemeteries, where stones are erected in memory of every person, (male, I believe,) who may die: for the more powerful and wealthy, three, and sometimes five stone obelisks, rudely hewn, are set up; (fig. 5. pl. 13,) some as high as 16 feet, with a sort of table monument in front of the middle obelisk, said to contain the head of the deceased. These memorials of the dead are every where in such complete preservation, untouched but by the hand of time, that there can be no doubt of their being held in great veneration; and I learned, that the chief religious ceremony of the people consisted in offering at these places to the manes of their ancestors, in which point they seem to assimilate with the Chinese.

From Chirra we passed on to the village of Mamlú, a short distance from which there is a valley, far more beautiful than that at Musmai; more extensive, more varied, and with a less scanty sprinkling of villages and cultivation; but no description could do justice to its beauty without the aid of the pencil. The access to the village of Mamlú is through a passage, partly natural, and partly artificial; about 9 feet high, and 6 feet broad, through the rock, which when closed, forms a barrier of no small difficulty. After passing through this, the road continues the same breadth, but *au jour* over head, and winding for 60 or 70 yards; it brought us to the village, from the south side of which was an extensive view over the plain, in which we could trace the course of the Súrmah and other rivers, through the plains, for at least 60 miles. The windings of the Súrmah are very remarkable; and we had a complete view of the track of the steam boat, from Chunaganj to Chátak. This situation is delightful, and we were told that a cool breeze almost invariably blew upwards from the valley below. The vista of mountains on each side extended, at least, 7 miles; and several small hills spring up in the valley, each of which would be called a mountain in England. The inhabitants flocked round us with fresh *Seville* oranges, and a few dried sweet oranges; and seemed all happy, contented, and well pleased, at the notice we took of them. Our pleasure, in beholding such smiling faces, was vastly diminished by the offence offered to our olfactory nerves; the scent emitted by the persons and dress, more closely resembling that of a dirty dog kennel, full of dried fish, than any thing else I can imagine; the houses proved not less dirty than the inhabitants, who shared them with their pigs and dogs. After leaving Mamlú we went to a cave in a limestone rock, into which a stream of water continually runs. The rock has veins of rhomboidal spar in it; and no doubt, various forms of crystals might be found on search; but for this I had not time, neither could I penetrate into the cave, having no means of passing the water: I brought away a few specimens. In passing from this cave, homeward, I met with a great quantity of stalactitic iron-stone; it is difficult to imagine how it became strewed over the plain.

The next day we visited the Musmai cavern, to the extremity of which we penetrated: this, also, is in a limestone rock, but entirely covered with stalactites, and the floor of it, at the entrance, strewed to a greater depth than I could remove them, with those singular globular concretions, of which it has puzzled mineralogists and geologists, to account for the formation. The entrance not being straight we soon lost the day light; after which, about 50 paces brought us to a chimney, up which we climbed some distance, and then turning to the right, through a horizontal hole, came to a difficult passage, of about forty feet; then a descent, another turn to the right, and a further passage, of about 50 yards, brought us to another chimney, after climbing which, we found ourselves in an oven-shaped cell, about 50 feet in diameter, and perhaps as many in height: in this hall there are stalagmite pillars up to three or four feet high, and large masses of sparkling stalactites, hanging down from the roof. The Kasiah people have a tradition of its being the residence of a spirit, named Bubún, and are afraid to enter it without visitors.

After leaving the cavern, we returned to the village of Musmai, and proceeding along the tops of the precipices of the northern side of the valley, visited two beautiful waterfalls; the smallest, by our measurement, was 158 feet, being a single fall of one branch of the stream, which bounds the Sanatarium. This we viewed only from above; but myself, and one or two more of the party, scrambled down to the bottom of the other, which must be between 250 and 300 feet, and formed a much more beautiful scene altogether than the first, both as regards the dell into which its falls, and from the greater magnitude of the stream.

The fourth day of sojourn, we visited only the bazar of Chirra, where, though there were a multitude of females assembled, there was no noise, or scolding. If these people were not so dirty, their good tempers, and freedom from prejudice of castes; their strict adherence to truth, and their honesty, would render them really valuable servants.

I wish I could persuade you to make a trip thither in September; a month which it is always desirable to avoid in the plains of Bengal.

I shall send a few geological specimens, and some curious insects, collected during our excursion.

C.

VI.—*On the Climate of Fattehpúr Sicri.*

With reference to the remarks at page 213, of the April Number of the Gleanings, I offer a statement for one year, of the monthly results of daily observations taken at 9 hours 13 minutes A. M. and 8*h.* 27*m.* P. M. (the times at which the mean temperature of the 24 hours is shown by the Leith hourly observations to occur,) compared with the monthly mean temperature obtained from the means of daily observations taken at sun-rise, and at 3 P. M. the coldest and warmest periods of the 24 hours. The observations were made at Fattehpúr, north latitude 25° 56′; east longitude 80° 45′, a place, the mean temperature of which, by many observations of deep well water, is 78°,50; further established by a series of daily observations for two years, viz. from October, 1826, to September, 1828, at sun-rise and 3 P. M. and which furnish the nearly similar result of 78°,61.—The mean pressure of the barometer, reduced to the freezing point, in the year exhibited in the subjoined table, was 29,293; and the fall of rain was inches 26,36; being about 10 inches less than the annual average. The evaporation calculated by Galbraith's Tables, agreeably to the idea suggested in Daniel's Meteorological Essays, was 97 inches.

The thermometrical dryness is 9,72; while in Calcutta, in 1829, the dryness was only 5,42, and the evaporation 125 inches. At Seringapatam, styled by Foggo "one of the driest of the habitable regions of the globe," the thermometrical dryness, in 1816, was 14.

Table, exhibiting the monthly mean temperature, taken at certain fixed hours, and the extremes of heat and cold, for one year, from October, 1828, *to September,* 1829.

Months.	Mean temperature at 9 h. 13 m. A.M.	Mean temp. at 8h. 27m. P. M.	Mean temp. by observations at sunrise at 3. P. M.	Extreme heat.	Extreme cold.
October, 1828, ...	78,94	78,38	79,15	95,5	64,5
November, ...	68,37	68,66	68,19	86	49,5
December, ...	60,69	60,38	60,91	77,5	44,5
January, 1829, ...	59,67	57,75	58,76	76,5	38,5
February, ...	66,51	62,32	63,37	82,5	41,5
March, ...	79,33	75,54	76,67	98,5	51,5
April, ...	91,65	87,51	88,58	110	65,5
May, ...	96,50	92,91	95,41	115,5	75,5
June, ...	94,32	91,21	94,51	116	78
July, ...	83,74	83,28	83,46	93,5	77,5
August, ...	83,59	82,88	83,21	92,5	77,5
September, ...	86,68	85,94	84,87	96,5	73,5
Mean and Results, ..	79,16	77,23	78,09	Ex. 116	38,5

Table of the monthly fall of rain at Fattehpúr, from 1*st October,* 1826, *to the* 30*th September,* 1830, *being a period of four complete years, in inches and decimals.*

	Oct.	Nov.	Dec.	Jan.	Feb.	March.	Apl.	May	June.	July.	Aug.	Sept.	Total.
1826-7	,39	,98	,45	,130	,00	3,22	,63	,69	,327	18,04	12,27	1,19	42,00
1827-8	,15	1,69	,45	,92	,06	,00	,04	,42	1,19	9,07	14,00	4,09	34,12
1828-9	,92	,00	,00	,57	,61	,00	,00	,25	5,15	11,05	7,53	,24	26,35
1829-30	,07	,03	,00	,00	,00	,04	,10	,15	2,95	13,31	8,16	16,44	41,28
Average	3,81	,67	,22	,70	,16	,18	,19	,38	3,85	12,87	10,49	5,49	35,94

VII.—*Notice of the Van Diemen's Land Tiger.* *By* J. Grant, *Esq.*

[Read before the Physical Class Asiatic Society.]

Through the kindness of my friend Dr. Henderson, I have the pleasure to send for the inspection of the Asiatic Society, the stuffed skin of an animal from Van Diemen's Land. It is called by the settlers the Van Diemen's Land *Tiger*, and proves very destructive to sheep. Whether it be synonimous with the creature called the Van Diemen's Land Hyena or not, I will not take it upon me to say; but the members of the Society will judge for themselves, as far as the following quotation from the last Hobart Town Almanack may enable them to do so: "Considerable numbers o the native Hyena prowl from the mountains near this, (a grazing farm belonging to a gentleman in Hobart Town,) in quest of prey among the flocks, at night. The shepherd is therefore obliged, during the lambing season, either to watch his flocks during the night, or to enclose them in a fold. One of these animals had just been caught before the party passed. It measured six feet from the snout to the tail. The skin is beautifully striped with black and white on the back, while the belly and sides are of a grey colour. Its mouth resembles that of a wolf, with huge jaws, opening almost to the ears. Its legs are short, in proportion to the body, and it has a sluggish appearance; but in running, it bounds like a kangaroo, though not with such speed. The female carries its young in a pouch, like most other quadrupeds of the country."

If the animal just described, be identical with the one now submitted to the Society, it must have been a larger individual. When the writer in the Almanack states that *his* animal measured six feet from the snout to the tail, I conclude he means, from the snout to the end of the tail. The newly killed animal too, it will be remembered, would measure longer than an ill-prepared dried specimen like this one, which measures from the snout to the end of the tail, four feet six inches. The colour of the animal is between a greyish and a tawny. The character and the head is wolfish and carnivorous, with a very deep mouth. The neck of the specimen appears longish, and unsymmetrical; but I attribute that to the mode in which it has been stuffed; and it is proper to observe, that the specimen was *presented* to Dr. Henderson—for if he had had an opportunity of preparing it himself, it would have offered, I doubt not, a very different appearance. The legs too, especially the hinder, have suffered in the preparation. Extending from about the middle of the dorsal region to the insertion of the tail, you will observe a succession of black transverse stripes, from the appearance of which, I presume, and its prowling habits, the creature has obtained its name of the V. D. Land Tiger. You will further observe, that it has got the marsupium or ventral sac, peculiar to a certain class of animals, hence termed *Marsupiata.* This part of the animal, however, on account of the imperfectness of the preparation, does not admit of satisfactory developement. It has got five clawed toes in each fore foot; hard, horny, and somewhat blunted, as if intended partly to dig or burrow. The hind feet have got four clawed toes each; the claws being rather longer and sharper than those in the fore feet. The teeth, in the specimen before us, are as follows:—Incisors $\frac{8}{6}$, small and regular, with the exception of having a worn appearance, as if they had gone through hard service. Canines $\frac{1}{1}\frac{1}{1}$, large, cheek teeth $\frac{6}{7}\frac{6}{7}$, or twenty-two teeth in each jaw. It is evident, at a glance, that the creature is neither a tiger nor a hyena, as its popular name would lead one to suppose. A reference to *Griffith's Animal Kingdom* shows, that it belongs to the family of the *Dasyuri*, which, according to Cuvier, is the fourth of the *Carnassiers;* being, says the same authority, distinguished from the *Sarigues* by having *two* incisors, and four cheek teeth less in each jaw than the latter. Thus there remain to them only *forty-two* teeth. Their tail is described as covered all over with long hair, (from which their name is derived, δασυς and οὐρος,) and it is not prehensile. In the specimen before us, the tail is covered all over with hair, but that hair is not long. The *Dasyuri*, we are further told, inhabit New Holland, and live on insects, carcasses, &c., sometimes penetrating even into the houses, where their voracity render them very unseasonable guests. Eight varieties of the *Dasyurus* are specified in *Griffith's Animal Kingdom;* and of these the specimen now before us would appear to approximate most to the dog-faced or *Dasyurus Cynocephalus*, which is described as yellowish, brown or grey, as large as a wolf or dog,—crupper marked with transverse black bands, and tail compressed. Accompanying is a faithful copy of the drawing of the dog-faced *Dasyurus*, as given in Griffith; but the epithet *cat-faced* would be much more applicable to it, I submit, if like the plate. The back stripes and the ears, however, identify it as the same animal, or at any rate a variety. The attitude, I am rather inclined to think, is fanciful. But there is another difficulty. The *Dasyurus, in Griffith's Animal Kingdom,* is stated to have cheek teeth $\frac{6}{6}\frac{6}{6}$, whereas the specimen under consideration had cheek teeth $\frac{6}{7}\frac{6}{7}$, or 12 in the upper jaw, and 14 in the lower. It is also stated in the same work, as a distinction among others, between the *Sarigues* and the *Dasyuri,* that the former have in all fifty teeth (50), and the latter only forty-two (42),—the specimen before us, however, has in all 44 teeth. Looking, then, at the difference between the shape of the head, especially in the cut of the mouth, between the animal before us, and the figure and description of the *Dasyurus Cynocephalus,* as represented and described in Griffith, is there not reason to suppose this one to be an undescribed variety? In that case, by way of convenience, and looking at its wolf-like expression, we might distinguish it as the *Dasyurus Lucocephalus.* I leave the subject, however, in good hands, and have to apologise for these hasty and inconclusive notes; but I thought, defective as they are, that they might, perhaps, excite those who are better qualified to a closer examination of the subject.

VIII.—*Some Account of a new Species of Felis. By* B. H. Hodgson, *Esq. B. C. S.*

Felis Moormensis. The Moormi Cat. Habitat Nepal. *Specific character.* Cat, with long, moderately full, uniform tail—deep bay above, paler below; ears and tip of tail, black; white chin; and face striped lengthwise with buff and black. The only specimen of this species which I have ever been able to procure, was a fine mature male, sent me alive, about 2 years back, by the Prime Minister of Nepal—with the intimation, that the animal presented to me was the first of the kind ever taken—the people of the country having been, by its capture, first apprised of its existence in Nepal. It was caught in a tree, by some hunters, in the midst of an exceedingly dense forest, situated in about the latitude of the great valley; and the *habitat* of the species may, therefore, be presumed to be the central portion of these mountains, or, that portion which lies equi-distant from the snows of the Himálaya, and the hot plains of Hindoostan. Though only just taken when it was brought to me, it bore confinement very tranquilly, and gave evident signs of a tractable disposition, and cheerful unsuspicious temper; so much so, as to convince me that a judicious attempt at taming it must succeed. None such, however, was made; and when the animal, after a 6 months' imprisonment, died of disease, he was still, of course, unreclaimed from his wild state of manners and temper; in which state he manifested considerable ferocity and high courage; the approach to his cage of the huge Bhoteah dog, exciting in him symptoms of wrath only—none of fear.

This species, in point of size, is nearly midway between the large and small cats—being as much larger than the latter, as he is smaller than the former. In its general form, proportions, and aspect, however, it is decidedly more allied to the great cats than the small ones, and indeed resembles the small ones only in the shortness of its nose, and the agreeable expression of its face.

It has a long, compressed body, with short legs, not remarkably stout; short thick neck; head of considerable breadth and depth, with flatted crown; nose

[1] *Moormi,* name of the tribe inhabiting that part of the hills in which the Cat was taken: but the animal being a stranger to their acquaintance, I cannot obtain a local name for it. It is, doubtless, new; and the name I have given it will do as well as another.

straight, short and abrupt; ears short, widely opened, and well lined within—erect, rounded, and untufted at their tips; tail long, rounded, well and uniformly haired; its tip slightly tapered.

The hind legs are considerably longer than the fore ones; and are distinguished by the true pardine length of the femora joint or member, indicating, like all other parts of the animal's form, very great agility. The jaws are very powerful, but the teeth not noticeable for superiority of size; and the front ones may even be said to be small; they are also close set, and compressed laterally, except near the extremities, where the lateral compression ceases, and an oblique truncation is observed both from without and within. The mustachios are large and very stout: the bristles above the eyes, 4 or 5 in number, and small. The expression of the face, (as already noticed,) is devoid of ferocity, and agreeable, approaching to that of the domestic cat. The whole superior parts of the animal, except the ears, and tip of the tail, and marks on the face, are of an uniform, deep, rich, brown red or bay. The ears, and tip of the tail, (above) black; and the marks on the face, pale buff, edged with black. With regard to the inferior parts, it may first be observed, that their general hue is that of the superior parts, only considerably paler: but the pectoral surface of the neck forms an exception, being as dark as the body above. The insides of the fore limbs are paler than those of the hind, being whitish buff; and they are, besides, marked with several transverse dusky bars: the paws dusky, and freckled with gray; the upper lip, pale buff, with 3 parallel rows of black dots; the lower lip and chin, white; inferior surface of the tip of the tail, the same; insides of the ears, like the inferior parts generally, but paler, or buff colour. It remains only now to describe the marks on the animal's face; and as these will probably serve, at least in part, to characterise the species, I shall set them down minutely. There are three principal marks on either side the head—one above the eye, and two behind the gape. Their general form is linear, and their general direction longitudinal; but the lines are not regular, nor their direction strictly lengthwise—the two proceeding from behind the gape, nearly to the angle of the jaws, though, in general, parallel to each other, tending to approximate behind—and the one above either eye, being rather arched above the centre of the eye. From the latter lines too, two shorter lines are put off obliquely, as they approach the opening of the ears. The central and larger portion of these marks is whitish buff; the marginal portion, all round, black. The mustachios have their basal half black, their terminal half, whitish buff; the eyes of a freckled greenish hue, like the domestic cats, and below them is a dash of whitish buff: the nose fleshy white; the nails black. Dimensions and size as follows:—

	Feet.	Inches.
Length of the body, from tip of snout to setting on of tail,	2	7½
Length of head, total,	0	6½
Nape to eyes,	0	4¼
Eyes to snout,	0	2⅜
Length of the tail,	1	7
Length of fore leg, to the line of the belly,	0	11
Ditto of hind ditto, ditto,	1	1½
Height of animal, at shoulder,	1	5
Length of the ears,	0	2½

Nepal, March 20, 1831.

IX.—*An Essay on the Game of Billiards.*

[Continued from p. 119.]

Here, perhaps, it may not be improper to introduce some remarks on the merits of an opinion, that "The angles of accidence and reflection are equal;" since it is advanced universally by the first authorities, and applied particularly by some, to the present subject, with a latitude of expression, not qualified by any exception, as might be expected when reduced to practice, if any were supposed to be; and none having been made, the fairest inference follows—an opinion that none existed. Yet (with due deference), the most simple act, by which information can be had in this case, is also the most convincing proof, that the doctrine is not only erroneous, but, that its universality is more frequently destroyed than one instance shown in playing the game, where it is not fallacious. For, let a ball be struck or driven indifferently with any thing against the cushion, at an angle less than a right one; and the lines of accidence and reflection marked: then reverse the stroke, by making the line of reflection that of accidence, and the ball will not be reflected in the other, but, in a line making the remote angle with the cushion considerably less, if not prevented by a twist. This diminution evidently takes place from the rotary motions in aid of the progressive, and if their influence be not denied, surely either such concomitants of the progressive, as are almost physically inseparable from it, ahould be mentioned abstractedly; or, admitted as giving no interruption to the universality of the doctrine, by being involved. But, to bear up the position in some measure, it may be said, Billiards (as a particular game), should be excepted; and that the doctrine will hold most completely in any other view. Is it then supported by the game of Tennis, when every Tennis-player knows how much the angle of reflection depends upon the manner of striking the ball with the racket? If Tennis will be called a particular game also, it may be asked, what game is not particular; and how many instances it will require, to unhinge the reception this doctrine has met with? Let the position be carried still farther, to any projectile, from a cannon ball, to a common bullet; if it obtains there, for what purpose are guns rifled, but, in order, by a twirling motion in a plane at right angles with the progressive, to diffuse the rotary tendency equally around, and thus correct the aberration of the ball, in its flight to the object aimed at: or if rotary motion be admitted, it is presumed similar causes will be allowed to have similar effects here also: for it is of no consequence, whether they proceed from a cue, racket, or gun-powder; the surface of a billiard-table, the floor of a tennis-court, or the barrel of a gun. Moreover, if the digression would not be thought too great, by infringing the department of metaphysics, the view might be extended from palpable, heavy substances, to air and sound; and applied there with no better success: for, how can the particles whereof they are formed, after impinging upon a surface, be supposed to float, and roll along it, if the angles of reflection, be equal to those of accidence? or, how can a whispering gallery be accounted for on a principle which precludes the possibility of conglomeration?

But the hallowed ground, upon which (it is conceived) this doctrine, when applied to light and colours, chiefly rests; although it should be approached with still more circumspection; it is hoped, will not be thought profaned, by flickerings of dark and tremulous conjecture. The co-existence, length of duration, and consimility before and after reflection, with which they are endued, and the precision their various rays display, together with the facility of making and multiplying experiments, seem to have recommended these subjects for examination, as paramount to all others in the field of nature, and fittest for the purpose of having the merits of the present question ascertained. But it appears, as if the issue, which (fostered by the greatness of a name), is now so much revered, and rules with universal sway, had its birth in a confidence—perhaps too firm, (though resulting from careful and persevering investigation thus directed,) and was thence transferred, rather by analogy than otherwise, to matters not supposed as favorably submissive to experiment: yet if the instances already brought forward, wherein it has been endeavoured to show this principle cannot hold, deserve any notice; may not the same kind of argument be used to render the position at least suspected; and negative universality made the inference from many particulars, with as much propriety, as positive from only one; and still more so, should the validity of this particular instance be at all disturbed, by hypotheses not at war with reason, or established principles?

It will be admitted, that with regard to light, no variation between the angle of accidence and reflection has been observed to take place either through the intervention of many mirrors, or any distance the eye can comprehend, after repeated trials: but it does not follow, that what has not appeared to our limited faculties can have no existence: and, if we consider the wonderful minuteness of its particles, compared with the smallest division of matter which can be distinctly presented to our senses; as also, that no two points within the same horizon are sufficiently distant to give the least idea of its progressive velocity, why may it not be projected from the luminous body with rotary motion likewise, and its momentum[1] have a similar effect upon the angle of reflection, for aught we can perceive to the contrary? But waving this, which seems to lie beyond the reach of intuition, and though some bodies at least must be allowed to have rotation antecedent to reflection, no small degree of it is acquired after, from the very act of striking against the reflecting surface; because the point of aggression being always necessarily between it and the direction of the accidental line, whatever be the form or nature of the projectile, a tendency to turn in proportion to the interval must be the consequence. How then even light, which is now the subject principally before us, can claim exemption from this law without destroying its materiality, is the difficulty submitted to be removed before received opinion should pass as proof of sterling rate, or currency be offered for its assay.

But to return. Players in their noviciate, not knowing how much the angle of reflection depends upon the manner of striking the ball; when it differs sensibly from that of accidence, are constantly finding fault with the cushion; though the charge is often more properly attributable to their own awkwardness, by not holding the cue in a line with the centre of the ball. This is a very common

[1] It has been found that the force with which bodies move, is, as their quantities of matter multiplied by their velocities; and Astronomers have proved from the eclipses of Jupiter's satellites, that light moves two millions of times faster than a cannon ball at the moment of discharge, when the least grain of sand would be intolerable to the most stubborn part of the human frame. Since then its particles, with all this velocity, make no painful impression on so delicate an organ as the eye, we are left rational means to be assured of their extreme minuteness.

failing, which a looker-on, aptly placed at a distance before the players, may clearly perceive; and if not corrected early, grows into a confirmed habit; yet its ill effects being confined to the active ball, and not materially taking place till after reflection, are therefore not preclusive even of eminence, in other executive departments of the game. All of this description (which is by far the more numerous), should invariably play back with the but-end of the cue, lateral accuracy being the less necessary on account of its breadth, as the middle of the ball must be struck by some part of it; and sudden opposition, which always promotes a tendency to twist, may be prevented by trailing. But the few, to whom a strict and timely attention has given established claim in the other class, should as uniformly play back with the point; because that power, which acts against the progressive motion, as has been already shown, and consequently makes a greater impetus necessary to drive the ball the same distance, may be prevented by a walking stroke also: and still more particularly where much force is required; for, not only the cushion may be struck with more exactness in the part designed, the eye being less detached from its object; but, the bodily frame is less shaken, and the nerves thrown into less disorder; on which account, for a little fanciful or doubtful advantage to be gained by a few strokes, it does not seem adviseable (where coolness and composure are so essentially necessary), lightly to use means that may disturb and unfit themselves for the rest of their play.

Here it may be noted likewise, the point of the cue should be always a little round; not only because it better serves the purpose of twisting, or walking; but, the middle of the ball is more truly struck, by being thus formed: for, suppose (see Fig. 12) *a*, *b*, to represent one position of the cue, where the middle is exactly opposed to it, as in the progressive; in that case, it is immaterial whether the point be round or flat; but suppose the position changed in the act of striking, to *c*, *d*; then, it appears, if the point be flat, the ball will be driven towards *e;* but if it should be round, it will be struck in an intermediate part with less aberration from that intended, and its motion be towards *f:* yet, as it is also more apt to slip from the ball, extremes should be avoided, making it at least sufficiently round, that all its parts may describe similar arches, when turned upon the bridge as a centre.

Also, a short bridge, if it admits of striking the ball with sufficient force, is preferable to a long one; this may be seen (in Fig. 13) where *b*, *c*, represent part of a cue, centrally in the line of direction, and *d*, the bridge; there the hand which forms it, is supported by the table, and steadiness only is required: but the chief difficulty rests upon the back-hand, which is without support, and at the same time, to give the impetus in the line of direction. Suppose then, in striking the ball *a*, a variation from the original position (which very few players, if any, can altogether avoid); and the cue to occupy the place of the dotted lines; it is obvious, the edge of the point would strike the ball in the middle: but if at twice the distance from the bridge, it is equally plain, the cue, without altering the angle, would vary twice as much; that is, the whole breadth of the point, and miss the ball almost entirely.

(To be continued.)

X.—*Some Account of the Chinese Caravans which annually visit Ava.*

[Communicated in a letter from Major Burney, dated Ava, 9th March, 1831.]

The Chinese traders visit Ava between the months of January and April. They come from two principal places in Yunan, in China; from T,heng-ye, which the Burmese call Mo-myen or Momien, and the Shans Menang-men, or Meng, and from Tali. Both of these places may be seen in most of our maps of China: the former, under the name sometimes of Tong-ye-chew, Chew being the Chinese term for a city of the second class. I had supposed this to be the Menang-Meng mentioned by the Chinese, who travelled overland from Siam to China in 1652, until I learnt that there is a second town of the same name, situated more to the eastward, and called Menang-Meng-Lao. But the Burmese name Momien would lead one to believe, that it is the same place as Mien, which the Tartars conquered from Ava, in 1272, as described by Marco Polo (See Marsden's edition, page 441); and the Burmese and Chinese, with whom I have conversed on the subject, admit that Momien, which is only a corruption of the Shan Menang-Meng, belonged at one time to Ava. The Caravans consist usually of 500 to 1000 men each, and are 25 days travelling from T,heng-ye to Ava, and 30 or 35 days from Tali. Their merchandize is brought in bamboo panniers on small ponies and mules, each of which has a load seldom exceeding 100 lbs. in weight. These animals are in a miserably poor condition, and they are directed on the journey by dogs, some of them of a large size, like the Kamtschatkadale species, or like the wild dog near Nipaul, described in Bishop Heber's Journal, only much larger, (Octavo edition, vol. 2d, p. 221). These dogs are emasculated, and one of them has, usually, charge of 15 Ponies or Mules, which he keeps from straying out of the road on the journey, and watches at night; on which service he has been known to attack tygers.

The Caravans put up at a village situated about 13 miles to the north of Ava, (six *taings*, and not *miles*, as Mr. Crawfurd reports in his work.) The village is named *Madé*, and inhabited by a good many Munipooreans. The Chinese put up within extensive palisaded enclosures, sending their cattle out to the country to graze. I have made repeated visits to this village, accompanied by a Chinaman who understands English and Malay, and I have been much interested and pleased. The inside of the enclosure is as full of men, merchandize, bustle and talking, as a large Junk which has just arrived from China at one of the eastern ports. Very few of the traders understand Burmese, but there is always a head man who acts like the Supracargo, or Captain of a Junk, superintends all sales, and is referred to, and apparently much respected, by the rest of the Caravan. He has under him a writer, who superintends the weighing, and keeps an account of the sales. I was surprised to see so few Burmese near the Caravans. Besides two or three collectors, with a small establishment of 10 or 15 men, there are no Burmese guards or *peons* to maintain the peace, or watch the Chinese, who are allowed to go about the country as they please.

The merchandize imported by these Caravans consists of copper, which is brought in the shape of pots and other utensils, the unwrought material being prohibited to be exported from China, coarse raw silk, *hartal*, or yellow sulphuret of arsenic, musk, and the skin of the animal which bears it; hams, honey, paper, large iron pots and pans, sweetmeats, large straw hats, fans, walnuts, chestnuts, dried and candied fruits, pears of the China kind, (being something between the apple and pear, and not very good,) and several others, what are called *chow-chow* articles.

Many of the sweetmeats and dried fruits, and among others, *leeches* are brought in small paper parcels, containing only about a viss or 3⅗ lbs. each. The hams are small but very cheap, selling this year for only 1 tical per viss, or about 8⅘ annas per *seer.* The honey is most excellent, being beautifully white and pure, and as thick as butter. I bought some of this for only 4⅕ annas per seer. The price afterwards rose, from the demand increasing. The Caravans also bring tea compressed into round cakes or balls, called by the Burmese stone tea. I observe that this kind of tea is used by the Tartars, who call it brick tea; and that the leaves are supposed to be made into these balls or cakes with the *serum* of sheep's blood. There are two kinds of tea. The one in round balls is said to be the produce of the Shan countries, and I think it coarse and bitter. The other, in round flat cakes, is the produce of China, and when you are accustomed to the peculiar flavour given to it by the mucilaginous substance, or *serum,* with which it is made into cakes, you will think it very fair tea. It sells here for only ¾ of tical per viss, or about 6½ annas per seer, and is cheaper, and I think better, than the tea brought by the Chinese Junks to the Eastern islands. The poor both in England and India would be happy to use it, but it is, at present, brought here in very limited quantities.

Opium also is imported by these Caravans. Before their arrival I had made extensive enquiries to ascertain the fact, whether this opium was really the produce of China, and I was led to believe that it was nothing more than Company's opium adulterated. No Chinaman here could give me a correct description of the Poppy plant, and I learnt that these Caravans buy Company's opium, and take it back with them. But having lately examined several of the Caravans, I am now satisfied, that the opium imported by them is really the produce and manufacture of China. They immediately recognized the capsule of a Poppy, which was shown to them, and described the process of extracting the opium. They assured me also, that the Poppy plant has been cultivated for the last 8 or 10 years at a place called Me-doo, two days' journey from Tali, but that the cultivation is limited, and carried on secretly, for if the Government of Pekin became aware of it, the cultivators would lose their lives. The quantity of opium imported by these Caravans this year, is very insignificant.

Amongst the different articles brought by these Caravans, I was most struck with some bales of coarse woollens, which had a piece of lead attached to them, with the Company's arms and manufacturer's name. The traders assured me, that this cloth had been imported at Canton; that they had given 2½ ticals a cubit for it in that part of China, whence they had come; but that here they could not get 2 ticals a cubit. I asked the owner of the cloth to give me the piece of lead, bearing the Company's arms, but he objected to its being removed from the cloth; showing, as I had before heard, that this stamp is much prized by the Chinese.

The Caravans return with hardly any thing, except cotton wool, which is taken up to Madé in large Burmese boats. In January and February these boats could not ascend the Irrawadi to within a mile or two of Madé, to a village called *Theret-mau,* where the cotton was transhipped into small canoes, 4 or 5 bales in each, and the canoes were pulled up to Madé. The cotton is brought to Madé in very large bales, from which it is taken by the Chinese traders, and packed into smaller bales, weighing about 120 to 150 lbs. and made so as to fit the backs of their mules and ponies. In the absence of cotton screws, this ingenious race compress the cotton into smaller compass by means of pits dug in the ground, over which a strong bamboo mat is laid, and the cotton and mat are then forced down together, and packed to the size required.

The Chinese trade is under the superintendence of the Queen's brother, Men-za-gyee, who finds it a very profitable department. His officers at Madé assured me, that the number of traders arrived this year, amounted to 5000, and that the value of each trader's investment does not average more than 20 ticals.

But the most extraordinary circumstance which I discovered in regard to these Chinese traders is, that almost the whole of them are Mahommedans. A few only who import hams are not; the rest are *regular* Mahommedans, refusing to eat with the Burmese, and killing their meat according to Mahommedan rites. Several of them can read a little Arabic; one man produced a religious work in that language, and read several passages to me in a loud chanting tone. They informed me, that they possess regular Mahommedan priests and temples at Tali and Pheng-ye; but they could give me no account of the time when, or the manner in which they were converted to the Mahommedan religion, observing only that this event occurred a great many years ago.

Many of the Caravans make two trips in the year; but about 10 days journey from Ava, there is another mart, to which many of these traders carry one load of cotton, and return for a second. All the traders wear a bandage of cloth round their ancles, and half way up to their knees, in order to protect their legs, they say, from thorns or other injury during their journey. The dialect spoken by these traders is not understood by the Macas or Canton Chinamen here.

I have taken great pains to explain to these traders the advantage of some of their Caravans going down to Moulmein, showing them the route, and assuring them that they would obtain much larger prices for their hams and honey, and every other description of goods, as well as much better returns, particularly money, to take back with them to China. *Pheng-ye* is close to the upper part of the Salueen, and were a British post established as high up that river, as lat. 20°, I make no doubt that some of these Caravans would be soon drawn down to Moulmein. Zen-may, which traders from Yunan annually visit in the same manner as they come here, is to the southward of 20 degrees of latitude.

Marsden, in his notes on Marco Polo, supposes that the city of Mien, conquered by the Tartars, in 1272, "must have been the old city of Ava, or some one of earlier times;" and he seems, from some coincidence of dates, to give the preference to Pagahm (pp. 448, 449.) But according to Burmese historians, old Ava was not founded until the year 1364, and Pagahm is much more than 15 day's journey from the confines of China, or province of Yunan. The Chinese traders told me, that the large dogs, which they bring down with them, are the natives of a country about 40 day's journey from T,heng-ye. These animals are, most probably, of the same breed of Thibet dogs, which Marco Polo, and Turner, in his Embassy to Thibet, notice; although certainly none of those brought here are so large as "asses." (Marco Polo, 415—419.)

Some of the Chinese traders invited me to accompany them to T,heng-ye and Tali; and I feel assured, that if a good understanding continue between the Burmese and ourselves, the plan of penetrating into China by this route of Yunan, may be adopted some day, by an enterprising European. The Chinese traders call the spot where these caravans stop, Khintoyan, from a small village near Madé, named by the Burmese Kywon-day-nen. In Sir G. Staunton's Account of Lord Macartney's Embassy to China, (vol. 2nd, p. 239, quarto edition,) it will be seen, that the tea used by the Emperor of China, and highly prized in that country, is the produce of the southern province of Yunan, made up into balls, by means of some glutinous liquid, and supposed thus better to preserve its original flavour.

XI.—*Analyses of Books.*

An Account of Steam Vessels, and of Proceedings connected with Steam Navigation in British India. By G. A. Prinsep, *Esq. Calcutta Government Press,* 1830.

[Concluded from our last.]

In our last number was given a brief abstract of Mr. G. A. Prinsep's recent publication on Indian Steam Navigation, with reservation for the present occasion, of his observations on the peculiarities of the Ganges as a navigable river.

Where a writer is not himself prolix or redundant, and where his remarks are all to the point, the difficulty of condensing them is much increased; and we know not how to choose a middle course between embodying the whole of his chapter, and contenting ourselves with a mere index of his deductions.

The characteristic features of the Ganges are fully described in Rennell's Memoir; but that great geographer seems to have been much misled as to some of the elements of its navigability; such as *average depth, slope of surface,* and *discharge.*

Thus he asserts, that " at 500 miles from the sea, the channel is 30 feet deep, *when the river is at its lowest,* and continues at least of the same depth to the sea; while no spot below Allahabad is known to be at any time fordable to an elephant." Again, he concludes from an instrumental level of 60 miles, made by order of Mr. Hastings, that the average slope of surface is 9 *inches per mile:* but the most serious error of all is in his supposition, that the quantity of water discharged by the Ganges, in the freshes, is only $4\frac{1}{2}$ times greater than during the dry weather; and that the melting of snows, or showers among the mountains, contribute so much as one-half to the annual rise[1].

The real circumstances of the mighty *Ganga* are widely different. It is strictly a tropical river, subject to alternate freshes and droughts; and with exception, perhaps, of the Delta itself, the country through which it flows is remarkable for the perfect contrast of its wet and dry seasons: from October to June, it may be said that not a drop of rain is seen; while during the remaining three months, it falls with but little intermission: the consequence is, that great inequality prevails in the bulk of the stream, and that the maximum and minimum discharge are more nearly as 100 to 1 than in the proportion quoted from Rennell. The following table shews the data from which this estimate, rude as it is, has been worked out:

River.	*Season.*	*Breadth of surface.*	*Average depth.*	*Average velocity.*	*Discharge per second.*
Ganges at Benares,	April,	1400 ft.	34,75 ft.	1410 ft.	20000 cub. ft.
	Rains,	3000	58,0	26400	1372500
Do. at Sikrigali,	April,	5000	3,0	5000	21500
	Rains,	10000	28,0	26400	1850000

For the sake of comparison, the circumstances of the great American river, are subjoined, as extracted from from Captain Hall's work.

Mississipi at Natchez,	Lowest ebb,	2400	50,0	3000	100000
	Maximum,	2700	100,0	13200	1000000

The average discharge of the Ganges throughout the year, may hence be calculated as 250000 cubic feet per second, at Benares, and 500000 at Sikrigali: which is

[1] Another error, committed by Major Rennell, not noticed by our Author, but one which has done serious harm at home, in leading to false deductions, is probably due to a mistake of the printer: he asserts, that the water of the freshes holds in suspension $\frac{1}{4}$th of its weight of silt or sand: now this must evidently mean either $\frac{1}{4}$th *per cent.* or " $\frac{1}{40}$th" that is $2\frac{1}{2}$ per cent. and the latter is the *utmost* that can be allowed.

much in excess of Rennell's estimate, and nearly on a par with the Mississipi, as derived from the data of Captain Hall and Mr. Darby. Our Author confirms this equality by the following comparison of the rain which may be supposed to fall within the range of the respective courses of the two rivers.

	Area of country above Delta.	*Annl. rain.*	*Area of Delta.*	*Annl. rain.*	*Total supply.*	*Annual expenditure by river.*	*Ratio to the supply.*
	sq. miles.	*inch.*	*sq. mi.*	*in.*	*millions c. f.*	*mill. cub. f. t.*	
Ganges,	332000	50	28000	84	59500000	15768000	26 per cent.
Mississipi,	8.86000	18	14000	60	53300.000	17344.800	32 ditto.

The river discharge is smaller in India, because of the greater absorption by the dried-up soil,—the greater heat,—and greater consequent evaporation. In the Mississipi, the bulk of water is never so disproportionate at different seasons, as in the Ganges, being only as 10 to 1; and hence the great advantages it offers to steam navigation.

The superficial profile or slope of a river forms a species of hyperbolic curve, between the rapid declivities of its source among the uplands, and its tangential dissipation in the ocean. In proportion as the supply of water increases, the curve rises in the centre, the two extremes remaining stationary: the maximum rise must be looked for about mid-course, which may be set down for the Ganges, as between Benares and Allahabad. So backward are the generality of the world in observing the ordinary phenomena of nature, that it was with difficulty Captain Prinsep could collect the following scanty materials on this interesting subject, in the Memoir on his New River Charts.

Place.	*Baro. elevation.*	*Distance from the sea.*	*Slope of the river.*	*Greatest known annual rise.*	*Rise in low season.*
	feet.	miles.	inches.	feet.	feet.
At Futtigurh,....	550	1150	?	10,0 ?	7,0 ?
Cawnpore,......	0	1070	?	15,0 ?	10,0 ?
Allahabad, ...	335	930	6	45,6	29,0
Benares, ...	270	800	5	45,0	34,0
Colgong,........	130	464	4	29,6	28,3
Jellinghee, ...	75	297	4 or less,	26,0	25,6
Commercolly and Custee, not quite certain, ...	?	250	?	22,6	22,0
Agurdeep,........	?	200	?	23,9	23,0
Calcutta, ...	10	100	1	7,0	6,7
Dacca, (by Rennell,)	?	120	?	14,0	—

There is an *apparent* anomaly hence deducible; namely, that the slope of the river in any point above the mid-course, will be less during the rains than in the dry season; which is altogether at variance with the laws of running water, but the explanation is readily found. "The bed of the Ganges, instead of having a continuous slope, consists of a series of pools separated by shallows or sand-bars, at the crossings of every reach, as would perhaps be the state of all large rivers emptied in an equal degree." Where the river has an unlimited width, these are due to the abrading force of the current of greatest velocity, in sweeping round the bend of a reach; in other places the effect may be increased by local resistance, such as is formed by the stone ghats at Benares, in front of which the stream has a depth of 52 feet at low water, whereas in the crossings of the reaches above and below, or where the whole breadth of the river has nearly equal velocity, less than 5 feet are found in the dry season[1].

The surface of the river is at that time a series of steps, or alternate deep level water, and rapid shallows; which, though they considerably impede the navigation of large craft, serve undoubtedly to keep the river open to light boats much longer than if there were none of these artificial dams; since the increase of slope remarked above, would otherwise tend to drain the whole dry in a short time.

The higher the river is ascended the more marked becomes this system of pools and sand-bars: In the Sikrigali shoals, Captain Wall, of the *Hooghly*, found 5 feet water, but near Allahabad the passage shallows to 2 feet: the steamer's progress was arrested below Mirzapoor by a shoal of 3¼ feet, stretching diagonally across the river.

Beyond Allahabad the state of the river is still more unfavourable to navigation: "Of the difficulty of passing up the Ganges in the first six miles above the Fort, the causes," Captain Smith fears, "are such, as will not warrant my holding out strong expectations of their removal: the principal obstruction is felt at the junction of the two rivers, where the large body of sand and earthy matter brought down by the current, particularly of the Ganges, is deposited near the eddies and slack water, is again suspended by the stream, as the rivers, rising and falling as they are constantly doing in different levels, alternately disturb each other, and again deposited in new situations; thus forming a shallow and continually shifting bar." In the dry season, the river meanders from bank to bank among extensive sands, cutting itself a channel, several feet deep, in what was the bottom in its swollen state; so that in such places the surface of the stream is frequently more than seven feet below the level of the deepest part of the bed in the rains!

Little can be done to improve the navigation of such places; the great perpendicular rise precludes the possibility of cutting a new course, which would require a depth of 60 feet; and the absence of superficial waters in the lower Dooab prevents the adoption of the more economical form of a lock canal. Captain Smith does not consider that steam tow boats, of small draught, could be advantageously employed; and indeed, it should be remembered, that when once the winter channel is formed, the sands alongside answer the purpose of tracking paths, and that it is only the want of water which impedes the progress of boats.

This officer has been employed in removing obstacles of a more serious nature in the Jumna: "The practicability of removing the ledges of rocks in the bed of this river, by blasting, was pointed out and acted upon by Captain Irvine, Eng. who was obliged to proceed to England, in 1826, from injury received at Bhurtpoor; the work has since been conducted by Captain Smith, and "already the rocky obstructions have been blasted and cleared for more than half the distance to Agra, including those of Kurreem Khan, where the whole channel was so interspersed with rocks, that the extreme difficulty of getting through caused sometimes a detention of weeks. This pass was opened last year; and at the same time *a dam was constructed to deepen, and give permanency to the channel*, by which the passage of boats is reported to have been facilitated in a degree *quite extraordinary*." It is worthy of attention, that although the natural rocky dam was removed, the necessity was felt of substituting another more manageable one of sand, to prevent the bed from being entirely left dry!

[1] In an abrupt angle of the Juboona, near Hoseinabad, the depth excavated by the stream, amounts to 72 feet, although in the reaches above and below, there are not more than 4 feet water.—P.

The changes of the course of the great river, since Colebrooke's Maps of 1796, have been ascertained within tolerable limits, by the reconnoitering voyage of the Hooghly: those of the Jellinghee and Bhagurutee have been accurately laid down in Captain Prinsep's River Charts, from Mr. May's recent surveys.

Above Buxar, the high-water channel does not appear to have undergone much alteration, but below that spot the character of the river changes, and its banks are composed of a softer alluvium: the following are a few of the principal aberrations within the last 30 years.

The mouth of the Surjoo, formerly 2 miles below Bullea, is now 1 mile above it, and the latter place is upon the edge of the bank. From hence the old and the new course cross one another like the interwoven coils of a double corkscrew; abandoning the banks of Chupra, encroaching upon Dinapoor, depositing a wide strip of culturable land in front of Bankipoor, and cutting away a breadth of 2 miles at Futwa.

There are certain points of intersection which remain, in a measure untouched in this oscillation of the stream, and experience seems to have pointed these out as the sites adapted for building; such are Patna, Bar, Soorujgutta, Baghulpoor: some are fixed by natural or artificial obstacles, as the rocky points of Colgong and Puthurghata, and the brick bastions of Monghir and Rajmahal.

Below Monghir the new channel deviates 4 miles to the northward, leaving a large tract of *chur*-land near Seetacoond. The island in front of Baghulpoor, has been more than half eaten away, bringing the stream to its ancient course near that town: "should it direct its force once more round the high bank thence to Souludgunj, we may again behold the formidable Colgong rocks, as in Rennell's time, and in Colebrooke's remembrance, surrounded by dry land."

At the present moment the famed pass of Peerpointee is deserted by the main river, which holds its course in the very centre of Colebrooke's island of *Dera Khoaspoor*, and a comparatively tranquil stream washes this place, dreaded by trackers, the passage to which is closed entirely during the dry months. The river, as if to compensate for deserting such a spot, is however apparently breaking its way afresh into the Terryagullee bend, under the foot of the beautiful hills which uprear their green masses to relieve the otherwise dull monotony of sand and water.

At Rajmahal, the last permanent rallying point is passed, and the river appears only to cease its corrosions of any bend of soft alluvium, and betake itself to an opposite channel, "when it has overshot the curvature proportioned to its magnitude."

The last sentence, (from the River Memoir,) alludes to a principle pointed out by Captain Prinsep, that in running water the magnitude of every elbow, or curve at a change of direction, is in direct proportion to the momentum, (or body and velocity,) of the stream. Thus it may be generally remarked, that the radius of curvature for the windings of the Ganges, when full, is about $2\frac{1}{2}$ or 3 miles; and if a mean line be drawn in the direction of its course, its meanderings may be rudely represented by semicircles of 3 miles radius on either side thereof; the whole breadth of country, therefore, liable to alternate corrosion and deposit, will be about 6 miles. The bends of the Jellinghee and Bhageeruttee have a curvature of $\frac{3}{8}$ths mile radius; those of the Matabhanga are of less than $\frac{1}{4}$th mile; while after their union in the Hooghly, the radius increases gradually to nearly $1\frac{1}{2}$ mile at Calcutta.

In the map of the Bhageeruttee may be traced a further exemplification of this principle in the gradual extension of the circle, until at last the narrow neck is cut through, and the river instantly deserts the long course round the bow, for the shorter, across the isthmus. Such occurrences are limited to small rivers; larger streams seldom passing the semicircle.

There is one advantage in a tortuous course; namely, that it diminishes the slope, and consequent expenditure of water, and also the corroding action of the stream. Were the Jellingee *rectified* by a series of cuts, it would soon become liable to the changes observed in the Bhageeruttee, and the outlet would be closed to navigation earlier than at present. The most navigable outlets, such as the Chundna, are extremely serpentine, and take off from the main river, many miles lower down than the others, which diminishes by several feet the slope of their surface.

Before closing the subject of the changes of the Ganges, we should mention the great alteration in the Burhampootur since the days of Rennell. The Jenye, then one of the minor bifurcations of the Megna, has of late years become the principal stream; while the old broad channel, immediately below its efflux, is gradually filling up, and is so shallow, that "Mr. Lamb crossed the Burhampootur, at Cuttyadee, without wetting his feet, not finding a stream any where more than a few inches deep, and which he could not clear with a jump."

The Jenye averages a mile in breadth, and has great rapidity. The tendency of this new outlet for the eastern freshes will be to accelerate the periods of inundation in the Ganges, until the latter river shall have enlarged for itself a more western outlet down the Chundna or other Sundurbun creek. "Agriculture may, perhaps, suffer; the production of indigo on low lands will become more precarious; but the navigation of both rivers, and the intercourse between them, will be greatly improved."

XII.—*Miscellaneous Notices.*

1.—*Method of spelling Oriental names; errors in the Account of Dr. Richardson's Journey to Laos, vol. II. p.* 211.

We are sorry to find, from the subjoined note, that the letter published in our 19th Number, regarding Mr. Richardson's Journey to Laos, has, in passing through our hands, been subjected to various objectionable mutilations in the names of places; owing partly to the newness of the said names to us, and the occasional illegibility of the manuscript; partly to our ignorance of the method of spelling followed by the writer. We need hardly observe, that names of places which are not familiar, should always be written with the utmost distinctness; because the sense of the passage affords no clue towards deciphering them, as with ordinary words. Indeed, in such cases, it would be a good rule to adopt the printed character, so as to render mistake impossible. The writer of the note will probably be surprised to hear, that with regard to the word *Meu-ang*, converted by us into *Men-ang*, we should again have made the same mistake, but for his illustration by the French word *peu*, so exactly like an *n* was his *u* formed. With regard to the second cause of our grievous mistakes, we submit we are as little in fault; for if the public, or rather Oriental scholars, will not agree to adopt one system of spelling eastern words and names, how is it possible there ever should be any thing like correctness. We have now, in fact, as many modes of spelling nearly as there are writers; and without knowing before hand which method the writer intends to adopt, it is of course very difficult, if not impossible, to avoid much mistakes. We think it a subject of regret that Sir William Jones' system is not universally adopted, being that adhered to by two learned societies; a circumstance which, in a matter of so little importance as the preference of one system to another, might surely be allowed to decide the question. We cannot perceive the force of the objection commonly made to it, of the uncouth appearance of the words. Oriental names, written according to any system, must appear uncouth to the European eye; but if the reader is enabled to pronounce the word correctly, this signifies little. Or if writers will have, each his own mode of spelling, they should add, either in a parenthesis, or at the foot of the page, an English or French word, in which the same combination of letters occur, the pronunciation of which shall be a key to that of the foreign word. As we have heard nothing but objections to our adoption of Sir W. Jones' system of spelling, which some of our readers inform us, make such sad havoc amongst their old familiar friends, that they can scarcely recognise them again, we feel half inclined to adopt this method; as it would prevent the possibility of mistakes by any one, yet would not interfere with the spelling preferred by each contributor. As thus, in the word in question, *Meu-ang*, (*peu* Fr.; far.) Here it is obvious the *eu* is pronounced as in the French word *peu*, and *a* in *ang*, as in the English word *far*.

"I see, in the July number of the *Gleanings of Science*, No. 19, my letter to you, regarding Mr. Richardson's visit to Laos, published. But I could have wished the Editor had allowed my orthography as to Siamese and Burmese names to stand. The *ou* of La-*boun* is like the two letters in *our*, and Labún will not represent the sound. The word is *Goung-boung* also, and not Gúng-búng. The Burmese grain is *N'hyen*, and not the odd looking word printed. The Siamese coin is *Fhoo-ang*, and not *Thouang*. The Siamese and Shan word for a town or country, is *Meu-ang*, the *eu* being more like the same letters in the French word *peu*, than any English sound. I shall have the critics upon me for the word which has been printed by mistake for country, *Menang*. When I have time, I propose to send you a map of Shan, with some observations regarding Dr. Richardson's map, in which he has made *Meu-ang*, *Leng*, *Loye*, etc. far too high, encroaching upon China, the frontiers of which have been ascertained, from actual observation, by the Jesuits. Will you kindly send these notes to the Editor of the *Gleanings*."

XIII.—*Proceedings of Societies.*

1.—Medical and Physical Society.

At the meeting of the Society, held on the 4th instant, Mr. J. Hall, Dr. D. Russell, Mr. W. Morgan, Dr. H. Mackintosh, and Mr. J. Kellie, were elected Members, and Rajah Kalikissen a Corresponding Member. The following communications were laid before the Society. A letter from Mr. Heward, of the Medical Board, at Madras, announcing his approaching departure for Europe, and expressing his best wishes for the continued prosperity and welfare of the Society; at the same time enclosing a donation of five hundred rupees, to be applied in furtherance of the general objects of the Society. The thanks of the Society were voted unanimously to Mr. Heward, and it was proposed that the amount of his present should be appropriated to the improvement of the Library. An account of Cholera, by Mr. Henderson. Dr. H. Mackenzie's Essay on the employment of Venesection in the cold stage of fevers. Mr. Galt's case of fever, terminating fatally by rupture of the heart. Dr. R. Tytler's case of snake bite. Appendix to his former report on Vaccination, by Mr. Cameron.

Mr. Hutchinson's Essay on fever was then read and discussed by the Meeting. After some prefatory observations, principally having reference to the work of Doctor Johnson on the diseases of tropical climates, Mr. Hutchinson remarks, that the ordinary causes of fever have been laid down, with sufficient accuracy, by the Medical writers of Europe. In the course of his own experience he states, as among the most prevalent, exposure to the sun at all times, but especially at unhealthy seasons; sitting in damp clothes, a too free use of cold washy fruits, a too frequent or protracted use of the cold bath, a sudden reduction of the usual mode of living, grief, mental anxiety, hard study, and more than all, exposure to an atmosphere loaded with marsh or jungle exhalations. With the exception of the Exanthematæ, he has not observed any of the diseases of this country to be of an infectious nature. He considers Malaria under two distinct points of view—first, as a noxious principle disengaged in the decomposition of animal and vegetable substances, and held in solution or suspension by water or atmospheric air, and by its action on the human frame, under circumstances favourable for the developement of its powers, producing local or endemic diseases: and, secondly, as the same principle disengaged by grand atmospherical changes, producing extensive Epidemic disorders. Of the insalubrity of surrounding vegetation, Mr. Hutchinson feels perfectly satisfied. Shrubberies about houses, are also objectionable. The circulation of air is interrupted by their branches; the surface of the ground is kept wet; to add to their beauty and luxuriance, their leaves drop and become decomposed, while on the tree they perpetually attract moisture and vapour, and perhaps evolve a principle detrimental to animal life. Mr. Hutchinson gave an original theory of the constitution of the atmosphere, which our limits will not admit of our more particularly referring to. Indeed, from the length of the paper, it is impossible for us to give even an abstract of it. How is the spread of Epidemic diseases to be accounted for? That there is an essential difference in the constitution of the atmosphere of this country from that of our own, Mr. Hutchinson expresses himself satisfied of. It may not be improbable, he supposes, that its state is modified in every different situation on the surface of the globe. In what this difference consists in, he confesses himself unable to explain. Perhaps it is a better conductor of caloric, than in more northern latitudes, or possesses a greater capacity for latent caloric, and consequently for retaining moisture and malaria in solution. 'But be the cause what it may, every one who has attended to the subject will confess, that we feel the cold of winter more intensely in this country than the state of the thermometer would seem to warrant. Thus with the thermometer at 65° in this country, we shall feel the cold as intensely as we should at 35° in England. Now this cannot depend entirely on our own feelings, for it is proverbial that Indians who return home, are particularly insensible to cold for some years after their arrival. This and other circumstances mentioned in the paper would seem, Mr. H. thinks, to indicate a power in the atmosphere of this country, of removing animal and vegetable heat, to which we have nothing similar in England, and he appears disposed to connect it with a peculiarity in its electrical constitution. He divides the Endemic of Bengal into three distinct varieties, viz. simple, idiopathic, and ardent fever; the same disease complicated with local inflammation, and the congestive or jungle fever. Into the details of the morbid phenomena of these, as well as of the treatment, we cannot enter here. The majority of fevers in this country are, he conceives, produced by Malaria, and the severity of the symptoms will generally be in proportion to the activity or concentration of the poison to which the patient has been exposed. He strongly condemns the large and indiscriminate use of calomel.

2.—Asiatic Society.—Physical Class.

At a meeting held on Wednesday, the 8th June, G. Swinton Esq. in the Chair.—

1. A series of Geological specimens of the rocks in the Tennasserim Archipelago, were presented in the name of Lieutenant R. Lloyd, H. C. N.

2. Also specimens of vegetable impressions in the coal and shale of Raniganj;—transmitted by the Reverend R. Everest.

3. A sample of the petrefied wood of Van Diemen's Land was received, with a note in explanation, from Dr. J. Henderson.

4. A report from Dr. Strong announced, that the borer in the Fort had attained an additional depth of five feet since the last meeting, in all one hundred and sixty-five feet, and was still at work in a soft sandy clay.

5. A paper was then read *on the Sandstone of India*, by the Reverend R. Everest[1]."

6. A notice by Captain Herbert was read, *on the Himmalayan Fossil Remains*, explaining, in general terms, the structure of that great mountainous range, and the circumstances of the discoveries in Fossil Mineralogy made therein during the last few years.

Meteorological Register kept at the Surveyor General's Office, Calcutta, for the Month of June, 1831.

Day of the Month.	Minimum Temperature observed at Sunrise.					Maximum Pressure observed at 9h. 40m.					Observations made at apparent Noon.					Max. Temp. and Dep. of M.B.Ther. obs. at 2h. 50m.					Minimum Pressure observed at 4h. 0m.					Observations made at Sunset.					Rain-gauge No. 1.	Rain-gauge No. 2.
	Barometer reduced to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.		
1	29,474	83,	1,9	s. e.	cu.	,507	93,	9,6	n. e.	cu.	,460	97,	1,3	s. e.	cu.	,408	98,5	14,6	s. e.	cu.	,402	96,8	13,4	s. e.	cu.	,394	90,	7,6	s. e.	ci.		
2	,448	83,5	2,1	s. w.	do.	,494	94,5	9,1	s. w.	do.	,410	99,3	13,9	s. w.	do.	,410	98,3	12,4	s. w.	do.	,384	96,7	12,5	s. w.	ci.	,431	89,	7,1	s. w.	do.		
3	,473	83,3	1,2	do.	do.	,504	96,7	12,9	do.	do.	,475	98,3	12,9	do.	do.	,390	98,2	11,8	do.	do.	,385	97,4	10,5	do.	cu.	,404	89,5	7,1	do.	cn.		
4	,501	82,5	2,1	n. e.	do.	,539	90,	6,1	n. e.	do.	,512	93,7	9,3	n. e.	do.	,451	97,	10,8	s. e.	do.	,437	95,6	10,2	s. c.	do.	,443	88,5	8,1	s. e.	do.		
5	,512	83,7	1,3	s. w.	do.	,534	81,	2,1	s. w.	n.	,542	83,7	2,6	s. w.	cis.	,461	89,	4,8	s. w.	cis.	,440	89,	5,6	s. w.	cis.	,452	86,	3,1	s. w.	cis.		
6	,506	80,	1,3	n. e.	do.	,526	89,5	7,1	n. e.	cu.	,493	92,3	9,1	n. e.	ci.	,442	95,5	10,4	n. e.	cu.	,427	95,5	9,8	n. c.	ci.	,449	86,8	3,4	n. e.	ci.		
7	,519	82,3	0,4	do.	cis.	,564	90,5	6,3	do.	ci.	,535	94,5	9,5	cm.	cu.	,472	96,	11,1	do.	cus.	,456	94,7	11,3	do.	cus.	,539	79,7	1,3	s. w.	n.		
8	,539	82,	1,6	cm.	cus.	,592	90,8	6,4	cm.	cus.	,539	92,5	9,8	s. w.	cus.	,499	84,5	13,8	s. w.	do.	,469	84,5	3,1	s. w.	cis.	,488	84,5	2,1	cm	cis.	0,35	0,30
9	,520	80,3	0,9	do.	rn.	,565	76,8	2,4	do.	rn.	,530	79,	1,6	s. e.	n.	,460	83,6	12,9	n.	do.	,449	85,	4,3	cm.	do.	,469	82,5	1,4	do.	do.		
10	,511	80,5	1,1	n. e.	cn.	,554	87,8	5,1	n. e.	cu.	,529	88,8	5,9	cm.	cus.	,504	85,5	13,9	n. e.	n.	,504	82,5	1,8	do.	n.	,501	82,	1,6	do.	cy.	2,00	1,88
11	,521	81,8	1,4	s.	cus.	,565	85,	3,6	s.	do.	,541	88,3	4,2	s.	cis.	,538	85,6	4,4	s.	cis.	,540	84,3	3,9	s.	cis.	,545	83,	2,6	do.	ci.		
12	,568	81,5	1,1	cm.	do.	,580	88,3	4,9	s. e.	do.	,542	91,	6,6	s. e.	cu.	,479	95,	9,1	s. e.	cu.	,491	87,	5,3	s. e.	n.	,530	86,5	2,6	s. e.	cus.		
13	,603	78,	1,6	do.	rn.	,641	79,5	1,1	cm.	n.	,618	82,8	1,9	e.	cy.	,540	88,8	3,9	do.	cus.	,529	89,8	4,9	do.	cu.	,554	76,7	2,3	n.w.	n.	2,88	2,57
14	,574	79,7	1,3	do.	cu.	,602	78,	1,6	do.	rn.	,585	80,5	2,1	cm.	cus.	,506	86,8	3,1	do.	cis.	,501	81,3	1,9	do.	n.	,505	78,7	2,	s. e.	do.	3,05	2,75
15	,479	80,5	1,1	s. w.	cis.	,530	86,3	4,1	s. w.	cis.	,496	90,8	7,1	s.w.	cu.	,440	93,6	8,7	s. w.	do.	,441	91,3	5,9	s. w.	do.	,456	85,3	3,2	w.	cy.		
16	,487	83,	1,4	n.w.	do.	,520	91,3	6,2	n.w.	do.	,492	92,	7,3	n.w.	ci.	,427	92,3	7,2	cm.	do.	,401	91,8	7,4	cm.	cis.	,419	87,8	4,4	cm.	cis.		
17	,486	81,5	2,1	w.	cu.	,518	88,3	5,6	w.	cu.	,490	92,3	7,9	cm.	cu.	,435	87,	3,6	s. w.	n.	,441	82,5	3,1	do.	rn.							
18	,468	81,7	1,3	cm.	cy.	,515	87,8	5,7	n.w.	do.	,479	90,5	5,8	do.	do.	,422	90,2	5,3	cm.	cus.	,405	87,	4,1	s. w.	n.							
19	,487	80,5	1,1	s. w.	cn.	,510	84,	3,6	s. w.	n.	,489	97,	4,6	s. w	cy.	,426	88,5	6,1	s. w.	do.	,389	87,5	4,8	do.	cus.	,431	85,	3,3	do.	cy.	2,85	2,80
20	,462	79,5	1,	cm.	cy.	,472	81,8	1,9	cm.	cy.	,408	85,8	4,4	n.w.	cus.	,365	87,3	4,8	n.w.	cn.	,346	87,	4,3	n.w.	do.	,427	77,3	1,9	s. w.	do.	0,88	0,50
21						,459	80,3	0,9	do.	rn.	,454	80,9	1,5	cm.	rn.	,402	83,5	2,3	s. e.	cus.	,404	84,5	2,3	s.	do.	,374	84,5	2,8	n.w.	cus.	2,00	1,48
22						,603	81,5	1,6	s. e.	n.	,577	82,8	1,1	s. e.	cy.	,529	85,6	3,9	do.	cis.	,506	85,6	3,2	s. e.	do.							
23	,593	81,5	1,6	s. e.	cu.	,608	85,5	3,8	do.	cu.	,585	89,3	5,9	do.	cus.	,532	87,8	2,9	do.	cus.	,522	86,8	3,9	do.	cy.	,511	83,7	3,3	s. e.	do.		
24	,521	80,	1,1	do.	cus.	,567	82,3	1,9	do.	cus.	,523	83,7	2,8	do.	do.	,484	84,5	3,4	do.	do.	,485	83,7	2,8	do.	cus.	,534	78,5	2,1	do.	rn.		
25	,455	80,5	2,1	s. w.	cy.	,503	82,7	4,	s. w.	cy.	,475	83,3	1,9	cm.	cis.	,446	78,7	2,3	cm.	rn.	,448	79,7	1,3	cm.	n.	,491	83,7	2,8	do.	cus.	0,60	0,50
26	,509	79,5	0,6	s. e.	rn.	,534	83,	0,6	s. e.	do.	,489	82,6	1,2	s. e.	n.	,464	80,7	1,3	s. e.	do.	,464	80,5	0,4	s. e.	do.	,478	78,3	1,9	cm.	cy.	0,40	0,30
27	,538	81,	1,6	s. w.	do.	,568	80,9	1,	s. w.	rn.	,552	82,2	2,5	s. w.	cus.	,495	83,9	3,5	s. w.	cus.	,490	84,5	3,6	s. w.	cis.	,467	80,3	0,9	do.	cis.	1,70	1,50
28	,557	81,5	1,2	s. e.	cis.	,554	84,8	3,9	s. e.	cis.	,544	87,7	5,6	s. e.	ci.	,483	88,3	5,6	s. e.	ci.	,473	87,3	4,6	s. e.	do.	,514	82,	1,2	s. w.	do.	1,25	1,10
29						,601	88,3	4,9	s. w.	cu.	,531	89,5	7,5	s. w.	do.	,501	86,9	5,2	s. w.	cis.	,490	86,3	5,2	s. w.	do.	,486	84,5	4,1	s. e.	cus.	0,35	0,30
30	,599	83,5	1,6	cm.	cu.	,601	87,	4,1	do.	cus.	,578	84,3	2,6	do.	n.	,572	81,5	2,6	cm.	n.	,557	81,7	1,8	cm.	cy.	,504	85,	4,1	s. w.	cis.	0,70	0,65
Mean,	29,515	81,3	1,4			,548	85,9	4,4			,516	88,2	5,7			,466	88,8	6,8			,456	87,6	5,2			,474	83,7	3,3			1901	1663

Abbreviations. In the column "wind," small letters have been used instead of capitals; *cm.* means *calm*. In the column "Aspect of the sky," *cy.* is *cloudy*; *cl. clear*; *rn. rain*; *ci. cirrus*; *cu. cumulus*; *cs. cirro-stratus*; *cus. cumulo-stratus*; *cc. cirro-cumulus*; *n. nimbus*. The Rain-gauge No. 1, is on the ground. No. 2, is on the roof of the house, 45 feet above it.

GLEANINGS

IN

SCIENCE.

No. 31.—*July,* 1831.

1.—*Of the Influence of Capital in Manufactures.*

I have first directed attention to the effects of Capital in increasing the disposable volume, of that primary description of wealth, on which the whole income of the society ultimately depends; and it must be obvious, from a reference to the reasonings contained in the section, which shows the entire dependence of the secondary, on this primary description of wealth, that capital, in its application to manufactures, cannot alter the nature of the connection between the former and the latter.

Let us suppose accumulations to be appropriated, in the first instance, in assisting in the division of labour in manufactures. Those who advanced capital with this object in view, would be enriched by the difference in the cost of feeding the greater number of labourers which was required, when the workmen were not in mutual cooperation, and when they were not exclusively engaged in one particular process in the production of a certain quantity of wares; and the smaller expenditure now necessary, when mutual cooperation and exclusive employment in one business, have been introduced, and have brought with them superior skill and knowledge. We may readily imagine how such effects in production may be brought about, by the mere appropriation of capital to the provision, in a suitable situation, of food equal to the labourers' consumption while employed.

But producing the same quantity of wares as before, and obtaining the former price for them, does not enable the capitalist to realize the greatest possible aggregate sum of profits, although it may enable him to obtain the greatest gain on each individual article sold. We have already marked the causes which determine manufacturers in bringing specific quantities of their goods to market before capital is employed; we must see whether the same causes are in operation, now that production has been preceded by the accumulation and appropriation of capital.

If while manufacturers worked individually, and without concert and cooperation, the demand for wrought wares was such, that 500 articles were brought to market, and given in exchange for 5000 measures of corn; and if, at this time, the production of 550 articles sunk the price of each to 7 measures; or if the reduction of the supply to 300 articles should raise price only to 11 measures, there being in the society, only persons sufficient to take off this quantity at this price; it is evident, that as society then stood, there could be realized, in this business, only

5000 measures of corn for the support of manufacturers; and this under the supposition that the raw material cost nothing.

Let us now suppose a capitalist to take on himself the preparation of these wares, and that, with concert and cooperation, the same quantity of work can be effected by a much smaller number of persons than before; say his outlay in feeding workmen is equal to 4000 measures of corn, and that he supplies the whole produce consumed; his profit on this speculation is therefore 1000 measures, if he continues to bring only the some quantity of goods to market as before, and to sell the articles at the same price. But his desire to increase his gain will induce him to lower the price of his goods, and to employ more workmen; and to sink more capital in production. There were only in the society, persons capable of purchasing 500 of these wares at their former price; but as he increases the supply, and lowers the price, there will necessarily be found many more purchasers. What then will guide him in bringing a specific quantity, and no more or less, to market? By keeping the supply at 500, he gets, on each individual article sold, a higher gain; and yet he will be found to increase the supply, although the inevitable condition of his obtaining a demand for this greater supply is his lowering the price, or getting a less gain on each individual article sold: his increasing aggregate gain must, therefore, be what guides him in so doing: he must find, that a greater aggregate profit than 1000 measures is obtained, when he sinks more than 4000 measures in this employment. If he sinks 4500 measures in production, and makes therewith 675 articles, and sells each at 8¼ measures, his profit on the transaction, will be 1068¾ measures: and this fall in the price will be evidently to his advantage; the gain, on the greater number of sales, being more than sufficient to cover the loss, incident on the sale of each article. His rate of profits, when he furnished the wrought wares through the means of a capital of 4000 measures, was 25 per cent; when he sinks 4500 measures in production, his rate of profit has sunk to about 22½ per cent: this change in the rate will not, however, any more than the fall in the price, tend to his impoverishment; it will accompany his enrichment. Should he, thus encouraged, proceed in increasing his productive capital, say to 5000 measures, and bring to market 750 articles; and then find a sale for this number, only when the price falls to 7 measures of corn; he will have brought too many products to market; and realize, on the whole of sales, an aggregate profit of only 250 measures; his rate of profits will then have sunk to 5 per cent. But we cannot imagine that he will persevere in this course; it is impossible that he should; this extent of supply cannot, therefore, become permanent, nor can this be the permanent rate of profits in this trade.

After prices have settled down to the point at which they must be permanent, if the capitalist should, by the introduction of better tools, or machinery, effect another saving in productive outlay, his rate of profits will again be increased; as will also be his profits in the aggregate; and he will find himself again in such circumstances, as to be again enriched by another reduction of price, so long as the loss on each article sold, is more than compensated by the extension of the market for his wares.

In the above, I have supposed the existence, in one particular trade, of but one capitalist: I have been, therefore, studying the rules by which a monopolist would be guided in determining outlay, and permitting a fall of price. But in so doing, I have, at the same time, been pointing out the laws which would determine the price of wares, and the extent of supply, if these wares were produced by hundreds of competitors; for whether we suppose the capital of 4500 measures to be employed by one, seeking to enrich himself; or the capital to be 450,000 of measures, and employed by 1000 capitalists aiming at the same object, the same motives must influence alike, the one or the thousand: if, under the existing circumstances of the society, there can be a demand for only a certain number of articles at any particular price, which I believe to be satisfactorily shown, and if a falling below, or increase beyond this quantity, brings impoverishment on those engaged in their production; it follows, inevitably, that monopolists and free traders have the same interest exactly, in supplying markets.

It is not, therefore, owing entirely, as has been generally supposed, to the influence of competition in trade, that prices fall: this event would take place, it appears, although perhaps more slowly, if competition were not known; and it is not the case, as we have been frequently assured, that when the lowest permanent, or as it is termed, the necessary price, is obtained, the manufacturers are in worse circumstances than when prices are higher. And we find, further, that the word monopoly has been, in a great measure, a bugbear; for believing in its influence, to the extent generally done, is believing that men prefer great prices to great gains; which it is impossible they ever should have done. One chest of tea, and one chest only in the English market, would sell for a higher price than if thousands of similar chests were to be met with. If obtaining high price alone were a monopolist's object, why should more than one chest be imported annually by the East India Company? and if obtaining high price be not the object of monopolists, what then, I ask, is their object? The answer must be, the largest aggregate gain. It is very true, that a limited number of individuals in a distant quarter perhaps, cannot bring products to market at so cheap a rate, as separate individuals, eagerly endeavouring, on the spot, to lower the cost of their wares; and that an exclusive management may be incapable of so conducting trade, in all its details, as to meet the whole contingent demand which might, but from this incapacity, spring into existence. The removal then of monopoly and restrictions, might tend materially to national enrichment; not however by inspiring with another principle of action, those who supply the market; but by tending to a reduction in the cost of production; to a consequent diminution of price, and to an extension of demand and consumption; by which not only greater gains would be made by the trading class, but a greater enjoyment insured to the greater number of individuals, within whose reach the product is brought, in consequence of a fall of price.

With every fall in the price of any article in actual demand in society, the society is inevitably enriched, and this not virtually but in reality; for all consumers of cheapened articles, besides being able to supply themselves as formerly, must now be possessed of a disposable fund equal to the difference between the present and the former price; and as all inevitably expend their whole income, either productively or unproductively, (mere hoarding being out of the question,) there must, after such an occurrence, be called into existence a new and effective demand for some other wares, if not for a larger quantity; or better description of those wares which have been cheapened; man's desire for wrought wares is, we know, limited only by the want of means to procure them:—lowering the price of wares is an increase of these means; for the revenue of the society consists, originally, of the products periodically given off by the influence of the living principle in food; and subsequently of these, together with the wrought products of labour and capital, which are, to the ultimate possessors, much more desirable than the food offered by them in exchange. If then the command of these more desirable products be increased, the real wealth of the society has been increased. Let us keep in mind that important reproductive power in which the income of society has its origin, and the probable readiness with which individuals will deprive themselves of a portion of the results of this power, or increase their own exertions that may obtain useful wrought goods, when these are brought nearly within their reach; and we may understand, how an increased quantity of food may come into the market for the support of an increased number of manufacturing labourers, whenever, by a fall in price, the useful products in preparing which they are engaged, are brought so low, that a slightly increased exertion, together with forbearance and care on the part of the lower and most numerous orders, suffices to secure them the new and greater enjoyment the cheapened manufactures secure: what was formerly wasted or neglected, when it was manifest that nothing more desirable could be had in exchange, may now be husbanded with frugality and care, when useful articles seek only, as an equivalent, little beyond what had before been considered as of trifling or no account; and thus the cheapening of the wares made use of by the poor, may work a change, from slothful and careless to frugal habits, of vast importance in increasing the wealth of the society; and may ultimately render that result of the reproductive principle, which was sufficient only to the precarious support of a family of savages, equal, through the means, perhaps, of those very utensils which have been cheapened, and through the management and frugality induced, possibly, by the very articles, to the comfortable maintenance of equal numbers as before, and to the support, besides, of those by whom the wrought articles are prepared. Besides, therefore, the new demand for wrought wares, proceeding from the disposable income of those who now have less to pay for the commodities which have been cheapened, we see the rudiments of further demand for the produce of new manufacturers, after the introduction of any important improvement in manufactures.

When capitalists are found no longer to add to their productive capital, we may rest assured, that they then divide amongst themselves, a greater aggregate amount of profits than they ever enjoyed before; or than they can obtain, with any other amount of capital, than that which is actually in use; and that consumers have been enriched by the greater command than formerly which is now enjoyed of manufactured goods. Nor are we to apprehend, as a permanent consequence of the introduction of capital into manufactures, and of the employment of more efficient tools and machines, any diminution in the demand for labourers; because, although less labour is required in producing the same quantity of wares as before; yet a new demand, to the extent of the income now disposable, has been inevitable, on a reduction of price, for a larger quantity of the same, or some other wares; and to this, we are to add the new demand for such additional produce of manufactures, as those can now offer, to whom, before the reduction of price, the use of wrought goods was debarred, as requiring, before it could be enjoyed, the sacrifice of too great a proportion of their pittance of food.

Although it is quite impossible, beforehand, to speak with any thing like certainty, as to the ultimate consequences of the introduction of any quantity of capital, or of any particular description of tools and machinery into manufactures; still, from the above considerations, it appears obvious, that any improvement in the arts, affecting commodities in general use, however slight it may be, will tend not only to the enrichment of capitalists and consumers, but to the distribution among labourers also, of as large, and possibly a larger aggregate of wages, than could ever have been expended amongst them under former circumstances. It is too true that misery must, for the time, be the lot of many workmen, on their being necessitated to change their habits and their trades; and that this suffering must be extensive and severe, in proportion to the suddenness and extent of the changes introduced in productive processes. But even these sudden changes carry their own palliative along with them; for the more rapidly improvements are introduced, the more speedily will prices be lowered, and ultimate demand extended: at the worst, this state of suffering can only be temporary; and the increasing permanent welfare of the whole society, must infinitely outweigh the passing sufferings of the few.

Although the introduction of capital, and improved processes in manufactures, tend to national enrichment, by permanently lowering the price of wrought goods, this is not the effect of the introduction of similar processes into agriculture; in the cultivation of the soil, these improvements only permit a similar progressive increase of population and wealth, to what takes place in underpeopled and fertile countries, in place of causing a permanent fall of price: for if we suppose capital to be hurried on the land, on the occurrence of an improved agricultural process, as we have supposed capital to be hurried to manufactures, the impoverishment of agriculturalists would be inevitable.—We have seen, that what counterbalances the effects of falls in the price of each wrought article sold, is that greater extension of demand, which insures a greater aggregate gain than is obtainable when price is high, and demand more limited; and this is so, because no limit can be assigned to each man's consumption of useful wrought wares. As we increase the disposable income of each, or enable him to obtain more wrought wares for a less consideration; we only bring within his reach goods superior in quality, or quantity, to those he could obtain before. The case is very different with regard to food, the produce of agriculture; the demand for this being, of necessity, limited to the consumption actually effected by the existing numbers of mankind, which consumption remains nearly the same under all circumstances. What brought the increasing quantity of wrought goods to market, was the certainty that manufacturers were thereby enriching themselves; whereas the certainty that agriculturalists would impoverish themselves, by suddenly increasing the quantity of food, would effectually keep down the supply to the wants of the existing population; and would prevent capital being applied to the land, except gradually, and as population increased. If we allow, that demand for food could not increase, while the same population only was to be fed; we must grant, that a fall in the price of food could not be accompanied by that extension of demand, which more than counterbalanced in the aggregate, the loss on the sale of each specific quantity of the article sold; and if we allow, that the existing population had previously brought to market, such quantity of wrought goods as they found most conducive to their interests, and which was equivalent, in the estimation of both parties, to the quantity of food offered in exchange; we must grant, that producing a greater quantity of food, would only reduce agriculturalists to the necessity of offering, in exchange, for any given quantity of wrought goods, a larger quantity of food, than they could have obtained the same wares for before.—Food, being the primary item of wealth, forms the basis on which the whole superstructure of enrichment rests; the population, the wealth, and the revenue, suddenly alters its quantity, and the economy of the whole system is at once deranged. In the reasonings in the opening of this chapter, I have calculated on an extension of cultivation as following the introduction of capital and improvements into agriculture: this extension must, however, be understood to accompany the progress of population, precisely as those extensions of cultivation did, which were supposed to lead society to that point in enrichment, at which we took it up, when a new progress was opened to it, by the introduction of capital. If wealth and population had then made an approximation to the limit to production and increase, which the physical circumstances of the country, together with the knowledge of productive arts defined; the improvement in productive arts which we contemplated, must virtually have removed the barriers by which they were opposed; and must have permitted a second progression of enrichment, and of population.

If the difficulty of obtaining food sufficient for an increasing population, be the cause of the progress of that population being repressed; the direct labour, requisite to obtaining an increased quantity of food, must, in ordinary circumstances in a well peopled country, be nearly so great, as to exceed the power of those to bestow, who wish to obtain it by their own labour, unaided by capital; a quantity of food, equal to a man's consumption, must, therefore, be equal, in the estimation of labourers, to what equal labour would produce in any other business; and if agricultural capitalists can command the produce of so much labour for every such measure of corn as suffices for man's support, it is self-evident that they can feel little interest in sinking capital, and superintending its outlay in producing more food than the quantity already obtained, merely that they may give more of their food for an equal quantity of wrought produce; while the former quantity must, in the estimation of the manufacturing class, have been an equivalent for their wares; nor will they find it more to their interest to sink an additional capital, for the mere support of a greater number of agricultural labourers than are essential to insuring them the command they seek of manufactured goods, and of providing for the wants of their own increasing numbers. In the interval, then, between the commencement of a new career of enrichment, and the subsequent approximation to the limits, which the nature and extent of the country, and the state of productive arts, prescribe, although the difficulty of obtaining more food, with the aid of capital, be not so great as to exceed the strength of those willing to labour in its production, yet this cannot render food more cheap, or of more easy acquisition than before, to the mere labourer; because the capital necessary for aiding in this purpose, cannot be obtained by the needy who desire so to employ it, unless the capitalist be enriched at the same time; and the labour required to raise food without the aid of capital is, as it was before, so great, as to serve as a check to the increase of such a population, as have only their labour to offer. The price of food, then, must be nearly permanent; and the quantity, necessary for a man's support, must always command, in the market, whatever products his labour would produce elsewhere, during the time the food yields him support.

But although there cannot be a fall of price in food of any consequence, there will probably, with the progress of agricultural science, be some slight reduction; agricultural capitalists will be necessarily more willing to part with food, when its quantity is more readily than before, susceptible of increase; the manufacturing population will feel the beneficial influence of this disposition, and will consequently increase in numbers, and enlarge also the number and nature of their products more rapidly, than the mere increase of population and demand would lead us to expect; and this reacting on those with whom it rests to increase cultivation, and who are only otherwise interested in extending cultivation, to provide for their own increasing number, the progress of agriculture will also proceed in a ratio accelerated on these accounts; agriculture and manufacturers, acting, alternately, as cause and effect, one upon the other; till again the greatest extension of cultivation has been effected, which is compatible with the greatest enrichment and increase of the class of agricultural, and with them, of manufacturing capitalists.

It may be objected to the theory of profits which I would establish, that men cannot know, exactly, when profits have sunk to that rate, beyond which their further fall brings impoverishment to individuals, and consequent reduction of the aggregate amount of profits realized in the whole society; that many producers, who had not been able, or willing, to increase their outlay, on the introduction of improved processes in production, must, after the rise had taken place in the rate of profits, have known nothing but increasing impoverishment with every subsequent fall in their rate; and that the desire of each to render his new accumulations as productive of revenue as his former accumulations had become, by similar employment, would tempt men still to thrust capital into production, till profits sunk to a very low rate. But it will be remembered, that the sinking of more than a certain amount of capital in manufactures, tends to an immediate reduction of the selling price in all commodities in the market, to the preparation of which this excess of capital had been applied; more than a certain quantity of wares not finding a vent, without the occurrence of such a reduction of price as prevails during the existence of a glut. It matters not then to general production, whether certain individuals have failed to take advantage of the opportunity, when it existed, of increasing their productive capital, and with it their gains; and it affects it as little, if, owing to the perseverance and large disposable capital of some, who continue, in despite of glutted markets and loss, to sink their growing accumulations in production, it should so happen, that their less wealthy competitors were, eventually, forced to give place, and to be supplanted in the market by the more substantial; the struggle could only be temporary; and the quantity of capital actually found yielding an income, in any branch of business, would be found the same in the end, as if no such struggle had taken place; provided no real reduction of the cost of production had been effected, which however is highly probable, in consequence of this competition.

There is less likelihood in agriculture than in manufactures, that overtrading should take place; the source of reproduction and increase being more immediately under the eye of the agricultural capitalist, his dependence on its cooperation is more evident. If, however, an excess of capital should be forced into employment, we have seen, that by such a proceeding, the capitalist only brings upon himself, at first, unrequited trouble and risk; and ultimately absolute impoverishment, if he should persevere to such an extent, as left the land incapable of feeding the number of labourers, and repaying, with an increased aggregate of profit, the whole increase of capital sunk upon it.

It may be as well, at this place, farther to advert to the false notions regarding that of which products are the result, which are engendered by the use of the terms "accumulated labour," or "labour in the last resort," in place of the term capital. In Mr. Malthus's work on Definitions in Political Economy, page 242, we find him stating, that the conditions of the supply of products are the advance of the accumulated, and immediate labour expended in their production, with the profits, superadded, of those whose advances are instrumental in effecting the production. Now this certainly conveys the idea, that products are the result of labour alone, some of which is directly, and some indirectly, applied; and that when a capitalist comes between labourers and the consumers of products resulting from labour, there shall be an extra charge laid upon the commodity, to make good his profits; or if we take the view of the case given by Adam Smith[1], we may suppose, that on this occasion, a deduction is made by the capitalist, to form his profits, of a part of the wages of labour; and that the consumer goes free: understand this, however, as we will, it is quite clear, that a wrong notion is created by the employment of such terms; and that no clear

[1] See his chapter on the Component Parts of Price.

idea is given of how capital acts in production; its distinctive property, that of only being brought into operation, when a saving is thereby effected in expenditure, is kept completely out of sight; and the circumstance also is unnoticed, that by the influence of labour alone, how greatly soever accumulated, and applied at different times, it would be utterly impossible to obtain similar results to those which capital yields.

If, as I conceive, there can be no employment of capital, except in cases where the amount of producing labour can be diminished, in a degree, at least, equal to the amount of the profits; then it appears, that in no case should we be justified in supposing, that the cost of a product can have an addition for profits tacked to it; nor can it be necessary that a reduction, equal to profits, should be made from the workmen. When a capitalist sinks his accumulations in production, the cost to consumers may not, in the first instance, be reduced; although to the productive capitalist it must be lessened: but if the saving, effected through the means of capital, be any thing considerable, the consumers will ultimately obtain the products on more easy terms, for the reasons already adduced, where I account for falls of price in wrought wares.

Capital being that portion of wealth which is devoted to facilitating and increasing production, the motive for its accumulation will exist in its fullest force, when, through some recent improvement, a saving has been effected in productive outlay; and when, in consequence, such a change has been brought about in the relations of outlay and net return, as indicates the possibility of increasing the capitalist's income, with increases of his productive outlay. With the progress of accumulation and employment to capital, the power of investing fresh accumulations will gradually be diminished; and the net proceeds, resulting from the employment of any specific quantity, will be gradually becoming less; while, at the same time, the power of making accumulations will be becoming greater, on account of the increasing richness of the class of capitalists; and this difficulty of finding new investments for capital, together with this falling rate of profits, will regularly proceed, till all openings for the employment of new accumulations have been filled; and this will have been effected, when capitalists find it impossible any longer to increase their share of the increasing national income. The enrichment consequent on the improvement in production, will now have become complete; and no further addition can now be made to the productive capital sunk in business, till, from other improvements, further facilities be afforded for obtaining similar results, with less outlay. Should such discoveries be made, and in a free and enlightened society they may be of daily occurrence, national wealth will again be progressive; the rate of profits will again be raised; and profitable employment will be again obtainable for new accumulations.

The progress of national wealth does not then depend on the mere progress of accumulations, ready to be appropriated to production, as we are continually told by the teachers of Political Economy; but on the power enjoyed of finding profitable investments for new accumulations: and nations are not impeded in their advance, by that loss of the power of accumulation, which writers on the subject of wealth lead us to attribute to the continual falls which they conceive must be taking place in the rate of profits; the rate of profits being considered, in their systems, as inevitably sinking, till the whole sum realized becomes an evanescent quantity. On the contrary, it appears, that when profits have fallen to their lowest permanent rate, it is then that accumulators will be found most eager and ready to contend for employment for capital, whenever new investments occur; and it is then, that every projected enterprize, however wild, will find speculators ready to engage in it; because it is then also, that the disposable income of all producers, and of the whole society besides, is greater than it ever was before. After a period of progressive enrichment, when the country is most wealthy, and has given the greatest possible employment to capital, then it is probable complaints will be most general of the slackness of business:—the labouring population, owing to the impulse alrerdy given to its increase, will be proceeding, at first, in such ratio, as sufficed to supply the formerly progressive demand for their labour; while that demand has, in fact, ceased to be progressive:—many men will, therefore, be found eagerly seeking employment as labourers; and, up to that time, as all that could be saved from the national revenue, readily found profitable productive investment, the savings, with this object in view, will have gone on increasing in an accelerated ratio, and, for some time, saving will still proceed in this ratio, while the profitable investments will have been completely filled:—the startling appearance will, therefore, be presented, of no investment being obtainable for savings; and this state of things will affect not only what was saved after production had reached its utmost points, but all other previous accumulations also; for then will be the time, when markets will begin to be affected by the gluts consequent on overtrading: distress, therefore, will be inevitable, and the cry of falling back in riches, and in trade, and anticipations of impending national ruin, wiil be in the mouths of many. In reality, however, trade will ultimately suffer no diminution; and will be only subjected to the temporary derangement and loss consequent on gluts. It will have been for the last addition to the labouring class, and for the last increases of accumulations of capital only, that employment could not be found.

It is known and admitted, that accumulation in a compound ratio, cannot proceed for ever; and the impossibility of productively investing every conceivable accumulation of capital, is universally felt. But although this ultimate consequence be known and felt to be inevitably true, still the proximate causes, and the modes in which the circumstances of production operate, in continually limiting the employment of accumulations, have been, I apprehend, but very imperfectly understood. Our greatest authorities in Political Economy appear, indeed, never to have studied this most important branch of their subject; for we find them all inconsistent here; at one time calculating as if all accumulations of capital, whatsoever their amount, were, of necessity, capable of setting labourers to work, productively and profitably; while, on the other hand, we find them admitting the influence of competition on production; and on the existence of a full complement of wealth, depending on the physical and political circumstances of the country under consideration:—we have latterly had it maintained, on the one hand, that production can only be limited by the want of products to be interchanged, and that capital can always be set to work in preparing the deficient products[2]; while we, on the other hand, find the same authors admitting, that if the products which alone could open a vent for other products, were food, the which, owing to the nature of things, could not be susceptible of indefinite increase; then there would exist a limit to production, and to the increase of demand and supply. —I have said, that those writers, who most strenuously maintain the theory, that increasing production inevitably opens a vent for additional products, do allow an exception, in the event of additional food being the only suitable article for taking such products out of the market, as happen to be there in excess. This, however, they only do incidentally, and no great importance is attached by them to the circumstance; their general belief being, that wealth is unbounded; that if products

[2] See the writings of M. Say and Mr. Mill on Political Economy.

do not sell, it is solely for want of other products to open a vent for them; and that the opening of the new vent, the want of which may, for a time, impede production, it is always in the power of man to effect; it being believed by them, (a consequence of their treating labour as the sole source of wealth,) that man enjoys the power of continually increasing wealth so long as he is willing and able to bestow labour and capital on the production of such descriptions of articles, as are suited to the different markets of the world; a knowledge of which suitableness, although it may not be possessed now, it is always supposed may be gained hereafter, if men are only willing to make the requisite inquiry.

In Dr. Smith's Wealth of Nations, we are taught to calculate on countries attaining a full complement of riches, "which cannot be exceeded under the existing circumstances of their soil, and climate, and their situation, with respect to other countries." (Wealth of Nations, Book I. Chap. IX.) We are, besides, constantly reminded, that falls or rises in the rates of profits, depend on whether the country in question is approaching to, or receding from, this state of full enrichment. The existence of a limit to production is, therefore, an essential datum, on which all his reasonings regarding profits and wages hinge. Indeed, he attributes vast influence to the effects of competition; and the existence of competition, of necessity, implies not only the existence of a limit to production, but the actual influence of approximation to that limit, as exhibiting its effects in those variations of the rates of profits, and of wages, which he attributes thereto; for it is impossible to conceive, that there should be that struggle for productive employment to capital and labour which competition implies, unless the quantity of employment itself were subject to some limitation. But in that very work, in which we have remarked the author contemplating, not only the existence of a limit to production, but the constant influence also, of that limit on the productive classes; we find it stated, "that the extent of trade does not depend on the trade itself, but on the trader." That "when a producer has more stock than suffices to set himself to work, he adds to his productive establishment, by employing one or more journeymen;" no reference being made to the state of the market for his wares; and we find the whole of the Dr.'s reasonings acknowledge the justice of this axiom, that increases of capital, of the fund for setting labourers to work, if brought into employment, must increase the wealth of the community: for wealth, he says, is the result of productive labour, and "labourers, productively employed, reproduce *with a profit*, the value of the materials consumed by them during production." "If," he further says, "the society were annually to employ all the labour which it can annually purchase, as the quantity of labour would increase greatly every year, so the produce of every succeeding year would be of vastly greater value than that of the foregoing; but," he continues, "there is no country in which the whole annual produce is employed in maintaining the industrious; the idle every where consume a great part of it; according to the different proportions in which it is annually divided between those two different orders of people, its ordinary or average value must either annually increase or diminish, or continue the same from one year to another."

Here then, although the influence of a limit to production is essential to the reasonings of Dr. Smith, we find the doctrine distinctly laid down, that it is optional with nations to become as rich as they please; and that the sole condition necessary to increasing wealth, is the feeding of the industrious, in place of the idle; a doctrine which his followers have pushed to the extent already pointed out.

Dr. Smith no where points out a reason why capital and labour should, at one time, be productive, and at others unproductive, of income or profit, although employed, at both times, in a manner similarr in evey apparent respect: Indeed, he invariably calculates on all accumulations of capital, and on all labourers, as being of necessity productive of gain, when employed on the preparation of "such articles as are, for some time at least, capable of duration, and of being exchanged for some other product."

Another error into which Dr. Smith runs, and which has pervaded the writings of all subsequent reasoners, is this. He judges, invariably, of the enrichment of capitalists, by the rate of the profit realized, and not by their amount in the aggregate. He has thus let slip the only mode of tracing the operation of the limit to production and enrichment, and has left these altogether uncertain; and he has, consequently, been led into the contradictions just remarked; on the one hand stating, that with increases of capital, and the will to employ it in production, wealth must ever be progressive; while, on the other, he tells us, that countries can enjoy only a certain complement of wealth; and calculates on the influence of competition for the means of employing capital, a thing which could not be known, but for the very influence of that limit, the existence of which he would seem to deny.

Look at the more remote consequences of these errors, in the conclusions of his followers: they, looking solely to the rate of profits, reason thus, and are warranted in so doing by their text book. The productive powers of labour are greatest in agriculture, when, with a small outlay of capital, a high *rate* of profits is realized; and when the productive powers of labour are great, the power of accumulation is great in proportion; for then it is that the surplus produce remaining after satisfying the wants of producers, is the most. As the *rates* of profits fall, the power of accumulation suffers reduction; for it is by transfers from the revenue of the producers that capital is realized. With the loss of the power of accumulating capital, which the fall in the *rates* of profits is supposed to cause, the progress of wealth is retarded; for wealth proceeds yearly increasing, rapidly or slowly, as transfers from revenue to productive capital, are large or small. With the falls in the *rate* of profits, consequent on the employment of increasing capital, being recompensed by a smaller and smaller return, as cultivation is extended over inferior soils, the power of further accumulation suffers a gradual diminution; and this proceeds till it is ultimately lost, by profits being absorbed altogether, or at least brought to so low a rate, that the motive to accumulation ceases to act. At this time capitalists will be living from hand to mouth, and will probably be in worse circumstances than labourers; and thus we are brought to this most strange conclusion, that when countries are most improved, and are consequently most wealthy, they have the least disposable wealth, and the smallest power of accumulation.

But if the reasonings advanced in this Essay are at all correct, it is shown, that at the time the progress of enrichment and population are arrested by obstacles offered by the physical circumstances of the country, together with the existing knowledge of productive arts among the population, then the power of accumulation is greatest; and then all the productive classes, of which society is composed, are actually in the enjoyment of larger incomes than they could possibly have possessed before. In proof of the correctness of these conclusions, I appeal to the experience of countries which have made the most marked progress in enrichment; and which have consequently made, what will be allowed to be, the most near approach to the physical limit to production; and I ask, whether it was not in such countries that the power of accumulation was the greatest? and whether it was not at these times, that this power exhibited itself most efficiently? Whenever new openings offered for the productive employment of additional capital, was it not then, and there, that they were most speedily filled? Was it not then also a matter of comparative indifference to the society, how rapidly national capital was destroyed; because fresh accumulations were already prepared, and courting employment, to supply any deficiency which might occur?

From this generally received opinion, that the rate of profits must continually sink, till profits are lost altogether, or till they are so trifling, that the motive to accumulation ceases to act, we are led to conclude, that the agency of capital in production is a self-acting principle, which hurries its unfortunate possessors to their inevitable ruin; a power which propels itself forward, in despite of the wishes of those who happen to be proprietors and employers of so unruly an auxiliary. But capital, it must be recollected, is inert *per se*, and possesses no inherent powers of yielding increase or revenue; and it can effect nothing, in as far as the periodical reproduction of wealth is concerned, without the cooperation of the reproductive principle, and of the labour of man, guiding its energies in the particular direction he desires. This agent, powerful as it is, is under complete controul; why then should its proprietors voluntarily permit it to work their ruin? and this it will most unquestionably do, if agricultural capitalists persevere in adding to their productive outlay, after they cease to obtain increasing aggregate sums of net produce from their lands; and if manufacturers continue to increase the production of their wares, after their income, in the aggregate, has experienced its greatest increase.

It has been my endeavour to prove, that the progress of wealth does not depend on the progress of increasing accumulations of capital; but upon increases of the power of employing capital, in a manner which shall secure to its employers increasing aggregates of profit; and because of the intense interest all classes must feel in keeping production closed up as nearly as possible, to that point which man's present numbers, and present knowledge of productive arts, permit. I likewise conceive, that there will be a continual pressure of production against the means of employing capital; precisely as there must ever be a constant pressure of mankind against the means of subsistence. These, too, indeed, are in fact, convertible propositions; for what does increasing the means of subsistence mean? It must be answered, that increasing what I have denominated the primary description of wealth, constitutes an increase of these means:—and if it be asked, what are the means of employing increased capital in production? it must be answered, that these means exist only when more of the means of subsistence can be obtained as a recompense for the employers of increasing quantities of capital.

From the way in which I have treated progressive enrichment, after the general employment of capital has been introduced, it may seem, that if my doctrines be correct, profits must occasionally rise much higher in their rates than experience warrants us in admitting: that in a country, for instance, which in a short period doubles or trebles its productively employed capital, the profits of stock will be sometimes found, during the interval, at 200 or 300 per cent. But even when new investments are most eagerly seeking new capital, we must keep in mind, that in manufactures the openings for the employment of capital, consequent on improvements, may follow, with much more rapidity than suffices for the growth of additional labours to meet the new demand for hands; because capital can be accumulated in a much shorter period than population can spring into being. The wages of the labourer must therefore rise, and capitalists must compete with each other to obtain workmen, even on terms less advantageous than before; the object they eagerly pursue being to increase the aggregate amount of their receipts, without reference to the oscillations in the rate which, during the interval, may be occurring.

with the widest conceivable opening for the employment of new capital, which, were wages to remain fixed, would raise the rate of profits to a very great height, this necessary dependence of enrichment on labour must produce the effects of counteracting, for the time, the rise of the rate of profits, and the cheapening of product; and of transferring a large share of the increased gains of the capitalists to the labouring class, to encourage the more rapid increase of that branch of the population, the absence of which is now the main obstacle to the progress of wealth. We might, therefore, after obtaining accessions of the power of employing capital, witness a fall, in place of a rise, in the rate of the net profits, which actually find their way into the purses of the capitalists: nay, many over-sanguine speculators might actually impoverish themselves from this cause. But notwithstanding the impetuosity and indiscretion of individual adventurers, which might lead even to their ruin; and notwithstanding that the necessity for obtaining workmen on their own terms, might more than counterbalance the rise in the rate of profits, still it will obviously be to the interest of the class of productive capitalists, to continue accumulating and throwing new capital into employment; because an annual income will thereby be secured to every sum of capital so invested: and as the thought uppermost in the minds of all producers, must be, how they can secure an increasing income; it must be some powerful obstacle, amounting indeed to nothing less than the certainty of subsequent impoverishment, which can check the bringing of new capital daily into employment. At any rate, the causes here assigned, are sufficient to prevent, in real life, any such appearance as profits in general extravagantly high in their rate; and practically, the only perceptible effect of the opening of new investments for capital in manufactures or trade, will be, a rising of profits, somewhat beyond their minimum rate, (that rate, I mean, to which they will have a constant tendency to fall,) coupled, at the same time, with an increased demand for labour, and a general show of bustle and activity.

We have just now, however, contemplated a rise in the wages of labour, from the competition of capitalists for workmen; and as the labouring population, no doubt, increased with the increase of their wages, a reaction must presently be experienced; and new labourers pressing into being, the competition will presently be on their side for employment. The wages of labour being, since the introduction of capital into production, an integral part of the productive outlay, it follows, that a fall of wages will produce effects precisely similar to such improved application of capital, as, by reducing outlay, altered its proportion to the net profits of the capitalists. Another rise in the rate of profits will now be experienced, which will, as before, be attended by another extension of employment to capital; and this will proceed till profits have again settled down to that rate which happens to correspond with the greatest increase of aggregate gains to the whole class of capitalists.

When not only profits, but wages besides, have fallen to that minimum rate, below which they cannot permanently remain; then enrichment will again have come up to that limit which physical causes, combined with the present state of knowledge in productive arts, inevitably prescribes; and at this period, as before, greater wealth will be in existence, and greater amounts of revenue will be distributed through the whole society, and through every class in the society, than could ever have been realized at any former period.

In the case of improvements in agriculture opening the way to a more extended investment of capital in that branch of production, we see an immediate preventative to a very high rate of profits, in the circumstance of the efficient demand for food only increasing with the increase of the population; and in the direct interest which cultivators have, (when the option happens to be given,) of constantly keeping only so much capital employed on their lands, as yields them the greatest command, at the least cost, over wrought products, and insures them the greatest aggregate of gains.

The rate of agricultural profit, which holds when these objects are effected, must, of necessity, be near the minimum rate; as the stock of food raised, must always be near that quantity for which there is a demand, and close upon that which would constitute an excess of supply.

When the wants of mankind have become various, and include, besides food, an infinite variety of wrought products, the net proceeds resulting from the influence of the reproductive principle, do not, by any means, suffice for satisfying even the labouring class; when, therefore, a fall of price takes place in those wrought articles which this class deems most essential to its well being, the surplus income, thus at their disposal, for making some additional purchase, will probably be devoted to securing a more ample provision of food for their rising families. After wages had sunk to that lowest rate, which is only sufficient for keeping up the existing population, such a cheapening of wrought goods might admit the coming to manhood, of an increasing number of labourers; and the subsequent competition of these for employment, would, of necessity, bring about another fall of wages; now a fall of wages being, like any other reductions of productive outlay, a sufficient cause for enabling a larger capital than before to find profitable employment, the relations of outlay, and net return, experiencing thereby a change, and the rate of profits rising beyond their minimum; a circumstance apparently so trifling, as the cheapening of pots and pans, or other common utensils of the lower orders, may suffice to cause an important progression both in population and in wealth. Nor would this apparently trifling cause be the only one, amongst other and remote changes, which would be capable of effecting a virtual removal of the barriers by which the progress of wealth had been opposed: it is indeed impossible to detail all that might have a tendency to produce this desirable effect; the following may, however, serve as instances, and thousands of others will not fail to suggest themselves to the reader.

In a society well advanced in knowledge, wherein food forms but a trifling proportion of what each consumes, agricultural capitalists will not estimate their income by the quantity of raw produce, actually reproduced on their lands, beyond what has been consumed as seed; they will judge of this by the net gain which they can realize in the market, estimated in the current medium of exchange; in other words, by the power they enjoy, of exchanging at will the produce of their lands, for the whole range of reared commodities which most contribute to their comfort; and as producers in every branch, have each accommodated their production to meet, as nearly as possible, the average wishes and demands of all their neighbours, this power will, in practice, be indicated by the readiness with which the products of the agriculturalists, or any other class, are convertible into money, or whatever may have been established as the common medium of exchange. Thus it is, that a tract of the most fertile land, from which a net production in kind is obtainable, of three or four hundred per cent. might be left waste as a desert, on account of its distance from any market, where the net produce could insure a command of all those products conjointly, without which, man, with his present habits, cannot exist. The whole excess beyond what had been expended in seed and agricultural labour, might be consumed in feeding the men and cattle necessary to transport it to the market. A mountainous tract, a marsh, a torrent, might produce effects similar to those of distance. What interest then could any capitalist have, in sinking his wealth in so unprofitable an undertaking? Let, however, a canal be cut, reducing the charge for carriage; a road be made; the marsh drained, or a bridge thrown across the torrent; and how differently would this fertile tract be circumstanced? That fertility in the soil, which formerly was not available to enrichment, would now, in concert with the reproductive principle, the labour and capital of man, become productive of revenue and of wealth.

So far we have contemplated the progress of enrichment, checked by no cause extraneous to itself. The absence of the conjoint and reciprocal action of the three concomitants which are essential to its existence and increase, together with the physical circumstances of the country under review, having alone interfered with the progress of enrichment. But when we consider the inevitable effects of absolute and ill-directed power in individuals, and of national animosities, in the dark ages of an infant world, we may readily perceive the causes of many impediments to this natural career of wealth. When we again consider the new and intricate relations which, in the progress of time, cannot fail to spring up in a society, conforming to existing laws and customs, however absurd and barbarous these may be, together with the effects of subsequent counter enactments, framed under the delusions probably of false theories, doubly entangling the involved meshes of this highly artificial web, we may readily imagine how wide a field is open, in the old world, for aiding the progress of wealth, by the alteration and amendment of existing institutions and habits: for the effects of mistaken policy are, as regards production, analogous to the natural obstacles already adverted to; the fiat of despotic power raising, in many cases, barriers more insuperable than Alpine tracts; and liability to arbitrary exaction, crushing, ere it has strength to bud, the latent germ of national enrichment.

II.—*On the Sandstone of India.* *By the Rev.* R. Everest.

[Read before the Physical Class Asiatic Society, 8th June, 1831.]

In the 17th No. of the *Gleanings*, a writer who has given us some valuable information respecting the rocks of the Bhartpúr district, after describing some varieties of sandstones, informs us, that "they belong to that great formation of sandstone, which is now very generally considered as identical with the *New Red Sandstone* of the English Geologists."

Now as I am one who do not coincide in the general opinion, that their identity has been established on more than a very distant and even trifling analogy between them, I have ventured to say a few words on the subject; premising, at the same time, that I have no further information on it than what I have obtained from the writer's present paper, and the two papers of Captain Franklin, one in the *Geological Transactions*, and the other in the Asiatic Researches. But, as the writer seems to hint that he is in possession of some additional facts, (see p. 146. line 37, and p. 147, last paragraph,) in that case, the present remarks must only be understood as a call upon the advocates of the assertion for further evidence.

Captain Franklin's papers, or paper, (for they are nearly the same,) is the only one in which any reasons are adduced in support of the opinion; and these reasons, if I state them rightly, are as follows:—(see Asiatic Researches, p. 248, &c.)

1st. That the formation includes a number of beds of variegated marks, and grits.

2dly. That it is quarried for architectural purposes.

3dly. That it is saliferous.

4thly. That it is horizontally stratified.

5thly. That it is unconformably stratified.

Now these beds of variegated marks, and grits, are not decisive marks of distinction between the new and old *Red Sandstone.* They may be seen in both. It is true, that Werner called his first flœtz *Sandstone*, the "Bunter Sandstein," from this character; but it is equally true, that geologists in England were at a loss to know, which of these two formations was meant by the name; until it was found that the "old red" on the continent was an unimportant bed, subordinate to granwacke.

For the sake of an example, we will go no further than the "Outlines." In p. 468, note, we find, "Red and variegated grits, alternating with slate-clay." English equivalent, "*Old Red Sandstone.*" Any one who has travelled over the "Old Red," may call to mind similar instances.

Indeed, as it is universally allowed, that these two formations are only successive deposits, produced by the wearing away of the primary rocks, we can hardly suppose, that their diffeernce of composition would be marked in the same country, where both came from the same rocks; and, were it so, still less should we have a right to draw any inference from such a character, in a distant country, where the rocks from which they were deposited, may have been totally different.

With respect to the second reason "that it is quarried for architectural purposes," the assertion will equally apply to most of the sandstone of the coal formation, as well as of the *Old Red Sandstone.*

The third reason is the only one I can estimate to have any weight with it, viz. that "the formation is saliferous," and on this head the evidence is far from satisfactory. The "Red Marl" of England, and the adjoining continent, is noted for containing extensive beds of rock salt and gypsum. In the Bhartpúr district we find there are "no deposits of rock salt and gypsum;" but "the soil is impregnated to a great depth with saline particles, and a saline efflorescence very generally appears at the surface. The majority of the wells too are brackish." It does not clearly appear upon what rock this soil rests, for shortly afterwards the question is asked, "Are such saline soils found only in connexion with rocks of the *New Red Sandstone* formation?" so that the soil here is simply the alluvium of the great valley of the Ganges. It seems that in the wells from which the salt water is drawn, the "richest water" is procured at a depth of from 57 to 60 feet. It is, therefore, probable that there is no extensive bed of rock salt below that depth: that there is none above it, is of course proved by the sinking of the wells. Captain Franklin's evidence is to the same effect. "The sandstone," he says, is saliferous, because "the plains below are saturated with salt;" that is, I presume, the alluvial plains of the Ganges below the pass of Tara. There are also salt works on the banks of the Tons river, but it is not mentioned from what source the salt is derived. I conclude, therefore, it is not a "*Rock Salt.*" As salt springs occur in the Northumberland coal formation, (see Mr. Wynch's paper in Geological Transactions,) no inference could be drawn from their presence in a *sandstone*, even were it proved that they issued from the rock itself, and were not the mere drawings of a saline soil. Not a word is mentioned of the gypsum, a more constant accompaniment to the "Red Marl," than the rock salt.

I now come to the fourth reason, "that it is horizontally stratified;" and the fifth connected with this, "that it is unconformably stratified."

The writer has forgotten, that the horizontal and uncomformable stratification of the *New Red Sandstone*, which he brings forward as a general fact, (see p. 146,) "Since the formation of the *New Red Sandstone*, the strata have not been subjected to the action of those violent causes, &c." is a circumstance peculiar to the English formation; that on the continent of Europe, the "*New Red*" is conformably stratified with the inferior strata; and that the difference in England only shows, that the inferior strata were upheaved before the *New Red* was deposited. It is upon no farther reason than this, as I understand him, that he believes the strata which basset out in the northern portion of the district, to be of anterior date to the other; and again, in the last paragraph, "The older *Sandstones*, which have been described in the Bhartpúr district, have, in other situations, been observed to basset out *through the Newer Sandstones*." It is to be regretted, that he has not explained this more clearly. As the fact is stated, I should rather believe it to be occasioned by a partial dislocation of the same strata, such as would be produced by a force upheaving from beneath, and which is common to every formation. In what manner he can prove the two rocks to be of distinct formations I am at a loss to conjecture.

We will now look a little further into Captain Franklin's paper, as there the evidence with respect to these two points is equally inconclusive.

The first range of hills at the Tara pass, finds the rock horizontally stratified; and at the second or Kutsa pass, the same. From Kutsa he visits several cataracts in the course of about 40 miles; of which Bilhohi is the first, and Cachei, on the Tons river, the last; and his remarks on them are, "From their composition, it is evident that the whole range of hills in which they are situated, is a mass of *Sandstone;* they show also, that there is a valley in the subjacent strata in this part, by exhibiting distinctly the *plane of inclination of the variegated stratum;* which being uppermost at Bilhohi, central at Bonti, lowest at Kewti, and disappearing below the surface at Cachai, *plainly denotes a subsidence, the axis of which is, perhaps, somewhere about the Tons river;* and this appears to be the thickest part of the formation." He then comes upon the limestone, which he has designated as '*Lias*,' probably incorrectly. I say so for no further reason than that it is not a *shelly limestone;* whereas the lias and the oolites are nearly made up of shells. A stranger to geology could hardly travel 5 miles on the lias, without being struck with its numerous remains. Captain F. travelled full 100 miles upon this limestone, and found in the whole way but one shell, of a very uncertain nature, as I have been informed by those who have seen it.

A little beyond Tendukaisa, Captain F. passes to the primitive rocks, and his words are, "After descending the hills, and advancing about three miles into the valley, a new field opens; the lower rocks are laid bare, and exposed to view, and instead of horizontal stratification, they become highly inclined, sometimes perpendicular, and altogether unconformable to those I have just passed."

Now the term "unconformable" here, is not used in the sense in which the English geologists have used it, with respect to the "*New Red.*"

The *New Red* here, is said to "rest unconformably" upon the older rocks, because the horizontal planes of its strata are seen resting upon the edges of the strata of the older rocks. Captain Franklin says, the older (primitive rocks) were "unconformable" to those he had just passed, or seen at 3 miles' distance, which can only mean, that the strata, at that distance from each other, had different angles of inclination.

From hence Captain Franklin turned to the north to Gt. Deori, and from thence passed, in an easterly direction, across the boundary of the *sandstone* to the primitive rocks at Jelelpúr. As far as the Bundain hills, the *sandstone* did not appear to differ from what he had seen before; but when he came upon the Kymar range of hills, (the next to the primitive rocks,) he found it "composed of siliceous gritstone, which evidently passes under the *sandstone* of the Bundain hills;" and in his paper in the Geological Transactions, he gives some important additional information, that "it is composed of quartz rock, varying to siliceous grit, and the strata are nearly perpendicular." So much for the horizontal stratification. To the west, near Googri, these strata are "intermixed with clay-slate and schistose limestone."

Captain Coulthard, who has likewise published a Map of this part of the country, has coloured this as transition; but whether from any further evidence, than the approach to quartz rock, and the highly-inclined stratification, he does not state. According to such a mode of reasoning, the "*New Red*" is sure always to be horizontal; because the moment the angle becomes inclined, it is declared to be a different rock.

I have looked at Captain Franklin's section in vain for any marks of stratification in the *sandstone;* but he states, that at the Bonti cataract, it resembles quartz rock, which indicates the granite to be near.

In another paper which he has written on "the Diamond mines of Panna," in the same formation, a resemblance to quartz rock is also stated to exist in the lower beds, at the Bagin waterfall; "and in all the glens, particularly in that of the Bagin river, black bituminous shale crops out from beneath the *sandstone.*" Further to the west, at Sabigerh, "black bituminous shale rises to the surface," which would seem to imply either that the strata rise to that quarter, or if they remain horizontal, that this bituminous shale bed has failed, as we advance eastwards. This distinction is of some importance, and it is a pity that the fact has not been well ascertained.

It will perhaps be asked, if these reasonings are thought inconclusive, by what means is it possible to distinguish the *New Red Sandstone?* If we look back a little at the history of the question in England, it will shew us.

In the earlier stages of English Geology, the position of the coal, with respect to the *sandstone,* was not clearly ascertained. In some places this last was said to overlie, in others to underlie the first. Now, as what are called the coal strata, are themselves composed of *sandstone,* and shale beds, alternating with beds of coal, and each of these beds are variable in thickness, the mere position of a great thickness of *sandstone,* either above or below the coal, would hardly entitle it to the character of a separate formation. It might be said, on the other hand, that this *sandstone* was only the upper or lower bed of the coal grits, somewhat more developed than usual:—that the coal had failed towards the upper or lower end of the series, a fact common to all alternating beds. But it was observed, that with the lower beds of coal alternated a fourth member, viz. a limestone; that as the coal failed the limestone beds gradually increased, forming sometimes huge mountains, either of the limestone itself or of limestone and shale interstratified, and distinguished as well by their minerals, as by their organic remains; and that there was usually a considerable thickness of this limestone between the coal and lower *sandstone.* Viewing then the whole as a series of beds of *sandstone,* limestone, shale, and coal, represented by the numbers 1, 2, 3, 4, the series would stand thus.

1 predominating, with 3, towards the upper end 2, rare.—*Old Red Sandstone.*

2 predominating alone, or with 3—1 rare—4 beginning to appear.—Mountain limestone.

1, 2, 3 alternating with 4 rare.—Millstone grit, and limestone shale.

1, 3, and 4 alternating.—Coal formation.

Now it is obvious, that without No. 2 on the limestone, no division could ever have been made between these beds, varying, as they do, infinitely in thickness,—in passages into each other,—in alternations with each other,—and repetitions.

But it was found in the Somersetshire coal field, that shafts sunk through the horizontal beds of *sandstones*, came upon the coal strata, inclined at a considerable angle, and a section (of the banks of the Avon, I think,) afforded a complete explanation of the phenomena. The coal strata, mountain lime, and *Old Red*, were highly inclined, as in the section I have drawn above. Upon them "rested unconformably" the *New Red*, the lowest bed of which was a conglomerate, containing pebbles of the older rocks, in particular well-marked ones of the mountain lime.

This unconformable position of the strata has been found to obtain universally in England, and, like the horizontal position, is a local phenomenon, with respect to this last circumstance. Of course, if a plain surface is heaved uniformly, it is still horizontal; it is only when one part is more heaved than the rest, that it becomes inclined; I could multiply instances of this in rocks of all ages.

But to set the question at rest from authority, I will refer to some papers of Professor Sedgwick, on the *sandstones* of Scotland, and the "*New Red*" of the northern part of England.—(Geol. Trans. vol. III. part 1.)

The first of these is a paper on the secondary formations of the island of Arran. The Professor finds in the cliffs on the coast of Arran, an extensive section of the strata exposed to view; and they are shortly as follows:—

1st. A great thickness of *sandstone*, with conglomerate, highly inclined, and "conformable" to the rocks on which it lies.

These *sandstone* beds "resemble the harder varieties of the *New Red Sandstone* of England, and exhibit a blotched and variegated character. Below these lie another set of beds, the upper portion composed of red and grey variegated blotchy marks." "Ironstone nodules are interspersed among these beds, some of which have that false cleavage so characteristic of portions of the *New Red Sandstone*." Then come some thin beds of red limestone, containing shells of the genera *Producta* and *Spirifer*, corals and eucrinites. Then come coal beds, with their usual vegetable remains. Then a limestone, "perfectly analogous to the mountain lime," with producta, orthoceratites, a spiral univalve, encrinites, &c.

Last of all, in succession, come, "beds of a highly indurated *sandstone* of a light red tinge, *alternating with masses of indurated shale of a red, grey, and greenish-grey colour*." "With the above is a calcareous conglomerate, and subordinate to it, irregular concretions of nearly compact carbonate of lime, not to be distinguished from the corn-stone of Herefordshire."

These characters, and the absence of vegetable remains, induce him to believe it to be the *Old Red Sandstone*. He sums up his account of it as follows:—"On a great scale it is to be viewed as a red conglomerate, with many subordinate beds of *sandstone, which cannot, either from the nature of the pebbles, or the cementing principle, be distinguished from the newer conglomerate; neither can the sandstone of the one series be described as differing from that of the other.*

The existence, however, in the one deposit of beds of arenaceous granwacke slate, near the bottom, and that of the cornstone in the upper part of the formation, strongly identify it with the *Old Red Sandstone*. Moreover, independently of any such distinctive characters, *the intervention of the well-developed groups of the carboniferous series, enables us, with certainty, to separate the two great deposits of conglomerate from each other, and to arrange them with the analogous members* *of English geology.* Here then I take my stand, and I call upon any one who attempts to describe the *sandstones* of India, to point out the coal measures and mountain lime, with its characterstic fossils, above or below them. We may remark here, as an instance of the deceptive nature of mineral characters, as guides in classing rocks, that the passage to granwacke, which he cites as characteristic of the *Old Red*, and which has usually been considered as decisive of it, belongs, as we see from his next paper, to the Caithness schist, which schist he considers as equivalent to the coal measures; though there is great doubt whether they are not to be referred higher. He concludes, "If the rocks of the Arran section were assumed as the general type of all contemporaneous deposits, there would be then no objection to a classification attempted by some geologists, wherein all the rocks of the orders above described, are considered as belonging to one great formation of *sandstone*, to which the carboniferous series is subordinate;" and "we think this classification may have its advantages in comparing the contemporaneous deposits of remote regions." To this remark I lend my humble assent, and propose to call ours "The great *sandstone*," or "*Red sandstone* of India," at least until we know something more about it. He adds, in conclusion, what I have before stated, that "want of conformity is not an element which will assist us in grouping together, or separating contemporaneous deposits in different parts of the earth."—See instances, in proof of this, in his Paper on Magnesian Limestone, note p. 39. I must not be understood as having asserted, that it is not possible to identify the *New Red Sandstone* by its internal characters. I believe that it is; and I should cite, from the paper just quoted, some of the leading characters of its great divisions, as a proof that it might be so. First then let us see, the marl slate, with its peculiar fossil fish, or the magnesian limestone, with its mineral characters well marked, and its suite of fossils, or the red marl and beds of gypsum, its constant attendants, or the red marl with beds of rock salt and gypsum. Not a saline soil, not brine springs, because, as this formation appears to be of no great thickness, the brine springs might belong to the primitive rock beneath.

I must not omit here, that there are some circumstances about this formation, which though far from decisive, lead us to conjecture that we ought to assign it an earlier place than the *New Red.* In the first place the transition rocks, (and I include under that name, the carboniferous series of Conybeare,) have been found to be more universally distributed over the globe in association with the primitive rocks than the secondary ones. I agree with Captain Franklin, that the *sandstone* which extends to Rajhmal is probably only a continuation of this formation; and I will go a step farther and say, that all the detached *sandstone* formations which are to be met with in the primitive range, between the Soan and Hooghly, are probably only outliers from it. We have reason to believe that the Bundelkund formation contains coal; and coal has been proved to exist in many of these detached basins; see for localities GLEANINGS, No. 19, Art. "*Palamow Coal.*" Between Rajhmal and Bancoorah, on the eastern flank of the range, consists a formation of carboniferous *sandstone*, probably little inferior in extent to that of Bundelkund. Regarding, then, these detached pieces as belonging to one formation, we may urge, in the second place, that it contains coal. Thirdly, we state its constant association with the primitive rocks. *New Red* also does rest upon primitive rocks; but an association so constant as this can hardly be said to be without weight, especially if we recollect that the primitive rock is more usually a syenite or syenitic granite, than an earlier member of that formation; and syenite is next in succession to the rocks of the carboniferous series, and is not unusually connected with them. Our fourth reason shall be, its frequent passages into granite or gneiss, and quartz rock. Our fifth, that it is interstratified with clay-slate; and lastly, that from the great rarity of organic remains in the blue limestone which rests upon it, the chances are, that that rock is of an earlier age than lias. These reasonings I know are inconclusive, but I can hardly deem them superfluous, for it is always best to look at a question under dispute in every possible point of view. Let me not be considered as underrating Captain Franklin's labours. No one can appreciate them more highly than I do. And I have only to add my hope, that this problem, and many others of interest in the geology of India, will shortly be explained to us, from the liberal patronage of the French Government, and the researches it has encouraged into the Natural History of the country.

Note by the Author.—That salt exists as deep in the earth as any mineral with which we are acquainted, is proved by its frequent, or almost universal occurrence in lava. For instance, some of the lavas of Ætna are said to have yielded 9 per cent. of common salt, by simple washing. The mineral springs of volcanic countries are usually strongly impregnated with it, and in this way it is liable to be deposited in all formations.

The writer in the *Gleanings* does not mention sulphate of lime as occurring, which is constantly present in the rock salt formations of Europe. He says, the salts, are muriate, sulphate, and carbonate of Soda. Now if we turn to Mr. Prinsep's Analysis of the hot springs near Hoseinabad, we find that they contain muriated, sulphated, and carbonated alkali. Need we then search any further for the reason of the saline particles of the soil in the Bhartpúr district? Near Hoseinabad the process of saline deposition is yet going on. What becomes of these hot springs, when they approach the surface, and percolate through the soil? Do they not partially evaporate, and leave behind them part of their saline contents? It would be difficult to believe that they did not. But it is not unreasonable to suppose, that the saline soil of the Bhartpúr country, owes its origin, like the *kankar* and ironstone, to springs long since dry, and which probably burst forth abundantly, either simultaneously with, or immediately after the eruptions, which we learn from Captain Coulthard's paper, have taken place in the Saugor district.

III.—*On Conjugate Hyperbolas.*

To the Editor of Gleanings in Science.

Sir,

I am induced to trouble you again on the subject of Conjugate Hyperbolas, and shall here consider the case in which the plane of the hyperbola is inclined to the plane of the cones. And this again subdivides itself into two other cases, first:—that in which the plane of the hyperbola is inclined to the base of the one pair of opposite cones, and perpendicular to the other; and second, that in which it is inclined to the bases of both pairs of opposite cones. It will be sufficient to consider the first of these cases; and here my object will be simply to show, that the common mode of considering the subject is wrong. I am not as yet able to say how it is to be corrected. It is more difficult to represent this case by a diagram than the former, and I must, in this respect, make greater demands upon the reader's imagination.

Let ABC, DCE, and BCD, ACE, (Fig. 3.) be two pairs of opposite cones, mutually conjugate. The planes of the base of these cones are the planes perpendicular to the paper passing through the lines AB, BD, DE, EA, which are the diameters of the base of the respective cones. Let T, U, V, W, be the centres, and let these planes be represented by AFHB, BQSD, DKME, ENPA, respectively. Then let FGH MLK, be in one plane, inclined to the bases AFHB and DKME, and perpendicular to BQSD, ENPA, so that the angle GXT should be acute, and LYV obtuse, the one being the supplement of the other, and each of the angles RZU, OFW a right angle. By this arrangement will be produced two hyperbolas, mutually opposite, viz. FGH, KLM, and two others, mutually opposite, viz. QRS PON. Now as the common plane of all these hyperbolas is perpendicular to BQSD and ENPA, so it is also perpendicular to the vertical section, which may be made by cutting the cones ABC, DCE, by a plane perpendicular to the paper, passing through the continued straight line XGLY. Hence two parts of the hyperbola FGH, on each side of this plane, viz. FGX, XGH are similar and equal to each other; and for the same reason, KLY, YLM are also mutually similar and equal, and the straight line GL is the transverse axis of the hyperbolas FGH, KLM : the question is, therefore, under these circumstances, are QRS, PON the conjugate hyperbolas of FGH, KLM, as according to the common definition they ought to be ? It is very easily seen that they are not; for if they were, then GL should be the conjugate axis of QRS, PON, and its half $L\Delta$ the semiconjugate. Now since QRS, PON are perpendicular to the bases of their cones, it follows from what was been demonstrated in my former letter, that their semiconjugate axis is equal to their distance from the vertical section, parallel to them, of the cones BCD, ACE ; that is, to the line UZ in the one cone, and WF of the other ; and each of these evidently is equal to the perpendicular from C, the point of contact of the apices of the four cones, to the line GL ; that is, the perpendicular from C to GL must be equal to $G\Delta$ or ΔL. Now this is impossible, because the distance of the hyperbolas QRS, PON from the parallel vertical sections, viz. the lines UZ and WF, or in other words, the perpendicular from C to GL may easily be conceived to remain the same, while the angles GXT, LYV, and consequently the magnitude of the line GL, and its half $G\Delta$, vary. That is, the constant perpendicular is equal to a quantity of variable magnitude, which is absurd.

Let us now suppose the cones placed in the situation represented in the second figure (Fig. 4.) of my former letter, and let a plane, perpendicular to the paper, pass through the line GL. It is evident this will cut off two opposite hyperbolas FGH, MLK, of which the semitransverse is $G\Delta$. By the same notations as in my former letter $G\Delta = \text{अ}$, $GX = \text{च}$, $\sqrt{AX \cdot BX} = \text{य}$, and $\text{व} = \dfrac{\text{अय}}{\sqrt{2\text{अच} + \text{च}^2}}$. Then to get the value of व, that is, the semiconjugate of the hyperbolas FGH, MLK, we must take a fourth proportional to $\sqrt{(GL \times GX) \times GX}$, ΔG and $\sqrt{AX \cdot XB}$. Supposing this done, and Θ to be the line, and let $G\Lambda$ be the perpendicular from G to the line AC, then $G\Lambda$ is either equal to, less, or greater than Θ. First let it be equal, then if a plane perpendicular to the paper be drawn through $G\Lambda$, and produced both ways to Ξ and Π, it will cut off from the cones BCD ACE two hyperbolas, whose transverse axis will be $G\Lambda$, or the conjugate axis of the two former hyperbolas FGH, MLK, and so far the object may be said to be attained ; but the reverse of this cannot be shown ; namely, that the conjugate axis of the new hyperbolas is equal to the transverse axis of the former. Next let $G\Lambda$ be less than Θ, then there may be two points found in the line AC, which may be joined with G, and a plane drawn through them, so as to produce two new pairs of opposite hyperbolas, with the same property of their transverse axis as the former pair. If $G\Lambda$ be greater than Θ, then no hyperbola of this kind can be produced by a plane passing through the point G.

It still, therefore, remains to inquire, how to cut off from the cone ACE a hyperbola, whose transverse axis is Θ, and its conjugates $G\Delta$; or to state the matter more generally, the problem is this :—Having given a cone of infinite magnitude, the angle at whose apex is known, required to cut from thence a hyperbola, whose axes are given.

In some cases the problem is evidently impossible; in others, no doubt, it is possible. Such of your readers, as have leisure, would confer a favour upon me by explaining the limits of these two cases, and also the solution of the problem in the case of its possibility.

T.

IV.—*On Shading Mountain Land.*

In some of the former numbers of the GLEANINGS, there have been articles upon the different methods of Shading Mountain Land: the method which obtains at the Royal Military College at Sandhurst, has not been mentioned. As the Royal Military College is the principal school for topographical plan-drawing and surveying, in the United Kingdom, and the place where the Officers intended for the topographical department of the British Staff, are educated in their art, and consequently as the system held there, must be considered as fairly having a claim to the appellation of the *English*, it deserves a place among the several methods in use. It has not that ideal mathematical precision in the depths of shade, sought after by the Germans; a precision which they propose to preserve even in the most hastily taken sketches in the field. The inapplicability of this system to practice is self-evident; for where can be the reason in weighing and measuring the ink, or the breadth of lines, to represent, with mathematical accuracy, a declivity, whose degree of inclination has been guessed by the eye[1]? In surveying, the degree of inclination of the ground must be estimated by the eye, and practice will enable a man to do so with a considerable degree of correctness, as any person, who has had any experience, must be fully aware. Absolute perfection is not to be obtained without a labour in the measurements, and in the plan, far beyond what any survey can ever be worth; but in fact, this rigid exactness and precision is not necessary for military purposes, to which class of topographical surveys I confine my remarks: an approximation suffices, but of course that approximation must swerve as little as possible, and in no notable degree to the eye, from the truth. The principles of the method taught at the two departments of the Royal Military College, reduced to the fewest possible words, are as follows:—1st, a vertical illumination—2d, the maximum degree of shade represents an inclination of about 45°, that is, the steepest declivities—3rd, perfect whiteness represents the horizontal plane. A deviation from the rule of vertical illumination is permitted in laying in the detail—trees, buildings, &c. in order to make the picture more pleasing to the eye, and to give the objects relief. Shading by the pen alone, without the aid of the brush, in hatches, is executed at Sandhurst in a style unequalled in any part of the world. The younger Stevens, who died there about two years ago, most ingeniously introduced a crossing of the lines, which superbly represented the gradual swellings and rollings of the surface, with all the delicacy and accuracy of the most cleverly handled brush; since his death, owing to the time this very high finish consumed, and the opinions repeatedly given in the Board Room, that a less laborious method would answer, the crossing has been laid aside. The beautiful appearance of these plans, in which the evident consumption of time, and the immense labour were so apparent,

[1] The advantage of the German method is that it is *capable* of representing any degree of accuracy obtainable—guesses by guesses—measurement by measurement.—ED.

induced a scientific officer of high rank, a member of the Board, to express his regret that so much should be done upon a material, from which it was impossible to multiply the copies by the press. The greatest care must be taken in military plans, to represent distinctly the different commands of ground; to accomplish this, at Sandhurst, when a plan drawn by the brush is receiving its last touches, a light shade, or tint, which may be called a *submitting shade,* (as it *submits,* to use a military term, the lower to the higher levels,) is thrown over all the plan. Except the most elevated summits, its deepest tint, which is laid upon the lowest bottoms or valleys, is very light, but it is made to vary in degree for each level. In shading ground upon the principle, that the degree of shade should be in an inverse ratio to the intensity of the light falling upon the spot to be represented, as is proposed by the Germans, we doubtless make a nearer approach to ideal perfection than in the method just mentioned, where all inclinations above 45° are blended in one undistinguishable shade of perfect blackness; yet for military purposes this latter method is, as it is hoped the following will prove, decidedly preferable. In the first place, every general officer, into whose hands a plan may be put, though able to read an ordinary map, and to understand that the stiffer lines are roads, the more waving, rivers, and that the dark blots are hills, yet is not to be supposed conversant with all the details of surveying and topographical delineation. In looking at his plan, and finding a hill shaded with four parts of ink, to six of water, and consequently sufficiently pale, he might very possibly suppose that it would be perfectly accessible to troops of all arms, and to save the time which might be lost in a detour: think himself quite safe in ordering a body of cavalry to pass over it; he would be much surprized, on coming to the spot, to find a steep precipice, having an inclination of 53° much more steep than any unrivetted rampart, present itself, and practicable only for goats or jägers.

In a plan, executed in the Sandhurst method, such an inclination would be delineated in perfect blackness, put on brokenly, to represent the jagged projections of the rock. Secondly, in nature we find none but the stiffest soils take naturally a slope so steep as 45°, on which account this is the steepest slope used in the construction of permanent earth-works; any slope more steep than 45°, becomes a precipice, and will be found almost invariably to consist of bare, or almost bare rock. Thirdly, all plans fade. As a plan becomes old, and has been a short time in use, the white parts of it become discolored and darkened; the pale shadings will fade; therefore, the light tints used to represent the declivities below 45°, in the German method, would become almost inappreciable. In making this objection, it is not to be inferred, that the Cimmerian style is advocated; indeed, the commonest fault with young draughtsmen is, the making their plans too black; these aspiring Rembrandts, thinking that there is no possibility of giving effect, but by using the extremes of black and white, make the smoothest gravel hill, stand forth in all the grandeur and ruggedness of rock and precipice. If excessive blackness be intolerable, objections equally lie against the other extreme; a medium must be held between the two, and a plan must be shaded with sufficient depth to be distinct. Fourthly, by making the maximum shade to represent 45° of inclination, the variation in depth of tint, between the different degrees of declivity, becomes more easily appreciable, particularly to the uninitiated. In an attempt to reduce the method, having the maximum shade at 45°, to a table founded upon a theory, arising from the actual illumination of the ground, the following line of reasoning was tried; that the degree, or depth of shade, be in an inverse ratio to the intensity of the light reflected from a given space upon the surface of the ground, as it falls upon the plane' in which the eye is supposed to be situated.

On the horizontal plane the light falls perpendicularly, and is thrown back, of course, in the same path. At 45° of inclination in the surface, the light is thrown off in a direction parallel to the horizon, and can never return to the plane of the eye. At any intermediate angle between these two, the light is reflected so as to fall upon that plane more or less obliquely, and the pencil will illuminate a larger or a smaller space upon the plane in which the eye is supposed to be situated, accordingly, as it may fall with a greater or less degree of obliquity: and consequently the intensity of the reflected light in that plane will decrease as the portion illuminated by the pencil shall increase.

The following table is calculated accordingly.

No.	Ink.	Water.	Angle of Inclination.
1	1	9	16°47
2	2	8	22°12.5
3	3	7	25 39.5
4	4	6	28 7.5
5	5	5	30
6	6	4	31 29
7	7	3	32 41
8	8	2	33 41
9	9	1	34 32

Serious objections lie against it: the principal of which is, that the degrees of declivity are not indicated with sufficient uniformity; as for instance, the shades representing slopes to 28°, are included in four parts of ink; for the next six and a half degrees from 28° to 34°.5, five more parts of ink are allowed, and but one part of ink is left to represent the remaining 10°.5, so that the differences of inclination, in the greater declivities, are to be distinguished but by very trifling variations in the tint. But in fact, few draughtsmen, except the Germans, ever trouble their heads as to the intensity of the light as it falls on the ground, or on the plane of the eye, after reflection; nor is it essential that they should. The object is simply, that the degree or depth of shade should represent a certain degree of inclination in the surface of the ground; and the clearest and most intelligible manner in which to regulate that degree or depth of shade, is certainly to make a conventional arrangement, that the parts of ink, speaking with reference to the twenty cups of ink and water, shall be applied in the direct ratio of the increase of declivity. This is the common practice with all English draughtsmen who are not theorists; and it has the advantage of being the plainest and least complicated of all the methods which have been devised. Even those who aim at exhibiting, with absolute precision, the measured inclinations of the ground, may use it with as much advantage as that founded upon the intensity of the direct illumination. Here follows a table :—

No.	Ink.	Water.	Inclination.
1	0	10	0
2	1	9	4.5
3	2	8	9
4	3	7	13.5
5	4	6	18
6	5	5	22.5
7	6	4	27
8	7	3	31.5
9	8	2	36
10	9	1	40.5
11	10	0	45

The method in which an oblique illumination is assumed, called at Sandhurst the *French* method, is totally inapplicable to military plans, there being no possibility of distinctly expressing the commands on the enlightened side of the ground. The only instance in which it is used at the Royal Military College, is in the plans of fortifications; and even here, notwithstanding the advantages it has on its side, as antiquity, the prejudice of the eye against innovation, and the pleasing variety of light and shade falling in alternately, opinions have been frequently given against it; and if it have not already given way, it doubtless soon will, to a more useful method, in which the degree of shade will represent the *command*, without reference to any other contingency. Another style of topographical drawing, deserving pre-eminently the appellation of the *pictorial*, has been attempted. The plan is drawn in the actual colours of the landscape, and the light is made to fall in an oblique direction, 45°; the eye is placed in a plane, having an inclination to the horizon of about 20°. A plan of part of the country about the lakes of Killarney, and of some mountainous and wooded ground, illustrative of some military operations in the West Indies, done upon this principle, and upon a very large scale, made a splendid appearance; but the subjects were purposely selected with a view of exhibiting the effect of such a method. It can only be used in particular cases, and is not at all suited to general purposes. In the paper upon this subject, in the 14th Number of the Gleanings, the attempts of our map-makers to represent the inequalities of the surface, are most justly censured; nothing can be more absurd than their shadings: valleys are made to look like hills, and hills like valleys; and the unfortunate rivers are as frequently made to meander up the sides of mountains, and along rocky and precipitous ridges, as in the plains and glens. It would be in vain to trace their principles from their practice; they appear to darken the map without any rule, other than their own caprice: the French map-makers are not much superior; they however do try to adhere to the rules for the oblique illumination. The Germans are certainly better, but their work is dreadfully coarse.

E. M. L.

V.—*Accurate Balances.*

In the course of the last few years, the increasing accuracy of scientific research has rendered necessary corresponding improvements in the implements employed. In the balance and unit of weight, and in the unit of measure particularly, instruments indispensable in almost every operation of a chemical and physical nature, the first philosophers of their day have introduced essential improvements: of the latter we hope hereafter to give our readers some idea, in describing the new measuring bars for the use of the trigonometrical survey: at present we shall confine our attention to the former object.

Captain Kater has described, in the Cabinet Cyclopedia, a number of the most perfect balances used in England, and his account would have been complete, had he favored us with plates of the most ingenious or delicate of them; in this deficiency, however, he is not singular; for in most works on mechanical philosophy, we find repeated a clumsy figure erroneous in the commonest principles, (plate XI. fig. 4.) which few respectable instrument makers would select for imitation.

The real principles upon which the delicacy of a balance depends, are too well known to need repetition at length: the beam is regarded as an inflexible bar, turning upon an edge or fulcrum in its centre, and carrying two supports, at equal distances, and in a right line, on either side, (fig. 1.) The centre of gravity is so much below the fulcrum, as to enable the beam to preserve a horizontal position.

When the outer knife edges or supports are above the fulcrum, as in fig. 2, the slightest deviation from the horizontal position will cause the descending arm to preponderate, until counterbalanced by the displacement of the centre of gravity; since the lever of measurement is estimated on the horizontal line, or is as the cosine of the angle made therewith by either arm : when the supports are below the fulcrum, as in fig. 3, it is obvious that the ascending arm becomes elongated, and consequently the angular movement, with a given addition of weight, will be proportionally diminished. The Hindústani balance is a sample of this erroneous construction, and with all the appearance of great delicacy, is in reality much inferior to our commonest apothecary's scales. It consists of a very slight steel beam, (fig. 5,) perforated at the centre and the two ends; through these holes are introduced the wires upon which it turns : now even supposing the three holes to be in the same line, the fulcrum must rest on the *upper*, while the supports turn on the *lower* surfaces; which are the conditions of fig. 3.

When the edges of the fulcrum and supports are circular, as must be the case, more or less, in all large beams, it should be remembered, that the condition of equal levers requires that the horizontal line should pass through the *centres* of these curves, (figs. A. and B.) provided that the fulcrum rests upon a plane surface : if this surface is curved also, it takes much from the accuracy of weighments, the descending lever being shortened by the oblique contact of the edge rolling thereon : thus, by shifting a loaded common beam with the finger to either side of its support, a preponderance may easily be produced, of very notable extent.

1. In delicate balances, and of these alone we now treat, it is necessary that the whole materials should be as light as is consistent with proper stiffness. Steel, therefore, seems the fittest material for their construction every where but in Bengal, where other inconveniences occur from the use of this metal. Platina is unfit for the purpose, or certainly not so fit as an alloy of silver and copper, which possesses less than half its weight. A hollow cone of this substance may be made lighter, and as strong as a steel beam : brass has the same advantages. Some makers prefer an open truss beam, and this form is certainly preferable for very heavy loads, but for delicate work it has an air of needless power, and a want of compactness. Captain Kater thought lightness so essential a property, that he constructed his standard beam of a mahogany plank, 70 inches long, 22 wide, and 2 thick, tapering from the middle to the extremities. Such an instrument might be better adapted to temporary purposes than to constant use.

2. The knife edges or fulcra should be exactly parallel to each other, and at right angles to the axis: in olden balances the fulcrum was generally a square cross piece rivetted in to the beam, and filed under its two extremities to an edge; this defect is now avoided, by grinding the fulcrum pieces into triangular prisms, and setting them through the beam by means of a cylindrical shoulder-piece, turned on the lathe. An exemplification of this structure is given in fig. 15, of a Wollaston balance; (also in fig. 7.) it presents the further advantage of an adjustment vertically for the centres of gravity and collimation, and laterally, by means of two capstan screws, for the equalization of the arms. The construction of the end supports does not require so much nicety : the same figure points out a neat and simple construction adopted by Mr. Robinson : the prism is fitted into a divided piece at the end of the beam, which acts as a strong spring compressed or opened by two small screws; by the oblique position of the cut, a minute motion upwards is also obtained for the adjustment of collimation.

Mr. Robinson has the merit of introducing another improvement: in all former balances, the weight was sustained by short portions, at the extremities only, of each knife edge, which subjected them to continual and unequal wear; this he has obviated by making the prisms bear on their whole length: Captain Kater thus describes the construction of some splendid balances made on this principle, for the standarding of the weights of Great Britain, duplicates of which were sent out to the new Calcutta Mint by the Hon'ble Court of Directors last year.

"The central knife-edge of the beam I am describing, was made 6 inches, and the two others 5 inches long. They were triangular prisms with equal sides of three-fourths of an inch, very carefully finished, and the edges ultimately formed to an angle of 120°.

"Each knife-edge was screwed to a thick plate of brass, the surfaces in contact having been previously ground together; and these plates were screwed to the beam, the knife-edges being placed in the same plane, and as nearly equidistant and parallel to each other as could be done by construction.

"The support upon which the central knife-edge rested throughout its whole length, was formed of a plate of polished hard steel, screwed to a block of cast iron. This block was passed through the opening before mentioned in the centre of the beam, and properly attached to a frame of cast iron.

"The stirrups to which the scales were hooked rested upon plates of polished steel, to which they were attached, and the under surfaces of which were formed by careful grinding into cylindrical segments. These were in contact with the knife-edges their whole length, and were known to be in their proper position by the correspondence of their extremities with those of the knife-edges. A well imagined contrivance was applied by Mr. Bate for raising the beam when loaded, in order to prevent unnecessary wear of the knife-edge; and for the purpose of adjusting the place of the centre of gravity, when the beam was loaded with the weight required to be determined, a screw carrying a movable ball projected vertically from the middle of the beam.

"The performance of this balance fully equalled my expectations. With two hundred and fifty pounds in each scale, the addition of a single grain occasioned an immediate variation in the index of one-twentieth of an inch, the radius being fifty inches."

In the smallest balance of the set, the end supports have a spring adjustment, which will readily be understood by reference to fig. 17. In the balances just described the knife-edges are of steel, turning upon agate planes; but for this country it might have been better to have constructed the whole of agate, rounding off the edges slightly, to obviate the danger of their chipping under heavy pressure.

3. The next point of importance in making a balance is the maintenance of its good qualities, by relieving it from shocks and friction, as far as possible, both during and after use. This object has been usually attained by lifting the beam off of its edges, by a sliding fork, and bringing up supports under the scale beams. Mr. Bate has introduced an important improvement in the mode of effecting the relief of the edges, which will be rendered intelligible by reference to the perspective view of one of his balances, in fig. 6: a strong triangular frame, having a vertical motion communicated by a lever and spiral segment below the stand, lifts off the bearings of the two end suspensions, so as to free the beam entirely from connection with the scale pans, during the process of loading and unloading them; by a further turn of the handle below, the beam itself is raised off its fulcrum by two Y slides, which catch corresponding brass pins protruding from the beam above the prism of steel, as is seen enlarged in figs. 7 and 8.

In causing the beam to descend, the supports are first disengaged, so that the weights can be nearly counterpoised by the suspension from the brass pins, before

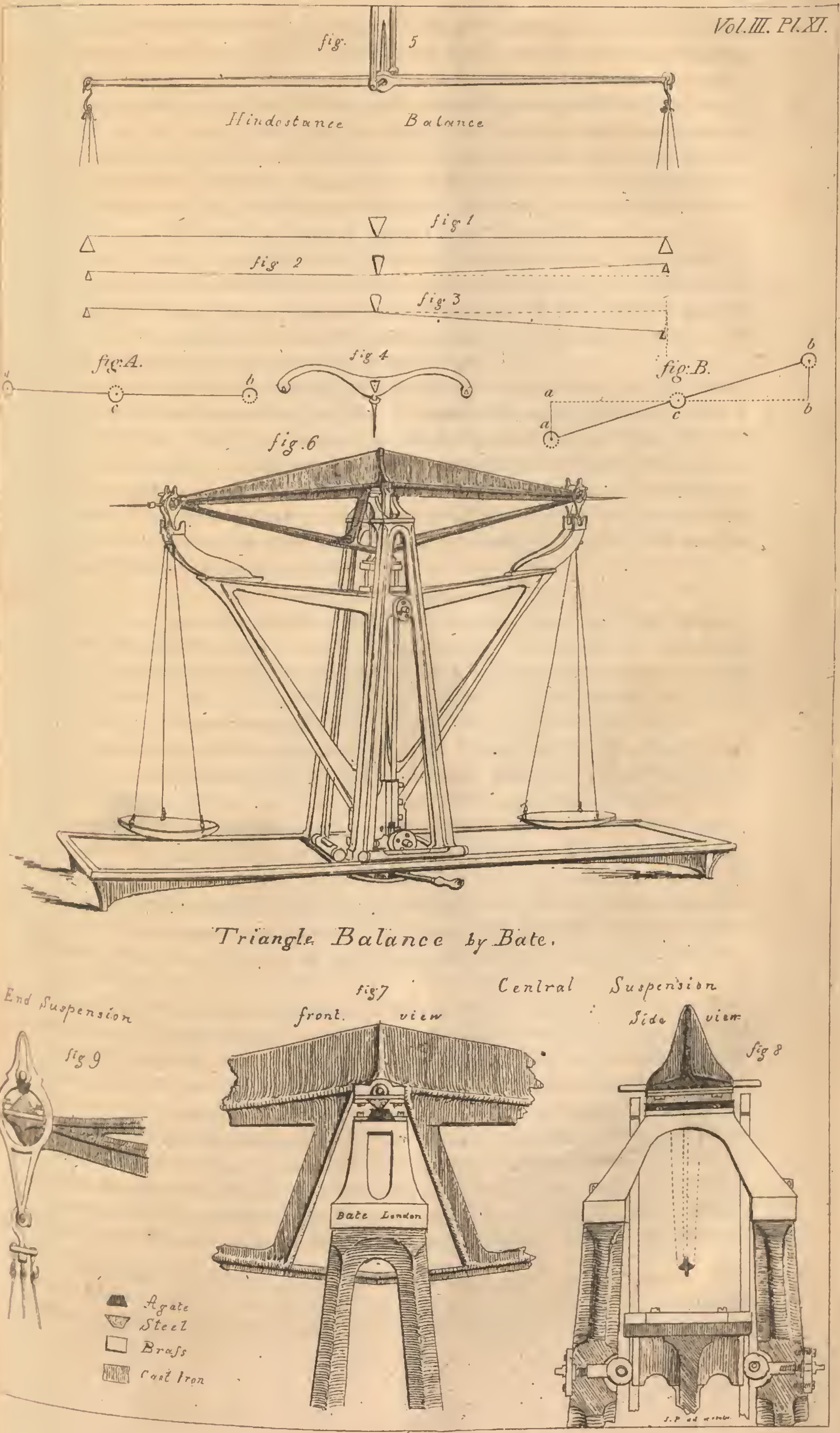


fig. 5
Hindostanee Balance
fig 1
fig 2
fig 3
fig:A.
fig 4
fig:B.
fig.6
Triangle Balance by Bate.
End Suspension
fig 9
fig 7
front. view
Central Suspension
Side view
fig 8
Bate London
Agate
Steel
Brass
Cast Iron

the real knife-edge is brought to bear. This improvement is of the greatest importance to the preservation of the good qualities of a balance for large weights; and there is nothing difficult in its adaptation to the ordinary commercial purposes in a more simple form. One amendment may still be suggested to the makers; namely, that the false supports or pins should be situated in the prolongation of the true edges, to prevent the rubbing which must take place, when the relief is not quite vertically directed: nay, it would be better to increase the length of the prisms themselves, and relieve upon the outer extremities of them, using the reserved part of the edge only for final adjustment of the weight.

I do not think it necessary to enter into a minute detail of the construction of the several parts of these very effective balances, because it may be found in the Cabinet Cyclopedia, vol. v. p. 286, or in the Phil. Trans. for 1826. And the general form will be understood from the accompanying plate XI. figs. 7, 8, 9. The beams are made of cast bronze, with feather edges.

The plan of making the relief of the fulcrum upon a portion of the edge itself, had suggested itself in the construction of an accurate assay balance, of which I have taken the liberty to trouble you with a representation in Plate XII. As there are a number of practical conveniences introduced in this instrument, a short description may not be without interest to those who have constant use for a balance of exceeding delicacy: that of which I am speaking will measure one ten thousandth of a grain, with 100 grains in the scales, which is equal to the one millionth part of the whole weight.

1.—*Of the Balance itself.*

The beam, (figure 13,) is made of a double cone of silver with one-fourth copper, beaten hard, and very thin: it is twelve inches long, and weighs less than a steel beam of only half the section; the centre block is perforated to admit a turned shoulder-piece, (fig. 12,) containing a prismatic knife-edge of agate, which is protected by a thin silver elastic jacket, fitting closely over its upper surface.

The agate prism is two and half inches long: it was ground and polished until the line of light on the edge was no longer visible under the microscope; from being worked by the hand on the hones, it acquired a very small degree of curvature towards the centre, (fig. 13,) of which advantage was afterwards taken[1]. The length of the prism is of great service in preventing any lateral motion on the bearings, but its principal object was to allow room for three different supports, so that the same beam should have three degrees of sensibility, according to the purpose for which it might be required. The mode of effecting this object is represented in fig. 13; where *aa′ bb′* and *cc′*, are the three pairs of supports, all made of polished agate.

The first, or common supports, *cc′*, were made with concave surfaces, as most convenient for ordinary use, in preventing the displacement of the beam; they were attached to the upper stage, and bore upon the part of the knife-edge nearest to the beam. The next pair *bb′* were fitted upon a moveable crutch, (fig. 11.) capable of rising through the opening in the brass stage, just sufficiently to lift the fulcrum off of the fixed supports *cc′*. The crutch was worked by a wire passing through one of the brass pillars of the stage, and connected by a lever and rod with one of the flower ornaments in the corner pedestal of the case, as may be traced in the section, fig. 14; the surface of the bearings *bb′* was only slightly curved, and from their application to the part of the prism outside of the first, the position of the ful-

[1] The ends of the prism were bevilled off to a point, so as to allow no contact with the confining walls of the support; and this point ought not to be neglected by makers, as the want of it is a source of much trouble in many excellent balances.

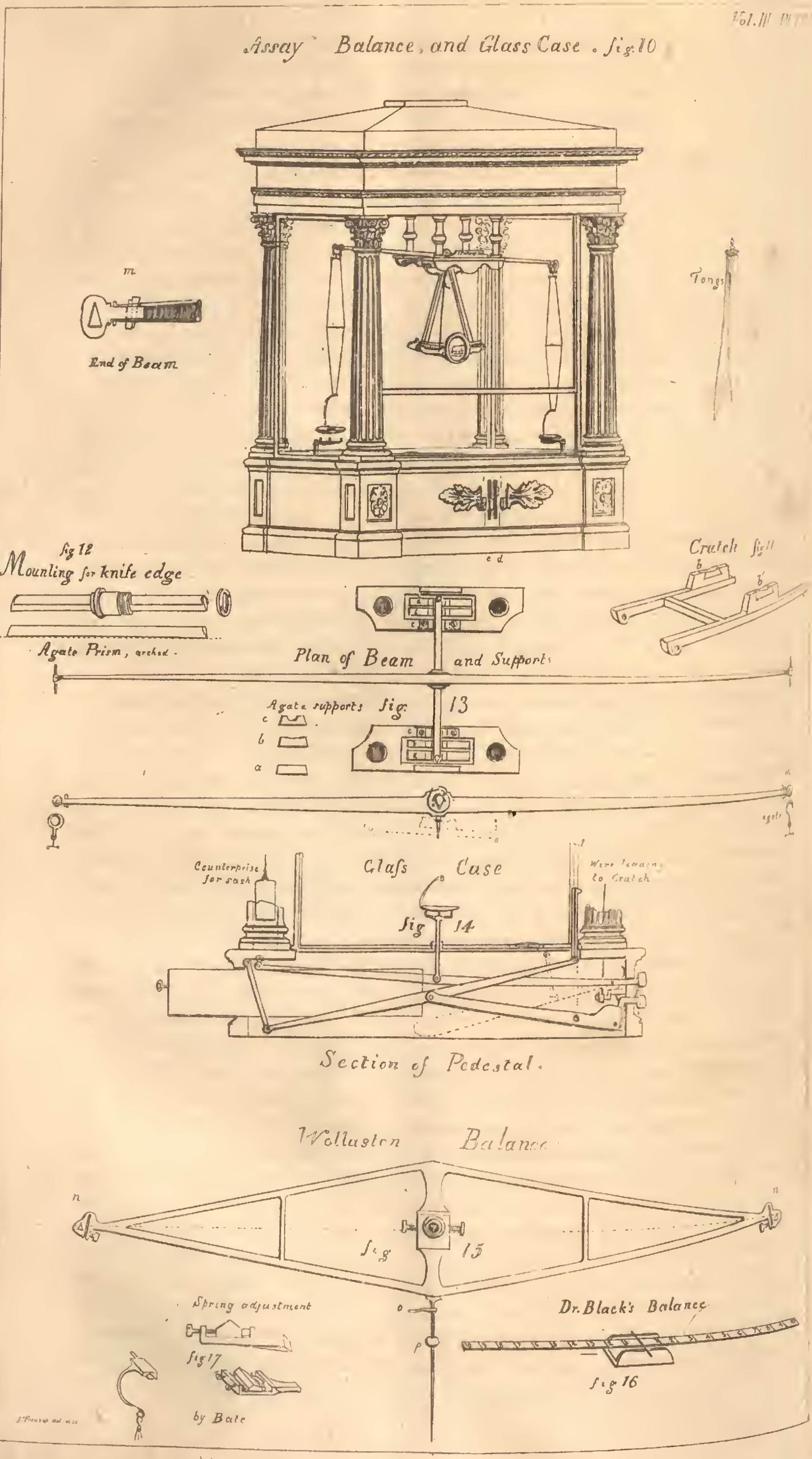
crum was slightly lowered, and that of the centre of gravity of the beam consequently raised, both combining to give increased sensibility to its motion.

The third set of bearings *aa'*, were constructed in a similar manner, working outside of *bb'*, and lifting the beam clear of them: the motion in both cases was communicated by cranks, to avoid any shock to the edge. The surfaces of *aa'*, were ground perfectly plane, and were highly polished: the increase of sensibility due to the depression of the fulcrum may be estimated by the number of oscillations made by the beam, which were found to be respectively on *cc'*, 7; on *bb'* 4¾; and in *aa'*, only 3½ per minute: but the alteration in the figure of the bearings, the perfection of the edge from being seldom used, and above all, the depression of the central fulcrum below the horizontal line, which is the condition exemplified in figure 2, combine in rendering the balance more than *three* times as sensible under the latter circumstances, *i. e.* the index travels over thrice the space upon the divided arc below. As it is convenient to measure very minute fractional weights at once upon this arc, it was necessary to provide for a change of the divisions with the change of bearings: it is needless to describe the mechanical contrivance for this simple object; suffice it to say, that the divisions for *aa'*, correspond to 3000ths of a troy grain, and that estimation may be made to a third of that quantity: a lens is fixed in focus to read off the indications. The end supports, with their rings, are entirely of agate; their prisms are longer than usual, to oppose the tendency of the scale-pans and silks to revolve, and thus wear the edge: instead of three silks also, the scales are suspended by a fine annealed silver wire, attached to a curved arm of the scale pan, to obviate the accidents liable to occur from catching hold of the threads with the tongs, in placing or removing the load.

2.—*Of the Scale Box.*

It may not seem superfluous, after so minute a description of the balance itself, to say a few words on the subject of the case which contains it; for where such an instrument is in constant use, a number of inconveniences are sure to strike the manipulator, which might be remedied by the communication of his experience to the artist. For instance, it may be remarked, that glazed wooden cases, are not suitable to this country:—the wood warps and admits dust into the box, and the glass frequently cracks; the strings of the sash frame are also a constant source of annoyance, from their breaking; especially when weighing operations are to be conducted under a *pankha*: again, when the frame supporting the beam stands on the floor of the case, small weights are continually missed, and dust lodges in every nook: many such particulars might be pointed out, but it will answer the same purpose to describe the attempts made to remedy them in the instrument now under review.

The case, (fig. 10.) consists of two parts:—an outer ornamental stand of wood, and an inner brass frame, glazed on all sides above and below, with plate glass; the front sash was counterpoised by weights in the back columns, with annealed silver wires in lieu of strings, passing over pulleys of as large a diameter as the entablature would conceal: but further to prevent the necessity of opening and closing this sash during work, a small sash was made to rise from below, by pressing upon one of the knobs of the flower ornaments in the centre compartment of the pedestal (*e*), it was fixed to a frame of iron, working like the parallel motion of a steam engine, and properly counterpoised, as will be understood from the section in fig. 14. By the side of the knob *e*, was another knob *d* connected with the supports under the scale-pans, and duly counterpoised, also without the intervention of strings or wheels; the same motion, therefore, which set the balance in action, served, when necessary, to close it from access of air, by bringing up the small window, and vice versâ. The central portion of the pedestal was


Vol. III
Assay Balance, and Glass Case. fig. 10
m
End of Beam
Tongs
fig 12
Mounting for knife edge
Agate Prism, arched.
Crutch fig 11
b
b'
Plan of Beam and Supports
Agate supports fig. 13
c
b
a
Counterpoise for sash
Glass Case
fig 14
Section of Pedestal.
Wollaston Balance
n
n
fig 15
Spring adjustment
fig 17
by Bate
o
p
Dr. Black's Balance
fig 16

provided with a drawer, opening from behind, into which the substances weighed were deposited, through a small spring trap-door in the floor of the case, to prevent their incumbering the case. The dimensions of the pedestal were 20 inches by 16, and 5½ inches high; the total height of the case was 30 inches, and the whole expense of construction, by native workmen, both of balance and case, was 158 Rupees.

As some apology may be due to your readers, for troubling them with so detailed a description of a balance made for my own purposes, and not likely to come into general use, I will, in conclusion, show how much more simple means may be applied to attain nearly an equal degree of accuracy, by extracting Doctor Black's account of a "very Sensible Balance" from the Annals of Philosophy, for 1825. It is represented in Plate XII. fig. 16.

"A thin piece of fir wood, not thicker than a shilling, and a foot long, three-tenths of an inch broad in the middle, and one-tenth and a half at each end, is divided by transverse lines into twenty parts; that is, ten parts on each side of the middle. These are the principal divisions, and each of them is subdivided into halves and quarters. Across the middle is fixed one of the smallest needles I could procure, to serve as an axis; and it is fixed in its place by means of a little sealing wax. The numeration of the divisions is from the middle to each end of the beam. The fulcrum is a bit of plate brass, the middle of which lies flat on my table when I use the balance; and the two ends are bent up to a right angle, so as to stand upright. These two ends are ground at the same time on a flat hone, that the extreme surfaces of them may be in the same plane; and their distance is such that the needle, when laid across them, rests on them at a small distance from the sides of the beam. They rise above the surface of the table only one-tenth and a half or two-tenths of an inch, so that the beam is very limited in its play:—see *fig.* 190.

"The weights I use are one globule of gold, which weighs one grain, and two or three others which weigh one-tenth of a grain each; and also a number of small rings of fine brass wire, made in the manner first mentioned by Mr. Lewis, by appending a weight to the wire, and coiling it with the tension of that weight round a thicker brass wire in a close spiral, after which, the extremity of the spiral being tied hard with waxed thread, I put the covered wire into a vice, and applying a sharp knife, which is struck with a hammer, I cut through a great number of the coils at one stroke, and find them as exactly equal to one another as can be desired. Those I use happen to be the $\frac{1}{30}$th part of a grain each, or 300 of them weigh ten grains; but I have others much lighter.

"You will perceive, that by means of these weights, placed on different parts of the beam, I can learn the weight of any little mass from one grain, or a little more, to the $\frac{1}{1200}$th of a grain. For if the thing to be weighed weighs one grain, it will, when placed on one extremity of the beam, counterpoise the large gold weight at the other extremity. If it weighs half a grain, it will counterpoise the heavy gold weight placed at 5. If it weigh $\frac{6}{10}$ths of a grain, you must place the heavy gold weight at 5, and one of the lighter ones at the extremity to counterpoise it; and if it weighs only one or two, or three or four hundredths of a grain, it will be counterpoised by one of the small gold weights placed at the first or second, or third or fourth division. If, on the contrary, it weighs one grain and a fraction, it will be counterpoised by the heavy gold weight at the extremity, and one or more of the lighter ones placed in some other part of the beam.

"This beam has served me hitherto for every purpose; but had I occasion for a more delicate one, I could make it easily, by taking a much thinner and lighter slip of wood, and grinding the needle to give it an edge. It would also be easy to make it carry small scales of paper for particular purposes." P.

VI.—*On the Aristocracy of Science.*

To the Editor of Gleanings in Science.

Sir,

It has been said with truth, that Science is of no country in particular; and that with one solitary, but striking exception, the practice of all civilized nations throughout the world is uniform in considering her votaries as belonging to no *class* in particular. Hence the freedom, the equality, the *free masonry* of the constituents of learned societies on the continent, contrasted with the exclusion, the formality, and I may add, the jealousy observable in similar institutes in England. For one practical man in the latter, will be found ten theorists, or individuals whose only recommendation to the honor of being ranked with men of science, is the strength of their purse, or superior local position in society. Hence all our great improvements in the arts and sciences have been accomplished by practical men, from the humbler ranks of life: witness an Arkwright—a Watt—a Fulton—a Davy—a Lawrence; while on the continent, it will be observed, nearly all their inventions have been the result of the labor of professed scavans. In England, the vast majority of the members of bodies termed scientific, have no claim to that title, the weight of practical talent resting with the unclassed and humbler sons of science. The natural consequence of this state of things in England is beginning to be felt: many individuals of sound scientific acquirements, but who had not the good fortune to be considered "*eligible*" to the honors of the Royal Society, or Society of Arts and Manufactures, in consequence of not moving in a line of life sufficiently elevated or aristocratical, have been received with open arms by the learned Societies of the continent. It has been sarcastically remarked, that these individuals were "*over-scientific*," that is, possessed of too much practical knowledge to deem it safe for them to be placed in contact with the mass of pretence which could be sifted out of some of the learned and scientific bodies of England. Be the cause what it may, we see how the wrong has worked its own cure, in the "Mechanics Institute," and the establishment of that able and practical publication, the "Mechanics Magazine."

From this harsh picture, let us turn to India—I should be wanting in respect to many gifted individuals, from whom I have experienced much kindness, were I to assert that the case is similar here. There is not amongst the European portion of Society in India, rich as it is in a concentration of talent, far exceeding that of any other of such limited extent, any institution specifically directed to those objects, to which the Society of Arts and Manufactures of London devotes its attention. Indeed, there is but one learned institution on this side of India, the Asiatic Society; and its honors are not attainable by men of the class in question, whose claims it would, however, be but justice to consider, and policy to admit. Practical men, conscious of their own powers, are too proud to solicit notice; and not being possessed of influence, or rich enough to command the honor of becoming members of societies, whose very existence depends on their profession of cultivating literature and the arts, rest content with their own attainments, and their knowledge perishes with them. Under this view of the case, the recent proposition of admitting honorary local members into the list of the Asiatic Society, is truly praiseworthy and liberal, with whomsoever it originated; and I trust it will be carried into effect, thereby gaining for the Society a vast accession of strength, not merely numerical, but rich in that which constitutes the chief recommendation of all scientific or learned societies, the aggregate of practical information possessed by their members. In all such bodies, to speak without offence, and to take an apt simile from the most industrious of the insect creation, there should be two classes; the scientific and the operative—the queens and the working bees. Without the assistance of the latter of these classes, a body may be very learned, and very scientific, but its efforts are not productive of practical benefit; much theory is started, and but little practice elicited.

The establishment of the Physical Class of the Asiatic Society, has, in a great degree, improved the sphere of utility of that society, so long confined to abstruse researches relating to the past, rather than in attending to the more important points—the present and the future.

In my humble opinion, the most efficient service which men of information can do, is to elicit the latent resources of the country; to bring into operation modes of procedure in any branch of economy, superior to those at present received—in short, to add to the sum of existing knowledge regarding India, whatever is likely to be of practical utility, to the country or its inhabitants.

The GLEANINGS have recorded much valuable information of the nature adverted to, but a vast fund remains, which will never be available, until the artificial distinctions which pervade society in this country, shall be waved in the equal eye of science; and in this respect, all men of information, whatever their occupation or rank, (and there are very few individuals of scientific acquirements, who will not be found respectable also,) be admitted to benefits to which they have a just claim.

PRACTICUS.

VII.—*Notice of a Lightning Explosion in Intally.*

To the Editor of Gleanings in Science.

SIR,

The daily papers have related several instances of the disastrous effects of the storm on the morning of the 13th instant, particularizing the death of severa natives who were killed, and the manner in which some houses were struck by lightning. Thinking that an account of the effect of the electric fluid, on an upper-roomed house in Intally which has not been mentioned in any of the public prints, may be interesting to your readers, and induce some of your correspondents to communicate through your publication some useful information as to the most efficient method of guarding against such accidents, I beg to trouble you therewith. I am persuaded, that many of the lightning conductors in Calcutta are so improperly constructed, as to be more likely to produce, than avert mischief; for I have observed some resting upon the roof, others having no connection with the ground, and some fixed to the side of the house by long iron fastenings driven into the wall.

The house referred to in Intally was struck about 3 A. M. on the east side, or rather south-east corner, from an explosion which apparently spread in an horizontal direction; the wall of the house being split below the upper cornice, immediately over a venetian window of the back staircase, down the bolt of which the fluid ran; but in coming in contact with the brickwork, at the bottom of the venetian, the electric fluid seems evidently to have separated; part descending inside, perforating the brick stairs, and part passing outside, probably from the attraction of the damp walls; the latter evidently forced its way through a parapet wall, over a projecting lower room, descending to the long bolt of a venetian door below, from the end of which bolt having no immediate attractive power, it split the frame to pieces, till it reached a small bolt at the bottom, the brass work of which it bent.

On reaching the lower story, both branches of the electric fluid seem to have spread in different directions, with different degrees of power; the strongest attraction appears to have been from the hinges and iron fastenings of a venetian door, which opened from the lower room mentioned to an inner one; part of the fluid having passed up the frame of this door, and through the wall, above, till it reached the venetian of a dressing room, immediately over it; part of which venetian it destroyed, attracted from one iron fastening to another, and finally passing up the bolt, penetrated the brickwork by a small hole, and escaped outward just below the cornice[1].

I have thus described where the electric fluid did most damage, but its presence was traced in no less than seven rooms, four bathing rooms, and the back staircase, in all twelve different places. In one of these two children were in bed, and in another a young man; through the brick wall of whose room a very remarkable small perforation appeared direct to the handle of the bolt of a venetian door, standing open against the wall on the other side; down this bolt the fluid seemed to have passed, and entered the wall again by another small hole, exactly even with the bottom of the bolt[2]; this room was in the north-east corner on the lower story, and the lightning had evidently been attracted by a long iron rod standing in the adjoining bathing room, other holes in the wall appearing at the top of the rod[3].

The proprietor of the house was preparing a lightning conductor, but had not erected it when this accident took place; it is now put up, being about twelve feet higher than the roof, with a pointed gilt copper cap. The lower extremity or base rests on the ground, two feet distance from the foundation of the house, inserted in a leaden pipe, which extends about fifteen feet from the house in a sloping direction, under ground; to which he is adding two other leaden rods or branches, which will extend still further, and be about five feet deep; water having now risen in the hole dug for the purpose, within two feet six inches of the surface. He intends erecting another conductor, in the same manner, at the north-west corner, distance from the first 100 feet; also laying narrow plates or rods of lead upon the roof or walls, connecting the same with the conductors.

[1] Upon examining the premises, it appeared to us more probable, that this fracture under the cornice, was owing to a second stream of lightning having been discharged from the wet roof in this place:—the direction of the fluid could generally be pronounced from the nature of the perforation, which was like a clean gimblet hole where it entered, and was broken away with the stucco, where it escaped.

[2] This was a very curious example of a deviation of, perhaps, fifteen feet made across a room, and through a solid wall, for the mere object of running a few feet down the metallic conductor, and afterwards resuming its course below. Another singular perforation was made through a wall to the corner of a picture frame, hanging on the other side; after soiling the gilded work at that place, and on the opposite corner, the electric fluid returned through another hole in the wall.

[3] The lightning here also seemed to us to have traversed downwards, as the plaster was knocked away at the top of the rod. All the circumstances developed in this instance, tend strongly in favor of the employment of conductors; and we agree with our correspondent in thinking, that the strips of lead on the roof would assist materially in conveying away any accumulation of electricity therefrom:—it might, however, be sufficient to place the rod near one of the rain spouts.—ED.

Hoping that the present communication may draw forth some information on the subject of electricity, which may be useful in saving the lives and property of others,

I am, Sir, your obedient servant,

A Subscriber.

P. S.—I had almost forgotten to mention, that the roof of the back staircase where the house was struck, is about four feet below the main body of the house, which makes the seeming horizontal stroke appear more remarkable; but it has been suggested, that the fluid probably descended perpendicularly, but had no effect on the upper part of the wall, from its being wet from the rain, which gave it a conducting influence.

VIII.—*Proceedings of Societies.*

I.—Medical and Physical Society.

Saturday, 2d July.

Dr. Strachan, Deputy Inspector General of Hospitals at Madras, and Mr. Rutledge, Surgeon, His Majesty's 55th Regiment, were elected Members.

The following letters were read. One from Mr. Piddington, of Neemtollah, with specimens of Part I. and II. of his Botanical Index of the Linnean Genera and Species of plants, with corresponding native names, which will prove an useful work to all persons interested in the study of Indian Botany and Materia Medica. One from Mr. W. Bell, Assistant Surgeon, Kemaoun Local Battalion, relative to the topical application by natives, in certain inflammatory affections, of the inside of the skin of a crow recently killed, in the same way that Baron Larrey states he had seen the inside of the skin of a sheep, while warm from the animal, applied to severe bruises of the body. A report on the diseases of Assam, by Mr. Leslie, Assistant Surgeon. Report on the diseases of Penang, by Mr. Boswell. An Essay on Pthisis Pulmonalis, by the same. An account of the Salop, or Orchis, procured in Kemaoun, with a sample of the article, by Mr. Lindesay. Abstract of a meteorological register at Lohooghaut, in Kemaoun, for twelve months, by the same. A case of inflammation of the veins after venesection, by Mr. Playfair, Superintending Surgeon. A copy of Mr. Christie's work on Cholera, printed in Edinburgh, in 1828, was presented by Mr. D. Campbell. Mr. Machell, Member of the London College of Surgeons, presented a copy of his work on cold and warm baths, several of which, as well as other apparatus, he had sent to Bengal. A case of very bad ulcer, cured by Mudar, was presented by Dr. H. Mackenzie. Mr. Grant presented a translation from an oriental work on the Pulse, by Rajah Kali Kissen; and a statement forwarded by Dr. A. Murray, 23d Native Infantry, received from Dr. Honigberger, in the service of H. H. Maharajah Runjeet Singh, relative to that gentleman's practice in hydrophobia. His principal object is to keep up a copious suppuration for several days from the bitten part, by applying the actual cautery, or where that is declined, a blister; and administering pills composed of mercury and extract of tobacco, until certain sensible effects are produced. A specimen of large Cobra was presented by Dr. Tytler, alluded to in a case recently laid before the Society. Mr. Cameron's report on Vaccination; Mr. Henderson's statement respecting Cholera on board the H. C. Ship *Berwickshire*, in the harbour of Bombay; Dr. Tytler's communication on a diseased condition of Barley, and Mr. Warrand's case, where the *Secale cornutum* was successfully administered, were then read and discussed by the meeting.

Mr. Cameron commences his report with the remark, that the state of vaccination has continued stationary for some years in Bengal; and that it meets with exactly the same obstacles, as those mentioned by Dr. Shoolbred, as far back as 1805, and arising principally from the jealousy and machinations of the *Tikadars*, or small-pox inoculators. Notwithstanding these prejudices, however, Mr. Cameron testifies, that vaccination still maintains its ground, and many respectable natives in Calcutta have their children regularly vaccinated, and great numbers of the lower classes are daily vaccinated by the vaccinators attached to the department; and of late, he thinks, they shew a greater disposition to avail themselves of the antidote than formerly; owing probably to the greater prevalence of small-pox, of which disease they have a very great horror. In consequence of the great prevalence of small-pox at many of the stations under this Presidency, for upwards of twelve months;—at Mr. Cameron's suggestion, a letter was addrcseed to the different Superintending Surgcons, by the Medical Board, calling upon them to furnish information on the subject, and desiring to know if small-pox had supervened on vaccination, and to what extent. In the replies received, although the disease prevailed epidemically, not one case is mentioned of genuine small-pox occurring after vaccination. In many cases that had been previously vaccinated, a modified disease shewed itself at several stations, which went through its course mildly, and disappeared in a few days: thus shewing that although vaccination is not entirely a preventive against small-pox; yet that, in those cases where it does occur, the disease is comparatively mild, passing off without leaving those dreadful consequences which generally follow an aggravated attack of small pox. We are therefore (urges Mr. C.) fully warranted in asserting, that Vaccine Inoculation still maintains its ground.

With the view of conquering the prejudices of the Natives, on the subject of vaccination, Mr. C. adverts to the fact of Government having directed that Native Doctors, educated at the Medical Institution, so ably presided over by the late Dr. Breton, should be instructed in Vaccination, and sent to out-stations where the natives had previously no means of availing themselves of this blessing. He bears gratifying testimony to the result of this experiment with respect to the Native Doctor sent to Munneepore. The vaccine vesicle, as it now exists in India, has been repeatedly compared by Mr. Cameron, throughout all its stages, with the plates of Dr. Jenner and Dr. Willan; and they correspond, he thinks, in every essential particular. We regret that want of space does not admit of our quoting some of the reports from the up-country stations adverted to by Mr. C., nor of giving his remarks on imperfect vaccination. Suffice it—that vaccination is imperfect—first, when the fluid employed has lost some of its original properties; secondly, when the persons vaccinated are soon afterwards affected with any contagious fever; and thirdly, when they are affected at the time of inoculation with some chronic cutaneous disorder.

With respect to Mr. Henderon's statement on Cholera at Bombay—It is premised that the H. C. S. *Berwickshire*, with a crew of 150 of the ordinary age, a larger proportion than usual of whom had not before crossed the equator, anchored in Bombay Harbour, on the 5th June 1830, with a cargo almost wholly consisting of coals and cases of military stores. Her passage had been favourable, and there were only five men on the sick list. From the 5th to the 10th, the work on board was very light. The weather during that interval was always sultry, particularly on the 6th and 9th. For several days before the arrival of the ship, the weather had been cloudless, and the thermometer and barometer nearly steady, the former at 84° and the latter at 29-90 inches; and from the day of arrival until the 10th, the thermometer had indicated a gradual rise of 3°, and the barometer a corresponding fall of 0-11 of an inch. As soon as the ship arrived in the harbour, the crew were put on fresh provisions as usual, and on the 7th, water was procured from a well belonging to Jemsetjee Irjeebhoy, and conveyed from it to the casks in the boats by bheesties in their skin bags. This well has the character of retaining water longer than most others in dry seasons. By most of those examined, it has been described as thick and discoloured, by some as being slimy, and others observed animalculæ in it.

On the 6th and 9th, both sultry days, there were squalls from the N. E. accompanied with thunder and lightning, and a little rain. "The squall which occurred on the 9th has been described, by all who were questioned regarding it, as being accompanied with a chilly blast of air from the N. E. for about ten minutes, and followed by a hot air or wind from the same quarter. Some of those who were examined saw nothing very remarkable in the squall, while others remarked at the time, a peculiar lurid appearance in the sky, and describe the alternations of the hot and cold blasts as being very sudden and uncommon. Some even remarked a peculiar unpleasant smell to accompany the N. E. wind. At this time, many of the crew were seated on the forecastle; but they speedily went below on the first appearance of rain with the squall, while, at the same time, the ports of the gun-decks were dropped, or half closed."

About midnight of the 9th, the first man was taken ill, while sleeping in his hammock, near the forepart of the ship. "Some hours elapsed before a second case occurred, and only six cases of the disease had occurred before four P. M. of the 10th. From that time, during the night of the 10th, and until noon of the 11th, they were increasing very fast." The Surgeons of the other ships had lent their aid during the night, and when the healthy were removed to Butcher's Island, and the sick to the General Hospital, eleven men had died, and about thirty had the disease. Many were attacked in their hammocks, several while sitting at light work on the poop, some when attending on their comrades, and there seems to have been no exemption from the attack from any situation or employment. Of two men who went on shore immediately after the squall of the 9th, in perfect health, one was seized with cholera and died on shore. Of three men who went on shore on the morning of the 10th, and returned to the ship in the evening, two were attacked and died on board. During the night of the 10th, few or none of the men who were well went to their hammocks, partly from the number of sick, who were hanging up; partly from the number required to wait on their comrades; but principally from a dread which the men had to go below, which induced many of them, as appears, to prefer walking the upper-deck great part of the night in a dejected state. After the removal of the crew to Butcher's Island[1], thirteen were taken ill on the 11th, five on the 12th, two on the 14th, two on the 16th, and two on the 18th, which last were cases of relapse. The Monsoon rains set in on the 16th. Of the whole crew, ninety-four men were taken more or less ill, fifteen died on board, sixteen in the hospital, and seven on the island. The state of matters on board the H. C. S. *Edinburgh* was considerably different, but our limits will not admit of our entering into the particulars. It appears, that several of the crew of the *Berwickshire* were in the practice of squeezing green limes into the shore water which they drank: many, however, were attacked who did not adopt this practice. Though the heat in the hold was, to the feelings, greater than on deck, the proportion of deaths among those who worked in the hold was two in ten less than among the rest of the crew. The sail-makers and quarter-masters, employed at sedentary work under the awning of the poop, suffered more severely than other parts of the crew. Some of those who recovered, described their illness to have commenced with panic at the havoc the disease was making. It did not appear that any unusual state of the atmosphere was perceptible for some days before the ship made the harbour, that the men were in the habit of sleeping on deck, or that they got out in any of the squalls while in the harbour. It did not appear that the sufferers had indulged themselves to an unusual extent in fruit or in water. Nothing in the investigation which could lead Mr. Henderson in the least to suspect the presence of contagion.

If the epidemic on this occasion was not dependent on a peculiar state of the atmosphere, it was, Mr. H. thinks, increased at that particular time by the meteoric changes which occurred nearly simultaneously with the attack, and which were attendant on the setting in of the S. W. Monsoon from the 6th to the 10th. "The first shower of rain falling at the end of May, on the dead animal and vegetable matter accumulated throughout the dry season, and the rapid decay of marine animal and vegetable matters thrown, by the prevailing winds, on the N. W. coast of the Island, and which is at that season very apparent to the senses, may be considered as co-existent with an increase of cholera in Bombay at that particular time." The prophylactic precautions in cholera must be of a very general nature. Among others, Mr. H. recommends the avoiding all sources of debility or over-excitement. There should be a proper regulation of the diet, drink, and clothing. This will consist in attention to the quality of the food brought to the ship; in the suppression or restriction of the use of fruits; in the filtration of water; and in the use of woollen clothing as much as possible.

With respect to the disease affecting Barley crops in this country, Dr. Tytler states that, in the upper provinces, it is named Lera, and that it annually destroys an immense quantity of the grain. The diseased substance he deems an organised body, which is demonstrated by its making its appearance in the earliest stage of the grain's growth, and gradually increasing in size till the ear is fully formed, and filled with this black matter. This substance is very poisonous, as was proved last year, by the circumstance of some chickens which accidentally

[1] A small Island about four miles up the harbour.

devoured a few ears, all dying in about twenty-four hours afterwards. Between the standard of sound grain and that of the extreme disease, which the drawing forwarded by Dr. Tytler represents, there are, he states, many shades or degrees of distemperature, in all of which the diseased grain is liable to produce a deleterious effect upon the animal system. The cause of this distemperature is wholly unknown.

VIII.—*Notices of European Science.*

On Caseum and Milk.—(Braconnot.)

[From the Quarterly Journal of Science.]

An excellent, because practical memoir on milk has been published by M. Braconnot, in the *Annales de Chimie*, xliii. 337, which offers many applications of a substance long, but not thoroughly known, not a few of which we anticipate will hereafter come into use. This substance is caseous matter, or as he had called it, Caseum.

Soluble caseum, and its applications—2,500 parts (grammes) of the curd of new cheese, as sold in the market, were heated to 212° for some time; it contracted, and became a glutinous elastic mass, swimming in much serum, and dried, it weighed 469 parts. It was a compound of caseum, with acetic and lactic acids: being divided, put into sufficient water with 12. 5 parts of crystallized bicarbonate of potassa, and heated, it dissolved with effervescence, producing a mucilaginous liquor, distinctly reddening litmus paper. Being evaporated carefully, with continual agitation, it left a soft portion which, as it is cooled, acquired consistency, was drawn out between the fingers into thin portions, and then dried in the air upon a sieve, it weighed 300 parts. This soluble caseum is a supercaseate of potassa, containing still butter and salts. It resembles isinglass, is of a yellow-white colour, translucent, and of a stale taste: it is perfectly soluble in hot or cold water, producing a fluid rendered milky by the presence of butter.

In this impure state the substance is easily prepared: instead of the bicarbonate, the potash or soda of commerce may be used. The following are hints for its application. Like gelatine, it may be preserved without alteration for any length of time, and may be obtained in enormous quantities, if required. Associated in various ways with food, it must prove of the greatest importance on board vessels for long voyages. Its aqueous solution, sugared and flavoured with a little lemon-peel, makes an agreeable and nourishing drink for invalids. It is a powerful cement: its solution, evaporated on glass or porcelain to dryness, cannot be removed without injury to the vessels; its hot concentrated solution has been applied with great success to join glass, porcelain wood and stone: the same solution forms a brilliant varnish; being applied to paper, it makes labels, which, when moistened and attached, adhere with great force. It may be used instead of isinglass in dressing silks, ribands, gauze, preparing artificial flowers, &c. It has not answered in endeavours to clarify beer, but is equal to milk or cream in the clarification of table liqueurs, giving them the softness and qualities of age. It may be used in place of creamed milk in the clarification of beet-root, sugar, syrups, &c. in conjunction with animal charcoal, without exciting any fear regarding the presence of serum. M. Braconnot thinks also, that by the help of a little ammonia the greater part of the curd, previously separated as above from its serum, may be taken up and converted into a dry substance. This, with the help of earthy salts, will be of great service in clarification; for having dissolved some of this preparation in water, a small quantity of muriate of lime and sulphate of lime in powder was added; the liquid remained clear whilst cold, but the slightest effect of heat made it coagulate uniformly throughout; the coagulum gradually contracted, and a perfectly clear liquid issued from it.

Milk has always been considered as a certain antidote in some cases of poisoning. The soluble caseum will perform the same office against most of the metallic salts, but there is reason to believe that white of egg is better than either against corrosive sublimate.

Chemical properties of Caseum.—Caseum is an acid which, because of its tendency to combine with almost every substance, it is very difficult to obtain pure. The soluble caseum already described is to be dissolved in boiling water, put into a funnel, the aperture of which is stopped, and left until a layer of cream has collected on the surface. After removing this, a little sulphuric acid is to be added, which will form a clot of sulphate of caseum; this is to be well washed and then heated in water, with just enough carbonate of potash to dissolve it. The mucilaginous liquor formed is, whilst hot, to be mixed with its volume of alcohol. It is necessary that no deposit form at the moment; it should occur only in the course of twenty-four hours, and will include the butter, the sulphate of potash, and part of the caseum. All is to be placed on a cloth, and a clear transparent liquid will pass, which evaporated to dryness, leaves caseum pure, except in retaining a minute portion of potash.

Caseum, or caseic acid, thus obtained, is a dry diaphanous substance, resembling gum arabic in appearance, and unalterable in the air. It reddens litmus paper, is soluble in hot or cold water, forming transparent viscid adhesive solutions, yielding by evaporation transparent pellicles, which again dissolve in water. The mineral acids, except the phosphoric, when added to the liquor, unite with the caseum, and produce white, opaque, coagulated insoluble masses. Very weak solutions are not thus coagulated, as may be seen by adding a little diluted sulphuric acid to such; heat does not cause the effect, but the moment a little lime is added it happens at once. Milk, with twice its bulk of water, is not coagulated by sulphuric acid cold, but apply heat and the effect is produced, because a little phosphate of lime in the milk then becomes sulphate, and acts as above generally; the combinations of cheesy matter with acids are imputrescent. Well washed sulphate of caseum was left with water for a long time; it gradually disappeared, but produced no putrid odour.

Vegetable acids precipitate caseum, unless in excess; potash, soda, and ammonia produce very soluble compounds with it, which are perfectly transparent, unalterable by air, and resemble gum. All earthy bases and metallic oxides form insoluble compounds. All salts, except those with base of potash, soda, or ammonia, combine with caseum to form insoluble compounds. Even a little selenitic water put into a solution of caseum, though it causes no change at first, yet, when heat is applied, produces insoluble pellicles, which are a compound of the caseum and earthy salt. The same or still more striking coagulation happens with sulphate of magnesia, and acetate of lime.

Strong alcohol does not affect caseum, weak alcohol dissolves it, sugar renders a solution of caseum more liquid, gum arabic renders it quite insoluble, probably from the presence of earthy salts in it. Infusion of galls acts with it as with gelatine. M. Braconnot suspects that vegetable albumen is nothing more than caseum with some earthy salts present.

Improved Milk.—Besides caseum and butter, milk contains salts, &c. which are not particularly desirable. M. Braconnot took $2\frac{1}{2}$ litres (4. 4 pints) of milk, heated it to 113° F., gradually added dilute muriatic acid, and agitated the whole. The curd formed contained the caseum and butter, and being separated from the whey, was gradually mixed with 5 grammes (77 grains) of crystallized sub-carbonate of soda, reduced to powder and warmed. No water was added, but the whole gradually dissolved. It had the weak acidity of recent milk, and formed about a half-litre of cream (a fifth of the first bulk), capable of numerous applications in domestic economy. If made up to its first bulk with water and a little sugar, it forms a milk more agreeable than the original, or it may be flavoured, &c. and used as cream. If it be heated with about its weight of sugar, it becomes remarkably fluid, and forms a perfectly homogeneous syrup of milk, which will keep for any length of time, and which, by the mere addition of a sufficient quantity of water, forms a perfectly homogeneous white opaque liquid, which is in every respect like sugared milk of improved flavour. The syrup diluted with water forms a nourishing drink for invalids, carefully evaporated, but not beyond a certain limit, or the butter would separate; it gave, when cold, a soft confection, which left for a twelvemonth in a loosely stopped bottle, underwent no change. This, when exposed in thin portions to the air, was rendered quite dry, and could then be crushed and kept for any length of time without change, being always reconvertible into useful states by the mere addition of water.

Meteorological Register kept at the Surveyor General's Office, Calcutta, for the Month of July, 1831.

Day of the Month.	Minimum Temperature observed at Sunrise. Barometer reduced to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Maximum Pressure observed at 9h. 40m. Barom. red. to 32°	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Observations made at apparent Noon. Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Max. Temp. and Dep. of M.B.Ther. obs. at 2h. 50m. Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Minimum Pressure observed at 4h. 0m. Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Observations made at Sunset. Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Rain-gauge No. 1.	Rain-gauge No. 2.
1	29,548	83,7	2,3	s. e.	cu.	,577	88,3	5,6	s. e.	cu.	,542	91,3	7,9	s. w.	cu.	,510	89,	5,3	s. w.	cu.	,490	86,7	4,	s. w.	cis.							
2						,559	89,	5,9	s.	do.	,540	89,5	6,1	s.	ci.	,477	91,	7,	s.	ci.	,478	88,9	6,2	s.	cus.	,511	85,7	3,8	s.	ci.	0,52	0,45
3	,540	84,5	3,	s. w.	ci.	,583	86,3	3,2	do.	do.	,543	89,	5,6	s. e.	do.	,486	89,5	6,6	s. e.	do.	,475	89,	7,1	s. e	ci.	,502	85,5	3,1	s. w.	cu.	0,48	0,45
4	,504	82,5	3,1	do.	cus.	,552	86,8	5,4	s. w.	cis.	,525	89,3	5,9	s. w.	cis.	,453	92,8	7,9	s. w.	cu.	,421	92,6	9,2	s. w.	cis.	,451	84,	2,6	do.	cis.		
5	,504	82,5	2,1	s.	do.	,542	87,8	6,4	s.	ci.	,515	90,5	7,4	do.	cu.	,462	92,3	6,9	do.	do.	,447	90,5	5,1	do.	do.	,463	85,7	3,3	do.	do.		
6	,509	83,3	0,9	s. w.	cis.	,548	89,3	5,3	s. w.	do.	,527	92,7	7,3	do.	ci.	,484	90,5	4,6	do.	cus.	,473	84,3	3,2	do.	n.	,529	82,3	2,6	do.	n.		
7	,536	83,7	1,4	do.	cu.	,572	88,	5,3	do.	cus.	,555	91,8	7,6	do.	cis.	,499	87,8	3,6	do.	cy.	,480	85,6	2,9	s. c.	do.	,529	84,	2,6	s. e.	cis.		
8	,495	79,7	1,3	cm.	rn.	,548	77,5	1,1	cm.	rn.	,541	80,5	2,1	s.	n.	,491	81,7	2,5	s.	do.	,460	83,5	4,1	s. w.	cis.	,494	82,	1,6	cm	do.	2,52	2,25
9	,488	82,5	1,1	do.	cis.	,511	88,8	5,9	s. e.	cu.	,500	87,6	3,9	s. e.	cy.	,452	89,5	5,1	s. e.	cis.	,434	88,5	4,8	s. e.	cus.	,472	83,5	1,8	s. e.	cu.	0,45	0,35
10	,495	82,3	0,9	s. w.	cus	,534	83,5	1,6	s. w	cus.	,514	86,5	4,1	s. w	cis.	,482	88,	6,1	s. w.	do.	,455	87,	5,1	s. w.	cu.	,496	83,5	3,1	s. w.	ci.		
11	,524	81,5	1,1	n. e.	n.	,551	85,8	4,6	n. e.	cu.	,533	82,7	1,4	cm.	cu.	,481	88,8	6,1	n. e.	cus.	,454	88,3	6,6	n. e.	n.	,477	84,3	3,4	n. e.	cus.		
12	,545	80,7	1,3	do.	cus.	,559	85,3	4,1	do.	cus	,554	85,6	2,4	do.	cis.	,509	86,3	4,4	do.	cis.	,501	86,	3,6	do.	cu.	,526	84,	4,1	cm.	cis		
13	,591	81,	1,6	do.	cy.	,631	87,	4,9	s. e.	cu.	,630	88,	5,7	s. e.	do.	,6?2	83,5	3,1	e.	rn.	,607	85,3	3,6	s. e.	cus.	,581	83,	3,6	s. e.	do.	0,47	0,45
14	,694	80,1	1,	cm.	n.	,712	86,8	5,1	do.	do.	,693	85,	3,1	do.	cus.	,651	87,3	6,	s. e.	cu.	,635	87,	5,7	do.	cu.	,652	83,7	3,3	do.	n.		
15	,708	82,5	2,1	e.	cu.	,733	87,3	5,2	e.	do.	,726	82,7	1,6	e.	n.	,689	85,5	2,8	cm.	rn.	,661	88,3	6,1	cm.	ci.	,674	85,7	3,8	do.	cl.		
16	,718	83,8	2,4	n. e.	do.	,755	88,	6,7	n. e.	do.	,738	90,5	8,1	n. e.	cu.	,693	92,3	10,	n. e.	cu.	,671	87,8	6,1	n. c.	cu.	,681	85,	2,6	n. e.	cu.		
17																,571	89,9	7,5	do.	ci.	,575	88,	6,1	do.	do.	,596	87,3	5,9	do.	ci.	0,28	0,25
18	,607	83,7	2,3	cm.	do.	,627	89,5	5,6	cm.	cu.	,593	91,5	9,4	cm.	cu.	,533	89,5	11,8	cm.	cu.	,512	91,8	10,4	cm.	cis.	,576	85,5	3,1	cm.	cis.	0,25	0,20
19	,586	84,	1,6	do.	do.	,623	88,	5,3	do.	do.	,603	92,6	9,9	s. e.	do.	,512	94,	10,3	s. e.	cus.	,502	87,3	5,1	s. e.	cns.	,522	86,	3,9	do.	do.		
20	,598	82,7	1,3	s. w.	ci.	,651	89,6	8,2	do.	do.	,637	90,8	9,1	cm.	do.	,552	95,5	12,8	cm.	cu.	,524	92,5	10,8	cm.	cu.	,544	88,	6,1	do.	cu.		
21	,577	83,	1,9	cm.	cu.	,620	86,3	3,3	do.	do.	,604	88,7	6,8	do.	cis.	,548	91,6	9,4	n. e.	do.	,524	89,5	7,1	do.	do.							
22	,570	81,5	1,1	n. c.	cus.	,610	85,7	4,3	n. c.	do.	,579	89,3	7,1	n. e.	cu.	,521	85,5	4,4	do.	rn.	,496	89,9	8,2	n. e.	ci.	,526	85,	3,1	n. e.	ci.	0,12	0,08
23	,564	82,	1,1	cm.	cis.	,573	88,8	6,1	do.	do.	,559	86,5	4,6	do.	do.	,511	85,8	4,1	cm.	cus.	,492	87,3	4,8	cm.	cu.	,531	84,5	2,6	do.	do.		
24	,551	81,7	1,3	do.	cy.	,580	82,	2,1	s. e.	cy.	,575	84,	2,6	s. e.	cus.	,537	81,	1,1	do.	cy.	,546	83,3	1,4	do.	cus.	,550	82,5	2,1	cm.	n.	1,35	1,10
25	,548	81,3	2,4	s. w.	cus.	,577	85,8	4,7	s. w.	cis.	,535	89,	7,1	s. w.	cu.	,471	90,5	8,3	s. w.	cu.	,451	88,9	7,2	s. w.	cu.	,455	86,	4,6	s. w.	cu.		
26	,425	82,	2,1	do.	do.	,458	84,5	3,8	do.	cy.	,443	82,	1,1	cm.	rn.	,398	82,5	1,3	do.	rn.	,379	82,5	0,6	do.	n.	,369	83,3	1,6	do.	cus.	0,38	0,35
27	,359	82,3	2,2	cm.	cu.	,384	84,7	3,5	w.	cus.	,366	85,7	4,	w.	cus.	,313	86,7	5,	w.	cus.	,291	83,5	1,8	w.	do.	,302	81,	1,1	w.	do.		
28	,316	81,5	1,1	do.	cus.	,369	83,	1,9	cm.	cis.	,349	86,7	4,	s. w.	do.	,308	85,7	3,8	s. w.	cis.	,302	83,5	1,8	s. w.	cus.	,358	84,	2,6	s. w.	cu.	0,25	0,20
29	,441	81,	2,1	s.	cis.	,479	85,6	4,4	s.	do.	,473	87,7	6,6	s.	cu.	,431	88,3	7,2	s.	cu.	,414	87,7	6,4	s.	cis.	,446	85,5	5,1	s.	cis.		
30						,518	84,3	7,4	s. w.	do,	,509	85,7	8,3	s. w.	cy.	,465	82,8	6,1	s. w.	cy.	,416	85,3	7,1	s. w.	do.	,467	84,5	5,6	s. w.	cu.		
31	,456	82,	2,6	cm.	cu.	,506	82,	3,6	cm.	cus.	,495	82,5	3,1	cm.	do.	,461	82,5	3,6	cm.	n.	,438	82,	2,1	cm.	cus.	,454	82,	2,1	cm.	cus.		
Mea[n]	29,536	82,2	1,8			,568	86,2	4,7			,550	87,5	5,5			,502	88,2	6,			,485	87,2	5,3			,508	84,4	3,3			7,07	6,13

Abbreviations. In the column "wind," small letters have been used instead of capitals; *cm.* means *calm*. In the column "Aspect of the sky," *cy.* is *cloudy*; *cl. clear*; *rn. rain*; *ci. cirrus*; *cu. cumulus*; [illegible] *cirro-stratus*; *cus. cumulo-stratus*; *co. cirro-cumulus*; *n. nimbus*. The Rain-gauge No. 1, is on the ground; No. 2, is on the roof of the [illegible]

GLEANINGS

IN

SCIENCE.

No. 32.—*August*, 1831.

I.—*On some of the* Scolopacidæ *of Nepal. By* H. B. Hodgson, *Esq. B. C. S.*

It is the more especial purpose of this paper to describe two new, or, at least, very rare and interesting species of Snipe, found in Nepal; very faithful drawings of which, large as life, are appended to the paper[1]. But, as these rare species, doubtfully allied, in some respects, to both woodcock and snipe, will be best illustrated by a comparison with the ordinary types of the two genera, and as—to judge by my numerous specimens of the common woodcock and common snipe, with reference to Shaw's descriptions of them—these my standards of comparison would not seem to be free from local variations, I shall precede my account of the species first alluded to, by descriptions and drawings of the common woodcock and snipe, as they occur in Nepal. This manner of proceeding will, I am aware, make my paper long, and perhaps tedious; but the beauty of the drawings (the work of a native artist, in my service) may atone for the tediousness of the descriptions; and, at all events, I cannot otherwise insure accuracy—not to mention, that if the Nepalese types of the common snipe and common woodcock, prove to be indeed varieties with reference to the European birds, I shall, by my additional labour, do, I believe, an acceptable service to the science which so agreeably amuses my leisure hours. Shaw asserts, that the common snipe is twelve inches long. The same author's generic character gives the anterior toes connected at the base by a membrane: and he adds, that this bird is not usually gregarious. A great sporting author, again tells me, that the woodcock weighs from 12 oz. to a lb. Now these are facts—if facts they be (not to mention others), which are not reconcileable with my experience in Nepal.

Scolopax Rusticola—Common Woodcock.

The finest specimens of the woodcock procurable in Nepal, measure 13½ inches long, with a bill of nearly three inches, and a weight of 11½ oz. Ordinarily, the fully grown birds reach 13 inches in length; but their average weight is not above 10 oz. I never weighed, save one, that was fully 11½ oz.—and that was an unusually large and fat bird, killed nearly at the close of the season, or in April.

The woodcock makes his appearance here, probably, about a month after the close of the rains, and remains with us till the accession of the hot weather; so, at least, we presume, from what we observed here, and know of the general habits of the bird—for the fact of his being *migratory at all* is not capable of positive ascertainment, owing to the density and darkness of our woods, except during the

[1] See remarks at the end of the paper. Ed.

cold months. We shoot him from November till April, inclusive; and the earliest bird seen was on the 1st November; the latest, on the 3d May. From the multitude of small-sized birds killed in November, (11 inches long, and 5 to 7 oz. heavy,) I conjecture, that the woodcock breeds near to us in the north, just beyond the influence of the rains; that he remains on the Indian side of the Himalaya, except during the rainy and hottest months of the year; and that during the other 8 months, by descending and ascending the various steps of the ladder of the Himachal, he preserves (as he may, almost without an effort), that moderate temperature which he loves. The central region, equidistant from the snows, on one hand, and the plains on the other, seems to be his favourite abode. But in the coldest months of the year he descends to the lesser hills immediately overlooking the plains of India, and even to the great forest, at their foot. He has been twice found, in December and January, in the midst of the plains of India—once in the Doab, and once close to Calcutta[2]: but these occurrences must have been casual. In the great mountains of India—such as the Vind'hya, the Syhadree and the Nílgiri—he is almost as common as in these regions. The woodcock moults soon after his arrival in Nepal; and again, just before his departure—assuming a fresh garb for winter and for summer—the latter, apparently, considerably more brilliant than the former. The tints of the plumage are subject to great variation—but the general colours, and their disposition, are perfectly uniform. The woodcock invariably seeks his mate before he quits us, in April: but at other times, he is seldom or never found in her immediate company—being, in his habits, one of the most solitary birds in existence. He is a bold bird, and seemingly much less shy of the neighbourhood of men and houses than is usually supposed. Small and open as are the Residency grounds, he frequently alights in them, and stays till killed. One bird visited us for four successive years, and remained throughout the season, on each occasion; becoming, at last as familiar as any bird with his habits of life, could be. Shaw observes, that the woodcock feeds chiefly by night—proceeding, regularly, to and from his day-time retreat for that purpose. In Nepal, at least, his retreat is ever the same with his feeding ground, and he feeds by day, all day—and, I fancy, only by day. He is almost always found in the rills which intersect our woods in every direction, and in which he feeds. He runs freely, but flies heavily, most unwillingly, and for a very short distance, unless much alarmed, fwhen he will break cover, and getting into an open space, exert, at least, for a ew moments, all that great power of wing which he possesses, though most loath to use it. But however small the coppice which he has chosen for his abode, for the nonce, hardly any degree of annoyance will induce him to quit it entirely, unless there happen to be another cover close at hand; for which he will, in that case, make; but not before he has been flushed and shot at, several times. An experience of 10 years' duration warrants my affirming, that there is only one species of woodcock in Nepal, which I believe to be identical with the common Europe sort: and, as woodcocks and most other *Scolopacidæ* are found in abundance here, either as passengers or periodical residents, the absence of the so called lesser cock, induces me to join those who doubt its existence, as a distinct species, in Europe. So far as I have observed, the woodcock invariably rises silently—the snipe, on the contrary, almost invariably, piping.

In respect to the external differences denoting sex in this bird, Shaw says, that "the female is *smaller*, and her colours less brilliant." I confess myself unable to detect, anatomically, the distinctive signs of sex in the woodcock; but I have procured many couples of them, which circumstances demonstrated to be male and

[2] Most likely from the Cásia Hills. Ed.

female, and I have always found the larger to be the blacker—the smaller, the redder, and, I should say, the more brilliant, bird. The following is an accurate description of the perfect state of the plumage: front half of the head, above, dull gray blue, or ash, with a black mark at the base of the bill, and here and there visible indications of the black bars on each feather within: back half of the head, and dorsal surface of the neck, black; divided transversely by three (or, including the foremost, four) pale yellow red bars: from the mouth, through the eyes, and a little beyond them, a broad black line: parallel to the above line, another shorter and narrower, across the ears: orbits, buff: remainder of the sides of the head, reddish buff, dotted with black: sides of the neck, the same, but darker, and the dots elongated to short transverse bars, as you descend the neck: chin, immaculate white: pectoral surface of the neck, dull reddish yellow, cross-barred, with brown black zigzags, and exhibiting, in front, a gorget formed of the fine black and chesnut hues of the back: breast, the same, margined round the shoulders of the wings with the lower horn of the black and chesnut lunation beginning above: belly, to the vent and thighs, the same; but paler, with the difference of intensity in the ground colour, distinctly marked across the bottom of the breast: under tail-coverts, the same, but the ground-colour and marks, both brighter, and the latter often assuming a lanceolate form[1]: upper parts of the plumage, elegantly barred, spotted, streaked, marbled, and variegated, with black brown, black blue gray, buff rusty red, and chesnut red, disposed in rows, crossed and interrupted at intervals, by lines and marks of various shapes, in a manner defying description—save only so far as it may be distinctly noted, that two parallel lines of the palest of those colours invariably run lengthwise down either side of the back, margining the scapulars, both above and below; bottom of the back, and superior tail-coverts, the same, but less variegated, and redder: quills, dusky black, triangularly indented on both webs with red: tail, jet black, with the tip blue gray, above, and glossy white below; and the webs indented with reddish, as in the quills: bill, fleshy brown, with a cold blue tinge, and dark tip: legs, bluish fleshy gray: irides, clear brown.

Gallinago Media—Common Snipe.

In Nepal, as in England, the snipe is not entirely migratory; some birds remaining with us throughout the year. But the greater portion go and come, like the majority of the *Grallatores.* They arrive towards the close of the rains, in August and September—and depart when the drought is at its height, or in May. They are most abundant at the close of the rains, when the whole country is covered with rice then ready for the sickle; every field presenting a swamp, just freed from water.

In the spring, they are found in the corn and mustard fields, near to permanent swamps; of which there are many in Nepal. In the winter, they are scarce, from want of cover.

In Nepal, the snipe is decidedly gregarious—and, when not stinted for feeding ground, exceedingly so. In October, in a single rice-field, twenty and thirty birds will be found, huddled together: and every Indian Sportsman knows, that in a snipe-country, his two guns are never suffered to grow cold. I am told, the like is the case in Ireland, as well as in those few counties of England, which alone are suited to the habits of the bird. England is not, generally, a snipe-country: and to this circumstance I attribute Shaw's error in supposing, that "snipes do

[1] Vide Shaw, xii. 45.

not usually assemble in flocks[2]." Their manners, in other respects, are well described by Shaw. They usually rise piping, and go off against the wind with a rapid zigzag flight; and to a considerable distance, except in very hot weather, or, when their site, for the time being, is surrounded by a country unfitted to their abode. When the snipe reaches Nepal in August and September, he is in full feather. About a month after his arrival, or towards the close of September, he moults—and again, six weeks before his departure, or in March. The finest specimens measure from 10½ to 11 inches, never more—with a length of bill, varying from 2¾ to nearly 3 inches. The fullest weights vibrate between 4½ and 5 oz. Shaw says, that the common snipe reaches a length of one foot. May I be permitted to doubt this? since, just before, he has described the *great* snipe, and given it only the same measure of length. Shaw says nothing about the snipe's tail, nor mentions any distinction in that, or other respect, between the male and female birds. I know not, therefore, how to account for a peculiarity which I have noted—which is, in itself, very marked, and is usually concomitant with other less decided diversities. I have noted these points at all seasons, and in birds of all sizes. They *may* serve to discriminate two separate species; though they, probably, refer only to more or less perfectly adult states of one—possibly, to the sexes in that one.

In Nepal, then, at all seasons, from August to May, I have killed many snipes, invariably distinguished by a tail of from 22 to 28 feathers—of which the 6, 8, or 10 laterals, on either side, are narrow, hard, and acuminated; and many others, at the same times and places, as invariably possessed of a tail of from 14 to 16 *uniform* feathers—the former birds, too, always characterised by shorter bills, and internal wing-coverts, much more regularly and beautifully barred. The drawings, large as life, which accompany this paper, will suffice, after what I have said, for the complete illustration of these points, which I now leave to more competent persons to decide the character of, having wearied myself with vain endeavours to come at the secret: for, I have been perplexed, not informed, by what Shaw says of the internal wing-coverts of the great snipe, and of the medial or common snipe.

Of the former, he observes, "beneath the wings beautifully crossed with white and dusky bars," and of the latter, "beneath the wings beautifully tessellated with cinereous and whitish,"—descriptions which, as far as they go, not very inaccurately apply to the first and second of my birds, respectively: but neither of these birds, assuredly, is the great snipe of Shaw, and both of them, in general plumage, answer sufficiently well, to the common snipe's appearance, as depicted by that writer. Then, again, Shaw's generic character of the snipe gives "anterior toes connected at the base by a membrane," whereas both these birds, the Jack, and the two large species, to be presently described, have, all alike, the toes cleft.

Regretting that I cannot refer to a later or more authoritative work, I shall now proceed to describe the appearance, in full plumage, of the common snipe of Nepal. The permanent colour of the bill is pale brown, but it is frequently overlaid with a greenish yellow tint: legs, dull bluish, most usually supratint-

[2] The expression is dubious: if it mean that they do not usually *fly* in flocks, like the golden plover, &c.—granted: but if it mean that they do not usually feed and reside together—that they are not commonly *found*, in vast numbers, in one and the same spot—I say it is no further true, than as they are scarce in any particular country or season, from some one or more circumstances of uncongeniality with their habits and wants. Quails do not *fly* in flocks or coveys; but they are social and gregarious surely?

ed with yellowish pale green : iris, brown : entire top of the head and nape, black, dotted with reddish, and margined on both sides, and divided in the centre by reddish yellow lines, running lengthwise : cheeks, pale ruddy yellow, dotted with dusky : chin, yellowish white and immaculate : from the gape through and beyond the eye, a dusky line, and another smaller one across the ears : neck, dusky and pale ruddy yellow—the colours disposed lengthwise, but not very distinctly, and on the lateral surfaces, in nearly equal portions—on the dorsal surface the dusky prevailing—on the pectoral face, the reddish yellow : breast, the same, but the colours paler and more indistinct : quite round the bends of the wings, on the sides of the breast, brighter ruddy yellow, with the marks disposed mostly crosswise ; but irregularly, many of them being wedge-shaped : sides of the body, cross-barred irregularly with dusky : entire belly to vent, pure white : thighs, the same, with occasionally a few faint dusky cross bars : internal tail-coverts, pale rufous yellow, with dusky zigzag bars, inclining to wedge-form : internal wing-coverts, consisting of nearly equal parts, of pure white and black, disposed transversely : upper part of the back, black varied with some rufous yellow dots and incipient bars, and margined on either side by a clear broad longitudinal line of ruddy yellow : scapulars, and flags falling into the line of them, the same, and similarly margined, but more variegated ; the dots spreading into lines, and descending either web, till, by approximating below, they become cuneiform : lower part of the back, (beneath the large scapulary plumes,) and superior tail-coverts, yellow red, cross-barred, but irregularly, with dusky black : quills dusky, the edges of the primaries, and tips of the secondaries, (save those already described as falling in with the scapulars,) white : external wing-coverts—the smallest, dusky, tipped with white—the centrals, dusky, cross-barred, with dull impure rufous yellow, or dull yellowish, barred with dusky—the largest, dusky, with white tips. The tail has the central feathers for ⅔rds from the base, full black—for the terminal third, orange, crossed near the tips with a narrow dusky band ; the tips themselves pale orange : but even these central feathers have their black basal portion indented with orange : and as you approach the lateral feathers, these indentations spread into bars, and fade nearly to white ; tips of these laterals, pure white : the extreme laterals dusky, vaguely barred with whitish towards the tips, and clearly tipped with white.

The bird, which has 14 to 16 uniform feathers in its tail, is distinguished from the above, by having the extreme lateral feathers of the tail more distinctly and regularly coloured—the ground being, in them, whitish, and the bars, (which are distinct,) dusky ; and, by having its internal wing-coverts, except those two or three long ones adhering to the sides of the body, white, very inconsiderably and irregularly marked with black. Here and there is something like a transverse bar, or rather cuneiform mark, the variegations being, for the rest, like blotches more than bars—and half the coverts being entirely devoid of them. This bird has too, almost invariably, a longer bill than the other ; but his general plumage and characters, with the exceptions noted, entirely alike.

It should now become my business to describe the two new and rare species of snipe, the account of which was the original sole object of this paper. But before proceeding with that account, it will be necessary for me to advert to the contradistinctive points of the genera Scolopax and Gallinago, in order that it may be seen upon what grounds I afterwards assign those two species to the one genus, rather than to the other—although, in truth, I am much less interested about their being consigned to this or that genus, than I am with the circumstance of their forming so interesting a link between the two. Comparing the bills of the woodcock and snipe, it may be remarked, that the woodcock's beak is much shorter in proportion to its size[3], thicker at the base, and more uniformly attenuated to the tip; that the upper mandible is less rounded, or, more cut out by the groove; that the tip of the bill is more obtuse and less rugose; and the division of the mandibles, at their tips, more abrupt. The nostrils are alike in both genera. The tarsi and toes of the woodcock are smaller in proportion to its size. The wings of the woodcock are fuller, and have the longest flags nearly an inch shorter than the longest quills. Lastly, the woodcock's tail consists invariably of 12 uniform, soft feathers.

On the contrary, the snipe's bill is longer, less thickened at the base, fuller on the sides, less uniformly attenuated—there being a decided thickening of the bill near the tip—the points of both mandibles, more acute and less abruptly sundered; the rugosity more marked.

The legs and toes of the snipe are longer, though the latter are similarly cleft to the origin, as in the genus Scolopax. The wings of the snipe are more angular, the first and last feathers being equally long, and the centrals very much shorter than either. Both genera have the first quill usually longest—but the 2d sometimes equal to it. And, to conclude, the snipe has the tail variously feathered, both as to the number and character of the quills; the laterals being, for the most part, very narrow and hard. Between the two genera, besides the remarkable distinctions of manners and size, there are two unerring diagnostics—which are, that the *tibiæ* of the woodcock are clothed entirely, and that the nail of the hind toe is truncated: whereas, the snipe's *tibiæ* are partially naked, and the nail of his hind toe is sharp and projecting as in the foretoes. I should not hesitate to characterize the woodcock, in his manners, *as a solitary* woodlander—the snipe, in his, as a *gregarious* tenant of the open country.

If these distinctions be accurately drawn, both the birds about to be described should, I conceive, be assigned, upon the whole, to the genus *Gallinago*; though both of them, in the material points of manners and size, approach the woodcock almost in the same degree that they recede from the snipe—being, in truth, about midway between the two genera in both respects; and though, besides, one of them has wings of a non-descript character, differing from those of both genera, and resembling entirely the wings of the genus *Rhynchæa*.

Gallinago Solitaria ? Solitary Snipe? *Hab.* Nepal.

The subject of the following description was, I believe, discovered many years back, in the Taráí[4], or woody and marshy belt of land, confining these mountains

[3] I never found a woodcock's bill exceed three inches, and that length is equalled by the bills of very many snipes.

[4] It, however, is only a casual visitant of the Taráí; its peculiar habitat being these mountains, from which it may be supposed frequently to issue into the wilder tracts, at their immediate base, during the coldest months of the year. Five years have now elapsed since we first found it here. We have killed several of the species every succeeding year, in our excursions for the purpose of shooting cocks. Many stuffed specimens have, since the period of the discovery, been communicated to various individuals—and amongst others, to Mr. Smith of Arrah, who has published a pretty drawing of the species, as correct as any drawing done from a single dried specimen can be. I only speak conjecturally, when I say, that this is the species discovered some years back in the Taráí, and still occasionally found there. Very possibly, therefore, the bird is entirely new. Nay, it is possible, that the Taráí bird may be identical, not with this species, but with the one subsequently described:

and the plains of India. But I have not found any description of it in print; it being clearly not the same with the great snipe of Shaw, (*Gen.* Zoology, xii. 51.) The name, however, is an extremely good one, (Solitary Snipe,) and should be retained, if not pre-occupied: for the bird is eminently distinguished from the common species by his solitary habits. He measures, when fully grown, 12½ inches, of which the beak is fully 3 inches. His weight, varying with his condition, is from 5 to 6 ounces, and upwards. He is, in Nepal, entirely migratory, appearing and disappearing at the same time with the woodcock. He is a very rare bird—more so, by much, than the cock; and of course, than the common snipe. In manners, as in size, he is nearly equidistant from the cock and snipe. He is never gregarious, seldom being found within several acres of his mate even: and he never resorts to the open country, nor to the centres of woods. His favourite site is a swamp on the confines of a wood, provided the swamp be fringed with brushwood; for if not so screened, he will not frequent it. He haunts, likewise, the bushy rills that descend from most of our precipitous woods into the more level country, and when flushed, he will go up and down them; but never follow them into the thick cover. If much alarmed he will ascend the mountain brow, and alight on a bare part of it, near the top, or scud away, with astonishing rapidity to another favourable site. His flight is exceedingly rapid and devious, like that of the common snipe: and like the snipes, his first flight is often a very long one. No bird of the kind is harder to kill. Judging from many specimens, and many circumstances, I infer, that the male differs from the female in being rather smaller, and more highly coloured, and not otherwise.

The form of this species is very elegant, resembling that of the common snipe, and without that dumpiness of figure for which the woodcock is observable. Referring to the particular account, given above, of the diagnostics of the common woodcock and common snipe, I cannot better describe the bill, legs, wings, and tail, of this bird, than by observing, that they agree with those of the snipe, just as they disagree with those of the woodcock. And, as this bird has neither the plumed *tibiæ*, nor the truncated hind toe nail, which belong so peculiarly to the genus *Scolopax*, he must be considered a snipe, without doubt, notwithstanding his solitary habits, and avoidance of the open country; the more especially as his general appearance and colours are those of the snipe. Indeed, it is not easy to mark clearly, the distinction in point of colouring between this and the common species of snipe; the colours and their arrangement being, in both, essentially the same. There is, however, this one invariable distinction between them, in point of colour, that, whereas the common snipe's belly is entirely immaculate white; the belly of the solitary snipe is, except a narrow portion down its very centre, cross-barred with dusky. For the rest, it can only be observed satisfactorily, on this head, that all the colours, including those of the bill and legs, are paler in this species. It may be particularly noted, that the conspicuous longitudinal lines of the back are, in this species, usually pure white, though, sometimes, rufescent white.

possibly even it may be *different* from *both* my birds, which, in the last event, will both be discoveries made here.

I have just ascertained, that a large species of snipe visits the Nílgiri mountains, with the woodcock, and that this species has been supposed identical with the *Gallinago major* of Shaw. I entirely doubt this identity; and believe, that the Nílgiri snipe must be the same with the solitary, or the scolopaceous snipe of this paper. But be that as it may, it may be as well here to add, that both the Nepalese species were discovered before the Nílgiri mountains were heard of as a sanatory retreat for Europeans, and of course, therefore, before the Nílgiri snipe was discovered.

His marks, too, are mostly less decided, and more inclined to dots than lines. Having noticed, that in the common snipe there are, (in many, if not in all circumstances,) two kinds of tail, it becomes necessary to observe, that this species possesses the many-feathered tail, with the lateral plumes, very acute and narrow. He has not, however, so many feathers in the tail as has that form of the common species—having only 18 to 20 feathers with, the 8 to 10 laterals, extremely narrow and hard. Were I satisfied about my competence to give a specific character, I should specifically denote this species thus :—Large, pale, solitary snipe, with tail of eighteen to twenty feathers; the laterals narrowed and hard; and belly, almost entirely barred.

In this species, the *tarsi* are not, perhaps, quite so long in proportion to the bird's size as in the common one—and the *tibiæ* are feathered rather lower: legs, fleshy yellow, or full yellow, never tinted with greenish : bill, palest fleshy brown, suffused with cold blue, and free from greenish tinge : iris, pale brown : entire top of head and nape, brown-black, dotted with rufescent white, and margined on both sides, and divided in the centre by longitudinal rufescent white lines; but lines less distinctly defined, or more interrupted than in the common species: cheeks, whitish, dotted with pale dusky : chin, white and immaculate : from the gape through, and beyond the eyes, a pale dusky line ; and another smaller one parallel to it, below : neck, pale dusky or earthy brown and rufescent white—the colours disposed lengthwise, but indistinctly, and, on the lateral surfaces, in nearly equal portions—on the dorsal surface, the dusky or brown prevailing—on the pectoral face, the rufescent white: breast, the same, but the colours paler and more indistinct, and mixed with some transverse dusky zigzags : round the bends of the wings, on the sides of the breast, brighter rufescent white, with the marks clear and transverse : centre of the breast, whitish, with transverse fuscous bars : sides of the body, white, with transverse zigzags of brown black : sides of the belly, to the vent, the same : mere centre of the belly, immaculate white : thighs, white, with occasional small dusky cross-bars : internal tail-coverts, palely rufescent white, with pale dusky transverse zigzags : internal wing-coverts, consisting of nearly equal parts of pure black and white, disposed transversely : upper part of the back, imperfect black, variegated with numerous dots, and some small irregular transverse bars of yellow red, and margined on either side with a broad clear longitudinal line, of white, or rufescent white : scapulars, and flags falling into the line of them, the same, and similarly margined; but more variegated with bars and cuneiform marks : lower part of back, (under the long scapulars and flags,) and superior tail-coverts, yellow red and dusky black, in equal parts, disposed in transverse zigzags—but both colours, and their disposition, much more distinct on the former than on the latter part : quills, dusky, all tipped with white ; and the outer web, also, of the first and second quills, edged with white, or fully white : external wing-coverts—the smallest, dusky, margined with white—the centrals, dirty rufescent yellow, barred with pale dusky—the largest, dusky, with white tips. The tail, with its central feathers, for ¾ths from the base, black, for the terminal ¼th, orange, crossed near the tips with black—the tips themselves rufous white, and with the laterals, rufescent white, becoming in the extremes, pure white, traversed with numerous, clear, dusky, bars.

Scolopax Gallinago: (Nobis.) Woodcock Snipe. *Hab.* Nepal.

This most interesting species was discovered in the valley of Nepal, several years back; and, in the interval, many specimens and drawings have been communicated to gentlemen resident in India, who take interest in Zoology. None of them has, however, so far as I know, (nor was any entitled so to do,) published an account of it: and, therefore, whilst I claim, at all events, the discovery of it I may proceed to the description of its size, manners, and appearance, as to that of a probably still, new bird. I propose to call it, for reasons which will soon be apparent, the woodcock-snipe, or scolopacious snipe: but if that name seem cacophonous, or improper, I would then suggest that this species should be called the Nipalese snipe—it being, as far as I yet know, peculiar to the eastern half of these mountains, or in other words, to the Nipalese dominions.

It is, I believe, entirely a bird of passage, coming and departing at the same time with the woodcock and snipe, last described—to which latter it is, nearly as may be, equal in size: for, though its dimensions of *extent* are, usually, not quite so great as those of the solitary snipe, owing to its more dumpy figure, and shorter bill and wings—its weight is equal or greater. Its spring moult is not completed till the middle of May, when it has paired, and is on the eve of departure—assuming, that is, its migratoriness; which, however, as in the case of the woodcock, cannot be proved. The latest excursion in which this species was procured, was the 11th of May. Three couples were killed. They had paired: and their moult was well nigh completed(5).

The full grown bird measures 12¾ inches; and its weight, varying with its condition, is from 5¾ to 6½ oz. and upwards. It is rare, and solitary, as the last; and in its manners makes a still nearer approach to the woodcock than that bird does: for its flights are short, and unwilling; and if alarmed it will quit its usual haunts upon the confines of woods—*not*, for the neighbouring bare hill-tops; nor, for some new congenial site at a remote distance, like the solitary snipe—but, for the adjacent thick cover; into which it will, when much annoyed, unhesitatingly enter as though it were a woodcock.

In its dumpy figure, and comparatively short bill, considerably thickened at the base, and thence pretty uniformly attenuated, it resembles the woodcock, just as it differs from the snipe. Its tail is shorter than that of the preceding, and has 16 to 18 (very rarely 20) feathers, with the laterals narrow and hard, but less decidedly so than in the solitary or common snipe. Its tail, therefore, agrees in general character with that of the genus *Gallinago*. So, likewise, do its legs and feet, which have the *tarsi* and toes fully as long as in the common snipe—and the *tibiæ* are even more denuded. The toes are cleft to their origin: the hind nail, long and entire. But it is to the wings of this bird that we must look for the distinctive mark of the species; in as much as, being entirely devoid of the long, hard, and acuminated character of the great quills of both woodcock's and snipe's wings, and, indeed, of those of most of the *Scolopacidæ*, they are peculiarly diagnostic. The wings are, for a bird of this family, decidedly short—they are, besides, rounded, soft, full, and bowed in or concave. The 2nd quill is equal or

5 I have this season taken particular pains to determine the migratoriness, or otherwise, of this species and of the preceding one: the result has been to satisfy myself that both are so, but only by compulsion: for they stay with us till the last moment, heedless of the heat, and only driven out by the multitudes of leaches infesting their haunts after the rains have set in.

My *shikaris*, or sportsmen, who continued making the round of all the places frequented by these birds, till not one was to be seen in any of them, last saw the solitary snipe on the 25th May, and the scolopacious species on the 8th June.—*July*, 1831.

superior to the first: none of the great quills are at all hardened or pointed; nor do they greatly exceed in length the central feathers of the wing. The last flags and first quills are equal—and, so far, the wings of this species agree with those of the snipe, whilst they differ from those of the woodcock. But in their fulness, or considerable and uniform breadth, they are more analogous to the woodcock's wings. As I have already hinted, the *Rhynchæa's* wings exactly resemble those of this species of snipe, which, like the *Rhynchæa*, has a comparatively soft, straight, and feeble flight. As the bird last described has a general resemblance, in point of colour, to the common snipe, with the particular difference of being paler; so this bird bears the same general resemblance to the ordinary type of the genus, with the particular difference of being much darker.

I should characterize the species thus—large, dark, solitary snipe, with short, soft, rounded wings, and belly entirely barred. Top of the head jet black, confined and divided in the fashion of the preceding, with rufous yellow: dorsal surface of the neck, also, jet black, with more or less frequent rufescent yellow marks, disposed lengthwise: top of the back, full black, almost always immaculate, and margined, in the manner of the three preceding, with pale rufous yellow, often smeared with bluish: scapulars, the same, save that one or two of the longest are variegated, with one or more transverse zigzags of pale rufous yellow, besides being tipped with the same colour: all the flags near the body and falling into or approaching the line of the scapulars, black, adorned with large and frequent transverse zigzags, bars, or cuneiform marks, of rufo-flavescent gray, (often tinged with bluish,) occupying as much space as the ground colour; and all these plumes tipped, likewise, with the colour constituting the bars and marks: most of the external wing-coverts, the same: small coverts at the angle of the wings, long coverts of the primaries, (which, however, as well as the bastard wing, are concealed, except when the wings are expanded,) and bastard wings, dusky-black, faintly fringed or tipped with impure whitish: quills, dark dusky, scarcely tipped with whitish: lower back and superior tail-coverts, dull reddish and dusky, in numerous, equal, transverse bars—the latter part more dull and indistinctly coloured than the former: tail feathers with the centrals towards the base, jet black; towards the tip, deep chesnut banded, as usual; and the tips themselves paled—with the laterals, gradually losing their colours, till in the extremes, the black basal portion becomes dusky, and the terminal red part, sooty white, which is crossed by one or two dusky bars: lateral and pectoral surfaces of the neck, blue smeared buff, and black or blackish; proportioned and disposed as in both solitary and common snipe: chin, rufescent white: breast, blue-smeared buff, barred obscurely with blackish transverse zigzags: rest of the body, below to the vent, whitish, with numerous dusky bars, as in the woodcock: thighs, the same: internal tail-coverts, with the ground rufescent, and the marks black: internal wing-coverts, alternately crossed with dusky-black and whitish, the former colour being the ground, or prevalent hue: iris, dusky: legs, clear plumbeous, or plumbeous faint-white: bill, a pretty full brown, usually tinged with cold blue, and paled below at the base, as usual. The male (judging by circumstances) is rather smaller and darker than the female. The following are the sizes and dimensions of the four birds described in this paper, and I take the liberty to recommend particular attention being fixed on them.

Average size and dimensions of the common Woodcock, common Snipe, solitary Snipe, and scolopacious Snipe, of Nepal.

	C.	*W.*	*C.*	*S.*	*S.*	*S.*	*Sco.*	*S.*
Tip of bill to end of tail, ...	1	1¼	0	10¾	1	0½	1	0¼
Bill, length of, ...	less,	3	0	2⅝	0	2⅞	0	2¾
		3½		2½		8		3½
Ditto, basal height of, ...	0	0—	0	0—	less,	—⅜	0	0—
		8		8		8		8
Length of tail, ...	0	3½	0	2½	0	3⅛	0	2⅝
Expanse of wings, ...	1	11½	1	4¼	1	7½	1	6
Length of tarsi, ...	0	1¾	0	1½	1	1⅜	0	1⅝
Ditto of central toe and nail, ...	0	1⅝	0	1½	0	1½	0	1⅞
Weight, ...	10 oz.		4¾ oz.		6 oz.		6¼ oz.	

Remark by the Editor.—The original of the above paper has been forwarded to England, with nine illustrative drawings of the natural size. It is here printed, not only as a security against its being lost, or its miscarrying, but also to guard against anticipation. The drawings we regret not having received; they consist of 1. Two of the woodcock; one standing, one flying. 2. Two of the solitary snipe; do. do. 3. Two of the scolopacious snipe; do. do. 4. Three of the common snipe; one standing, two flying. Of these latter, one has the variegated, the other the uniform tail.

II.—*Note on the Literature of Thibet. By* H. H. Wilson, *Esq. Sec. As. Soc. &c.*

The extent and general character of the literature of Thibet have been, for some time past, accurately described. The Missionaries who visited Lassa in the beginning of the 18th century, stated correctly enough, that it was voluminous; that it was devoted chiefly to the doctrines and legends of the Bauddha religion; and that it was originally derived from India. It does not appear, however, that any of them ever cultivated the language of Thibet with sufficient assiduity or success, to have developed, in detail, these general positions; and all that they have left us of Thibetan literature, as embodied in the *Alphabetum Tibetanum* of Georgi, is justly pronounced by Mons. Remusat to be in the highest degree meagre and unsatisfactory.

The subject of Thibetan literature has subsequently engaged the attention of several eminent scholars in Europe, as Adelung, the author of the *Mithridates*, Pallas, the Russian traveller and naturalist, and in the present day Messrs. Klaproth and Remusat. As long, however, as elementary works, grammars and dictionaries are wanting to place the language of Thibet within the reach of European students, it is not to be expected that much conversancy will be obtained by them with the literature: accordingly the two distinguished individuals last named, Klaproth and Remusat, admit the imperfectness of their enquiries, and are obliged to have recourse to Mongol and Chinese authors for such information respecting Thibet, as they possess.

During the last few years the approximation of the frontiers of British India, to those of Ladakh, and our improved intercourse with the Bhot countries, and with Nepal, have given a new interest to the subject, and have naturally excited a wish to become better acquainted with the languages and literature, the moral feelings and religious principles of the people. The means of obtaining such information are yet defective, but they have been latterly very much augmented, and are likely to receive important accessions from the labours of Mr. Csoma De Körös. A zealous and indefatigable member of our Society, Mr. Hodgson, the resident in Nepal, has availed himself, as the Society is aware, of the local opportunities he has enjoyed to collect a very considerable number of books current in that and the neighbouring countries: many of these he has presented to us; others he has been authorised to procure for the College of Fort William, and they also have been transferred to the Society by the liberality of the Government. Hitherto, however, we have benefited but little by their presence; the language and the characters being unknown to any of our Calcutta members. This defect is about to be supplied, and Mr. Csoma has expressed his willingness to compile a detailed catalogue, with such illustrations as may prove advisable, in conformity to a wish expressed by the Government that he should undertake the task. Mr. Csoma has also prepared a Grammar and a Dictionary of the Thibetan language, which he proposes to complete and publish during his stay in Calcutta.

The short period that has elapsed since the arrival of Mr. Csoma in Calcutta, has not admitted of his entering upon any particular examination of the books in our possession. It appears, however, that in addition to sundry detached and miscellaneous volumes, we have in our library an entire and nearly half a duplicate copy of one of the great Thibetan collections, that called the Kah-gyur: of the other, or the Stan-gyur, we have not an entire set; although it is possible that we may have some of the works of which it consists. This is a matter for further examination. In the mean time, Mr. Csoma has favoured the Society with catalogues of the contents of both works, derived from original authorities. These, although far from being so minute as to leave nothing to be desired, offer a number of novel and curious particulars, some of which I have extracted for the information of the Society.

The Kah-gyur is explained by Mr. Csoma to signify 'translated precepts;' its principal contents being the moral and religious doctrines taught by Sakyasinha and his disciples, and translated from Sanscrit into Thibetan, by the joint labour of Indian professors of the Bauddha tenets, and of their ablest converts amongst the natives of Thibet. The introduction of Buddhism into that country took place, according to original writers, referred to by Mr. Csoma and to the universal tradition of the Lamas, in the reign of Srong-tsan-gambo, in the 7th century of the Christian era. The principal works, both of the Kah-gyur and Stan-gyur, were translated in the eighth and ninth centuries, and some parts of them in more recent periods. The Stan-gyur being a collection of a similar character, as the Kah-gyur, as the name imports, or 'Translated instructions.' Mr. Klaproth, who speaks of these works as the *Gand-jour* and *Dan-jour*, is mistaken in designating the latter as a commentary upon the former.

KAH-GYUR.

The Kah-gyur consists of 100 volumes, arranged in seven principal divisions or classes, termed I. *Dulva*. II. *Sher-chhin*. III. *Phal-chhin*. IV. *Kon-tsegs*. V. Do. VI. *Myang-das*. VII. *Gyut*. These are mostly contractions for appellations of greater length, as for instance, No. II. *Sher-chhin*, is properly *Shes-rab, Kyi-pharol-tu-chhin-pa*. Each has also its Sanscrit equivalent, as we shall presently particularise.

I. *Dul-va Vinaya*. Education, discipline, or propriety of conduct. This class consists of 13 volumes, comprising a variety of treatises in seven principal divisions, upon the discipline to be observed by the religious members of the Buddha faith, illustrated by legendary anecdotes of Sakya Sinha, and other individuals of distinguished sanctity.

II. *Sher-chhin*: The name of this division, at full length, is a literal translation of the Sanscrit *Arya Prajná Páramitá*, or venerable transcendental wisdom. The class contains in twenty-one volumes five works, so termed, and a sixth of a more miscellaneous description. The first five are discriminated according to the number of verses they contain. The first and greatest being known as the *Arya Sata Sahasrika Prajná Páramitá*, or that which has 100,000 stanzas; the others are the *Panchavinsatika Sahasrika*, *Ashtádesa Sahasrika*, *Dasa Sahasrika*, and *Ashta Sahasrika*, from their containing 25,000, 18,000, 10,000, and 8,000 stanzas. They are said to treat of the same subjects, the metaphysical notions of Buddhism, as taught by Sakya, and to differ only in the extent to which their elucidation is carried. This portion of the KAH-GYUR is highly esteemed, as the text book of the prevailing sect of the Bauddhas in Thibet, especially of the *Madhyámica* division of the followers of Sákya. It is also called the *Yüm*, or mother; *Prajná*, or wisdom, being considered as the mother of the *Bodhisatwas*, or cultivators of divine intelligence, and is no doubt the work intended by Klaproth, when speaking of a Mongol translation of the *Gand-jour*—or, as he explains it according to Remusat, *La colonne merveilleuse;* he observes, that a Mythology, in 12 volumes, under the title of *Yœm*, has been added to the 100 volumes of the *Gand-jour*. The *Yœm* is not, however, an addition, but part of the series, and is full of religious and moral speculations, not mythological descriptions.

What renders this portion of the KAH-GYUR particularly interesting, is the circumstance of our possessing the original, as well as the translation. Amongst the miscellaneous volumes presented to the Society by Mr. Hodgson, is a complete copy of the *Arya Sata Sahasrika, Prajná Páramitá*, in Sanscrit, in the Lantsa characters, in five large volumes, of four and five hundred leaves each. There is also a duplicate copy in the Devanagari character, and consequently the contents of this work are readily accessible to any Sanscrit scholar. To examine them, however, even superficially, would occupy a considerable time, and it is sufficient at present to advert to the existence of the work. I may add, however, that Mr. Csoma and myself have severally translated a few pages of the Sanscrit and Thibetan copies of the first *Khand* or section, and have found a close and perfect coincidence between the two.

III. *Phal-chhin: Buddhavata Sanga:* Association of Buddhas. This consists of six volumes, chiefly occupied with praises and legends of different Buddhas.

IV. *Kon-tsegs: Retna-kuta:* The jewel-peak. This is a collection of Bauddha doctrines and legends, in six volumes; many of the passages are in the form of a dialogue between Sákya and his disciples.

V. Do: *Sútra:*—Aphorisms, brief rules, or *dicta*. Thirty volumes belong to this class, containing 76 different works on the metaphysical and moral doctrines of Sákya; legendary accounts of that teacher, or other *Bauddhas*, and *Bodhisatwas;* Prayers and hymns addressed to them, and discussions on the consequences of actions as witnessed in repeated births, or the doctrine of the metempsychosis.

VI. *Myang-das: Nirvána Sútra:* The doctrine of emancipation from existence, is contained in the two volumes of this class, along with a detailed account of the liberation of Sákya himself, which is said to have taken place in Kámarupa, or Assam.

VII. *Gyut: Tantra:* Mysticism. This class is formed of 22 volumes, the subject of which is a system of mystical and magical worship, analogous to, or identical with, the *Tantrika* ritual of Hindustan. The principal work, in this class, is called the *Kála-chakra*, the circle of time, or *Tantra Raja*, the king of Tantras. It is said to have been first made public at a fabulous city called Shembala, supposed to be situated near the Sihon (Sita) river. The work was thence carried to India in the 10th century, and thence to Thibet in the 11th century. Besides this, there are works descriptive of the incantations and worship of the eight goddesses, the *Nayikas* probably of the Hindus, and charms for the cure of diseases, and for acquiring various superhuman faculties. The collection includes also hymns and prayers to the chief objects of Bauddha veneration ; and one work, the text book of the oldest sect in Thibet, describes the different emanations of Adi Buddha.

The original author of most of the contents of the KAH-GYUR is supposed to be Sákya. His instructions and preachings were oral, but they were collected and committed to writing by his disciples. The *Prajná Páramitá*, is in this manner, ascribed to Kasyapa, who was one of Sákya's most eminent pupils, and succeeded him as Hierarch. Ananda, his successor, compiled the *Do* class, and *Nyi-va-khoo*, a Thibetan, the *Dul-va*.

The principal translators of the KAH-GYUR were, of course, in some number, but they are not very numerous, and the same names frequently recur, such as those of the Indian Pundits Jia-mitra, Prajnyaverma, Surendra Bodhi, Anandasri, Vidyakara Sinh, Manjussri Gerbha, and others ; and those of the Thibetan Lotsavas or interpreters, Bande-ye-shas-de, Zang-yesh-de, Kawa-Apal-Bettsegs, Lubidwangpo, Suchenrin Zang, &c. There were also some Chinese in this number, and some collections are said to contain translations from Chinese works.

STAN-GYUR.

The STAN-GYUR is a collection of a still more voluminous description than the preceding, and extends to 225 volumes. These are divided into two great classes, the *Gyut* and *Do*, or mystical doctrines and miscellaneous aphorisms; the former is contained in 87, the latter in 136 volumes. Besides these, one volume is filled with *Stotras*, hymns to the *Buddhas* and *Bodhisatwas*, and one volume is an Index.

I. *Gyut.* This, as in the KAH-GYUR, is a collection of *Tantrika* works, to an extent which it would not be easy to parallel in India; the 87 volumes containing 2640 different works. As the catalogue of Mr. Csoma does not specify the Sanscrit names, it is not possible to judge of their identity with similar works in this country. But those of the KAH-GYUR are not identifiable, and the same is probably the case with the treatise of the STAN-GYUR. Although, however, the works themselves may not be exactly the same, there is no doubt of the identity of the subject, as we have works on the formation of the *Mandala* or mystical diagram, on the cure of diseases by charms, on the worship of evil spirits, on the practice of *Yoga*, on the attainment of superhuman faculties by the performance of magical rites, and the repetition of mystical phrases and words.

The great abundance of *Tantrika* mysticism in the Buddhism of Thibet, and also no doubt of Tartary and China, is rather inconsistent with the abstract and quietarian spirit of that religion. How and when they became associated is a matter of interesting enquiry, not only for Thibet but for India. In both countries the system of the *Tantras* is, no doubt, subsequent to most other forms of worship ; and in Thibet its introduction appears to have commenced with the *Kala Chakra*, in the 11th century: and it is worthy of notice, that it is derived from India only intermediately ; the origin of the work being referred to a more northern region. The history of the *Tantra* ritual in India is far from being ascertained ; but the greatest, and perhaps the worst portion of it, is commonly considered to have originated in the North-east of Hindustan, and in comparatively modern times. It may be worth while to enquire, how far Thibet may have repaid India with the spells of the *Tantras* for the speculations of Buddhism, and whether any connexion subsists between the Shamanœism of Siberia, and the mysticism of Thibet and Hindustan.

II. The *Do*, or *Sútra* class of the STAN-GYUR, is not only of a much greater extent, but it is also of a much more miscellaneous character than the corresponding division of the KAH-GYUR. A number of the volumes treat of the same subjects, and many are comments upon them, or on some of the works of the KAH-GYUR, but the larger portion is not exclusively Buddhist: many of the volumes belonging to the general literature of the Hindus. Thus, besides accounts of the different philosophical schools, which are probably controversial, and therefore connected with the religious system of Bauddha, there are several works upon logic, rhetoric, and Sanscrit grammar. There is also a translation of the *Amera Kosha*, or lexicon of Amera Sinha, and of a poem—the *Megha Duta*, or Cloud Messenger, of Kalidas. There are works on medicine and on the mechanical arts. A *Nita Sastra*, or system of civil government, and a translation of the verses on the same subject attributed to Chánakya. There are also several vocabularies, Sanscrit and Thibetan, and some original grammars of the vernacular dialect.

The nature of both these works will now probably be accurately apprehended. They are collections of the works of different authors and translators, and consequently, of works of different periods. The greater number of the works contained in both, are supposed to have been translated, as above observed, in the 8th and 9th centuries of our æra; and with regard to the KAH-GYUR, this is no doubt correct; as besides the uniform tendency of its component parts, the same individuals appear to have been employed upon the translations. From this, of course, the *Gyut* or *Tantra* portion, is to be excepted; the principal work of which, it is acknowledged, was not introduced into Thibet until the 11th century. The same dates, the 8th and 9th centuries, are assigned for the translation of the principal portions of the STAN-GYUR, and may be correct in some instances; but the more miscellaneous nature of the collection renders it probable, that the works take a much wider range of date than those of the KAH-GYUR. The same circumstance may be inferred from the vast number of writers specified as the authors, who could not have been contemporaries, or nearly so. Few of the names, too, either of *Pundits* or *Lotsavas*, although more of the latter, are the same as those of the KAH-GYUR: on the other hand, there are some names of great note in the catalogue, as those of the *Bodhisatwas*, Manjusri, Avalokila, and Maitreya, and the *pundits* Nagarjuna, Arya Sanga, and Aryadeva, whose names are not to be found amongst the contributors to the KAH-GYUR.

The association of *pundits*, and learned natives, in the preparation of such voluminous translations, and the consequent developement of a national literature from a foreign source, in the course of one or two centuries, are circumstances of considerable interest in literary history. It is clear, that a powerful influence must have been exerted, and the civil and religious authorities must have prosecuted the task with singular spirit and zeal. It was also managed with great judgment, and one of the first steps may be recommended to a more enlightened people and period. This was the preparation of a vocabulary of the Sanscrit proper names and the technical and philosophical terms of the original works, with their equivalents in Thibetan; and it was then enacted by the authorities, that in all future translations, these equivalents should be invariably employed. This vocabulary still exists, in three forms, varying according to their greater or lesser copiousness. One of them, the middle one, prepared in the time of Ral-pa-cha, the 9th prince from Srong-tsan-gambo, the first patron of Buddhism, is comprised in the STAN-GYUR, and a copy of it is in the hands of Mr. Csoma, who proposes to give a version of it. A specimen of the work is submitted to the meeting. It will no doubt furnish a most convenient clue to the whole system of the Bauddha faith.

Considering, therefore, the Kah-gyur and Stan-gyur as collections embodying the literature, sacred or profane, of several centuries, the next question to determine is when they were first formed. This, however, is not precisely known, but it is probable that they did not assume their present shape precisely until the beginning of the last century; similar collections, perhaps, existed, but not exactly the same, and it was not until they were committed to the press that they could be regarded as secure from those variations to which, from their extent and the unconnected character of their contents, they were particularly liable. A conviction of this may have led to their being printed, which was done by order of Mi-vang, Regent of Lassa, between the years 1728 and 1746. The first edition was printed at Nar-thang near Tesha-lung-po, and the same place is still celebrated for its typography. A smaller edition, but one highly prized, is printed at Derghi, 40 days east of Lassa. The Narthang copies are printed in very large types on long slips of paper, made from the bark of trees, especially the bark of the *Daphne involucrata* of Wallich. A printed copy costs about 1000 Rupees. Copies at least of parts of both works, are also met with in MS. sometimes illuminated with paintings of Buddha saints and divinities, and sometimes executed in characters of silver or gold; we have several specimens of the latter. The cost of the works prevents their being very widely circulated; and few, except monasteries of some note, or individuals of rank, possess copies. According to Mr. Klaproth, also, the Mongol version is not procurable, without permission from the Dálái Lama, or the emperor of China. This is not the case in Ladakh, where a wish exists to multiply copies as much as possible, and facilitate their purchase.

III.—*On Political Economy.*

As it is my misfortune to differ from the writer, who has lately favoured us with some observations on value; (Gleanings, No. 20, et seq.) I beg to state a few of the objections I have to offer to them, as shortly as the nature of the subject will allow. To begin with his enquiry into the nature of value, (No. 20.) After two prefatory assertions, one of which is, that "man cannot exist without food, water, and air;" he goes on to tell us that, "Before man voluntarily exerts himself in any acquisition, the gratification, the exertion is calculated subsequently to realize, must, in his opinion, be more than sufficient to counterbalance the sacrifice submitted to in obtaining it. He must compare and balance in his mind, before he proceeds to action, the one against the other; and that which preponderates, he must reckon the most desirable of the two." Or, in other words, as I understand him, he must compare the usefulness of the object with the labour or cost of obtaining it. Now most people would be inclined to call the comparison thus made a "valuation," and the result of that valuation, or the measure of the usefulness of the object, in terms of the means, or cost of obtaining it, the value. Thus, for instance, a man in a state of nature climbs a cocoa-nut tree, and obtains a cocoa-nut. Here the climbing, or cost of obtaining, would be the value of the nut. But our writer would think otherwise, for he adds, "the result of the comparison, must, in the great majority of cases, be in favour of the possession (of the object): Hence the existence of an idea of value attaching to such possessions, *superior to something with which man as a moral agent is conversant.*" I cannot divine the meaning of this last phrase, unless it be equivalent to the plain English of "superior to the cost of obtaining them," and if such should be the meaning, still less can I conceive why it should be so strangely obscured in the expression. But, to return to the point; after the above statement, he goes on, " Value then is not, strictly speaking, a quality existing in any substance, but it is *an affection of the mind of man.*" Should this be true, he has certainly found out something new, for it is what I venture to say, never entered into the head of any one before, and I congratulate him on his discovery; but I have to submit to him whether, in such a case, the discussion on it is not rather within the province of writers on the human mind, and altogether foreign to Political Economy. For my own part, I confess I should as soon have thought of half-a-crown, or a yard measure, being an affection of the mind. However, in his next paragraph, he informs us, that "although metaphysically treated, there be no such quality in bodies as value; still as there must ever arise a perception of value, in connection with certain bodies on which man's existence is dependent; it may not, in ordinary discourse, lead to error to treat of the inevitable concomitant, as if it really existed in that, with which it is ever found conjoined." It is to be presumed, that his meaning here is, that " the preception of value" is what exists in the mind, which, we need hardly observe, is a very different thing from the value itself existing there. He next proposes to treat of this inevitable concomitant, " as if inhering in the class of bodies already pointed out;" and having thus affixed a meaning of his own to the term value, he draws his conclusions from it, which " are directly opposed to all existing theories on the subject," that " in place of labour being the cause of the existence of the value, it is the previous existence of value which is the original cause of the exhibition of labour." As this conclusion entirely depends on the peculiar meaning he has given to the word value, we must now turn to his defence of his meaning in a further number, (GLEANINGS, No. 26.)

He seems not to be aware that it is usual among men, when reasoning on any subject, to agree to make use of certain terms, which are often recurring, in but one sense, purposely to obviate the inconvenience of having different conclusions drawn from the same premises, which might be the case, if any term in those premises were used in two different senses; that these terms are often defined, and where they are not, it is the custom to reject all secondary and metaphorical meanings, and to make use of the words in their original and proper senses. Now, as what is useful and desirable, is often also valuable, it happens that one of the secondary meanings of the word ' valuable,' is ' desirable,' or ' useful,' and things that are desirable are said ' to be of value' or ' to have value.' Having used the word in this sense, he turns to *Crabb's Synonymes*, a work of no authority whatever, justifies himself by a poetical quotation, where ' life' is said to have ' no value,' meaning, that it is not desirable. But he is bound in discussions of this kind to make use of terms in their strict and proper meanings, unless the contrary be expressly agreed upon; for there would be no end to the confusion produced, if every man were entitled to choose his own meaning for the same word, and then to draw conclusions from it. The question, therefore, for us is, what is the proper meaning of the word ' value?' It appears to be a translation of the Latin word *valor*, and to be synonymous with ' price,' ' worth.' So far Johnson's Dictionary tells us, but we have another method of ascertaining the true meaning of a word, and that is, by comparing it with its derivatives. Thus from ' value,' we have ' valuable,' and ' to value.' Taking the first of these, we may assert of any thing valuable that it ' has a value,' or can be valued. Now as the writer tells us, that air, water, and sunshine, are valuable, let him set three cups, one filled with each, before him; let him value, or appraise the contents of each cup; let him name their values. It is extraordinary, that the double negative adjectives, in our language, derived from the root, 'value,' should not have explained to the writer its true meaning. Thus, besides 'valueless,' said of a thing on which no value can be set, because it is not desirable; there is 'invaluable' spoken of a thing on which no value can be set, because it is so exceedingly desirable. Value is the result of comparison, and the moment we lose the means of making this comparison, or valuation, we also lose the idea of value. Were the term 'valuable' synonymous with 'what is really good, or believed to be so,' as the writer, and Mr. Crabb would have us believe, then 'invaluable' would be similar in meaning to 'undesirable,' to which it is, in fact, directly opposed. When, in addition to this, we find it expressly laid down that 'value,' synonymous with 'utility,' is not used in Political Economy, what shall we think of the writer complaining of what he calls the 'monopoly of the term?' Well, indeed, may *he* deplore it, for when the last excuse is cut off for using words in double senses, then "his occupation's gone." He afterwards tells us that he intends to confine his use of the term 'value' to that 'value which is appreciable,' and explains to us that 'valuable bodies,' are those which are susceptible of 'specific valuation,' or of being estimated at certain quantities of that which is in immediate connection with the consciousness and perceptions of the moral agents, who are the sole percipients and appreciators of value. Was this definition given with a view of making the subject clearer to us?

In his second paper, we find his peculiar views more fully developed. To state them briefly, but I trust fairly, they are as follows:—

1st. Man is under a continual necessity for food, which is the 'basis of primary wealth,' the only essential to his existence, besides water and air.

2d. There is a tendency also in human population to outrun the means of subsistence, or the quantity of food that can be procured.

3d. Therefore, there must always exist a large portion of the population of a country, who will be willing to give their utmost labour in return for a mere subsistence, that is, for a bare sufficiency of food to support life. From hence it follows:

4th. That the utmost exertion of which individuals are capable, being the same, or nearly so, and the quantity of food sufficient for the support of each, being the same, or nearly so: we have the means of knowing what quantity of labour, or its products, a certain quantity of food will command; we have something 'fixed and determinate,' a 'positive or REAL VALUE,' which he elsewhere calls an 'invariable value.' (Should this be true, he has discovered an invariable standard of value, the want of which has been so much regretted; a discovery scarcely less notable than his preceding one.)

5th. No increasing price, and value of food, can be continually created and obtained, which it has now become usual to consider as the ultimate destroyer of profits, and the sole creator of rent for landlords.

6th. As the labourer will never receive more than a mere sufficiency of food, and the result of his labour on the soil will be a produce considerably more, the overplus will fall to the share of the owner of the land—thus man's necessary wants being 10, and the produce of his labour 15 or 20, and the vast majority of mankind being ready to give, for the possession of 10, their utmost exertion; and for this, though producing 15 or 20, they will only be recompensed by the receipt of 10, 'those who cannot live by manufactures, will readily offer to take upon themselves the labour of fully working the soil upon any terms the original agriculturists may be willing to accept, and hence a landed gentry is created.' He asks afterwards, "What becomes of the modern theories of rent?" And he may well do so.

Now as every one, I think, will allow that these assertions (4, 5 and 6,) may be fairly deduced as corollaries, from the conclusion immediately preceding them (3), it is with that we have to deal. If that can be proved to be true, I have no objection to offer to the consequents.

That I may not be accused of misrepresenting him, I will state it in his own words: "The labourer's numbers pressing upon that amount of subsistence, which these classes, (the agriculturists and capitalists,) can be tempted to bestow, in exchange for the results of the utmost exertions of these poor people; the estimation in which that is held, which suffices for the support of a human being, must be then as great as it was in the days of pristine rudeness and poverty, and must equally command the utmost exertion, which a human being is capable of bestowing." There are few parts of the world I know of, where man yet exists, as he did in the days of " pristine rudeness and poverty." The only part I can call to mind, is the southern end of the Malay Peninsula, and some of the neighbouring islands, where a race of aborigines are said to exist, who have made no progress whatever in improvement. They are unacquainted with the use of clothing. They have no sort of habitation to shelter them from the weather. They have no kind of implements, either for the chace, cultivation, or domestic purposes. They do not even use firing for cooking their food, but subsist upon such raw fruits as the forests afford them, with the addition of whatever else edible their unaided hands can seize. These naked innocents, no doubt, esteem that quantity of food which suffices for the support of a human being, as an equivalent for the utmost exertion of which they are capable; but in no other part of the world that I remember, does the assertion hold good. It is utterly false of men in England, and throughout the rest of Europe; it is equally so in most parts of Asia, perhaps the whole of America, and that part of Africa which is best known to us; therefore, speaking of the world in general, we may assert, that it is false altogether. One would think the writer had never seen an English cottage and appurtenances. Did he never see a meal. eaten therein, and mark how much of that was superfluous? I mean greater in value than the mere measure of raw corn necessary to support life. Let him next look at the mode of life of the Hindoo labourer. Has not he also something superfluous? If the writer be still inclined to maintain his assertion, let him fill a measure, say of barley, sufficient for a man's daily food, and let him ask a Hindoo to give him his utmost exertion for a day in exchange for it. Let him ask an English labourer a similar question. Let him also consider for what quantity of corn a Hindoo could be induced to give his utmost exertion for a day; and also, for how much of the same, an Englishman could be induced to work for a day; and then let him ask himself, whether he was not dreaming when he called food 'invariable' in its value when compared with labour. Having thus shown, as I conceive, that his conclusion is false, we have next to observe by what means he has managed to arrive at it. The effect not existing, the alledged cause has been insufficient to produce it: he brings forward the tendency in human population to outrun the means of subsistence, but carefully keeps out of sight, the causes that counteract its influence. Thus he states the term requisite for doubling population at 25 years, and infers, that whenever that rate of increase does not take place, great part of the population are in the destitute state before alluded to, ready to exchange their utmost exertions for the mere quantity of food sufficient to support life; forgetting that of the three checks, moral restraint, vice, and misery, the two first will come largely into action before the third is felt. He sets before us the case of a country acquiring its own knowledge of agriculture. Countries (he apprehends), become progressively more capable of yielding food to increasing numbers. Increasing numbers bring with them increasing knowledge, and succeeding generations must be benefitting, not only by the permanent effects of all their predecessor's labours, but by the continually increasing knowledge of facts, handed down from their progenitors. And again, "We are not from the experience of the world at large, justified in contemplating such rapid progress in agriculture (as to cause a glut), except in the case of new, fertile, and unbroken countries falling into the hands of a people well versed in the arts of agriculture. These events must ever be looked upon as exceptions to the ordinary course of production, which this century, and the next, may have to witness, but of which succeeding generations will know nothing." But most of the countries, the history of which we know, have not acquired their own knowledge of agriculture. The knowledge of the means of producing corn and wine was derived from ancient Egypt, which country sent out colonists, with the knowledge of their progenitors, as far as India on the East, and the Thracian Chersonese on the North. The Greeks again sent colonies to the neighbouring islands the North of the Black Sea, Sicily, and Italy. The Romans brought the art with them into Spain, Gaul, Germany, and Britain. So far, then, from these events being exceptions, should we not rather say, that during the whole course of ancient history, from the fabulous times of Osiris to the Roman emperors, "new, fertile, and unbroken countries were continually falling into the hands of a people well versed in the arts of agriculture," from the Atlantic to the Indus, from the Mediterranean to the Baltic. During the dark ages the progression was probably suspended; but since then, the discovery of a fourth continent, and an island (Australasia), nearly equal to a fifth, has given ample scope to colonization. The writer seems to have no more idea of new countries supplying the old with corn, in exchange for manufactures, than he has of the possibility of migration. He says, "For instance, in place of some labour being necessary, as at present, for obtaining from the earth's surface those items constituting primary wealth, on which our subsistence depends, they had been procurable merely for appropriation; still as population must come up to the means of subsistence, those who first possessed themselves of the land, and of the means of making this mere appropriation, would presently enjoy the power of withholding that food which was in excess to their own consumption, and this they would unquestionably do, unless those who subsequently came into being, made it worth their while to bestow this excess upon them:" I say, that putting the case generally, they would enjoy no such power. The overplus of population would naturally pass beyond the frontier continually further, and further off, where they might live on more easy terms. Part might, perhaps, remain behind, employed in manufactures; and the landlords, living near a market, would enjoy a price for their produce equal to the cost of carriage from distant countries. His case cannot happen until the whole world is peopled to the fall. If we turn to McCulloch's notes to the Wealth of Nations (vol. 4, London 1828), we find (note 2, definition, sources, &c. of value), that "the expenditure of labour is not the only source of exchangeable value. Provided a commodity or product in demand can be appropriated or enjoyed by one or a number of persons to the exclusion of others, it may have exchangeable value," and the instance is given of a waterfall on a man's estate. Are we not then surprized to find the writer taking this very case of appropriation, and holding it up as a discovery of his own, a phenomenon to be explained from his own reasoning, in opposition to Mr. McCulloch and his school. He has changed the example for one of his own, and then drawn a wrong conclusion from it. Colonies are in so far equivalent to an actual extension of the surface of the mother-country, as they are continually sending the produce of newly cultivated ground to market. In the present circumstances of the world, his case might happen, in an island or other district separated from the rest of the world, where no colonists could go out, nor any produce could come in. And, thirdly, it might happen in a country where a body of landholders having usurped the legislative power of the state, made use of that power to prohibit their fellow-citizens from migrating, or from exchanging their manufactured goods for food produced in newly peopled countries. But such a set of men would deserve to be regarded as no better than a public nuisance, like a swarm of locusts, or a blight on the harvest.

Yet it is hardly probable, that even in this case men would be again reduced to the pristine state of poverty. Having, in spite of the law of population before alluded to, once raised themselves into civilization, and enjoyed a portion of what the writer terms 'secondary wealth,' this has partly become essential to them. For instance, if the landlords of Europe were to allow no more to the labouring class than a bare sufficiency of corn to satisfy hunger, what would be the consequence? Possessing neither clothing nor lodging, would not great part or the whole of these wretched beings perish? Undoubtedly they would. And this leads us back to his first assertion; (No. 1,) that food is the only essential to man's existence besides water, and air, and here we reach the root from which all his fallacies spring. Food is *not* the only essential to man's existence. Clothing and housing are also essential, at least without the tropics. Thus, instead of the rest of the community being placed in a state of complete dependance on the original agriculturist or landlord, so that he can at pleasure withhold from them his surplus food, and compel them to labour for him on his own terms; the dependance is reciprocal. The grower of corn needs the labours of the clothier and the mason, as much as they need his.

The substance of the writer's argument is not new. It is the daily cry of advocates of Corn Laws, and advocates of sinecures, that no increasing price and value of food can be obtained, nor the contrary; for the market is so overstocked with labour, that the law of competition would prevent the labourer by any means getting more than he does; less than that, he cannot exist upon. But they are, in general, too wary disputants to state as boldly as the writer does, the only circumstances in which their assertion would hold good, namely, when the population is in a state of utter destitution, ready to exchange their utmost exertions for a bare sufficiency of food to support life. Our writer too, though he has stated this case as a matter of fact, would seem to think it a little preposterous, for we find him in his next paper endeavouring to extricate himself from it, forgetting, that in so doing he is destroying the very foundation on which his conclusion rested; we have it supposed, that "some wrought wares are as necessary to the existence of man as food," and he allows, "it is very true that in practice there is nothing which possesses an intrinsic, or invariable REAL VALUE." Here, too, we have him blaming Mr. Ricardo for maintaining, that "although a million of men may, after the introduction of improvements in production, make double or treble the amount of riches; they will not thereby have made any increase in value," because with the real increase of wealth, appreciators of value (i. e. population), must increase.

But some time must elapse before the population *can* increase, and during that time, at least, Mr. Ricardo's assertion will hold true. The phrase used implies this, for it is not "they will not also make," as if referring to the future effect of their production, but "they will not thereby have made," meaning, that by the mere act of producing, they will not also have created beings to consume. For the final 'must increase,' read 'may probably increase;' for, see his own words in the next page. "We must always calculate on a mixed result from the conflicting influence of the prolific power and luxurious habits."

In this paper he gives us the following piece of information : "if what was essential to a man's support between the harvest, were 20 measures of grain, and if twenty, on any given tract of country, were the number of labourers by whose exertions the greatest net produce, or 400 measures, could be obtained, the labour of 10, or any number less than 20 causing a net reproduction to be evolved, less in amount than 400 measures ; while the employment of 21, or any number more than 20 labourers tending to the evolution of a net produce, greater perhaps than 400 measures, yet not equal to 420 measures, or what might be absolutely essential to the support of the additional labourer ; in this case, neither more nor fewer than 20 labourers could be found existing on that tract." He has forgotten the Capitalist, who must have advanced at least a year's support to the labourers, and will probably require some interest for that advance beyond the 400 measures. In the note he adds, "The matter to be determined in practice, is the point at which the greatest net aggregate return is obtainable; and the question of the proportions which may happen at this time to hold between outlay and return, is one of mere curiosity." So that, the usual rate of interest in a country be 5 per cent. and a man finds that by laying out £ 100 he can gain a profit of 10, but that by laying out £ 400 he can only gain, on the whole, 16 ; the proportion existing between outlay and return will be matter of mere curiosity to him. He will lay out the larger sum ! We next come to his remarks on Mr. Ricardo's system of Wealth and Value, and we find the following passage : "But it may be answered, that Mr. Ricardo also looks to the quantity of labour of which products are the result, with a view to determining originally their real value. This, however, I maintain, he ought not, in consistency, to do ; for he denies the existence of real, or of any kind of value, except what is relative." On this point he is continually misrepresenting the Political Economists. He charges them with denying the existence of real value, and looking only to the relations of products with products. They do neither of these. They allow the existence of real value, and compare each separate product with labour.

In Mr. McCulloch's notes before quoted, we find "the real value of a commodity is measured, or determined by the amount of the sacrifice it has cost, or the labour required to produce it." He it is who has made the blunder, by his ignorance of the meaning of the word 'real,' which he has supposed to be synonymous with 'positive,' and therefore that, by denying the existence of any but relative, they were also denying the existence of real value. The great difference between him and the Political Economists, is this, They take labour as their ultimate standard of value, not blind to its defects, but aware that any further investigation could lead to no useful result. He endeavours to go a step farther, and prove that the 'invariable standard' exists in food. Having written 9 obscure pages on this, he at last owns, that "in practice there is only a very rough approximation to it ;" which seems to be about the same as no approximation at all, for as we before quoted, "in practice there is nothing which possesses an invariable value." By a quibble, in the meaning of the word 'value,' he contrived to give us three former papers containing 20 pages, and he now employs 9 pages more on his own mistake of the word 'real.' Thus we find him blaming Mr. Ricardo for confounding real price with relative price, as he chooses to call it. The truth is, Mr. Ricardo uses real price (cost of production), and exchangeable price as convertible terms, which he had fully a right to do, because, generally speaking, the one will be identical, or nearly so, with the other. He may see this explained both in McCulloch's note on Value, above-mentioned, and Mr. Mill's Elements, chap. 3, section 2, so clearly, that I cannot suppose any, but one, who had never read it, or had utterly forgotten it, or had determined to quibble on it, could doubt its truth.

We next come to his remarks upon wealth and periodical increase. He begins by quoting 12 verses from the book of Genesis, to prove, "The dependance of man on food! The nature and properties of that which constitutes his food! The original gift of a parent stock, whence future supplies were to spring; that man was to eat his bread in the sweat of his brow," &c. If I were inclined to be guilty of the bad taste of quoting that sacred book upon every trifling occasion, I could also prove that clothing was as essential to man, in a fallen state, as food; we might have believed all this without the authority of Holy Writ, but what then? Next he calls seed "the procreative, reproductive, and incremental principle," and tells us that wealth is not produced by labour alone, but by "well-directed industry co-operating with the vital principle inherent in the reserved stock of seed;" as if one were to say, "A steam boat is not impelled by its steam engine alone, but by its steam engine co-operating with boiling water." These are truths certainly, but it may be worth the writer's while to consider, whether they are not among that class of truths, which people usually denominate 'truisms,' and fit meditation for that kind of 'incremental' man, called a child. However, he tells us they are "important considerations," and that from not having attended to them, the Political Economists have fallen into error: now this is exactly what we want him to shew us. Again, in the next page we have, "The fallacy is, of supposing men to have only occasion to labour, whenever they may happen to be in want of wealth." Although we might have supposed that the good men, who undertook to instruct the world, were perfectly aware that a man could not make his corn grow by standing on his head, or any such antic, it does not follow that they thought it necessary to inform their disciples of the same. However, let them speak for themselves. "Labour may be defined to be any sort of action, or operation, whether performed by men, the lower animals, machinery, or *natural agents*, that tends to bring about any desirable results:" and, "But when it is said that the value of the commodity, or product, is determined by the quantity of labour expended in its production, *reference is only made to that species of labour which is possessed of value, that is, to the labour of man, or of capital expended upon the commodity, or product.* In so far as non-monopolized natural agents concur in production, they do what is done gratis. Their labours are often of vastly more consequence than those of man, or the capital produced by man; but as they are performed spontaneously, they are neither valuable themselves, nor can communicate that quality to any thing else." (McCulloch's Def. of Labour.) Next we have a long distinction between capital and labour, with an allowance that capital is only a better disposition of labour, yet it is not "accumulated labour." Thus a man makes a spade, and works with it: now he will, by this, get a much greater return than he would by labouring, from day to day, with his fingers alone; therefore the two must be different.

Enough has been said to shew that the writer's views on Political Economy are at variance with those generally received at present: but there is one other point on which he differs from most men. It has been usual with those who have enriched the world with great discoveries, to broach their peculiar views, at first with diffidence, knowing that their single opinion was opposed to that of numbers, who had equal, and perhaps, better means of investigating and judging than they had. Would not the writer have done well to have agreed with them in this particular? Might he not have stated his own views fairly, but modestly; compared them with those of his opponents; and left the world to judge to whom "the outrageous fallacies," "the lame and impotent conclusions," "the rotten foundation" belonged? We find him, at his setting out, accusing the Political Economists of advocating the infallibility of Mr. Ricardo, insinuating by this, that they claimed for their leader what none in modern times, but the papists ever did for theirs, namely, that his bare assertion was entitled to implicit confidence. He has confounded "the infallibility of Mr. Ricardo" with "the infallibility of Mr. Ricardo's reasonings on a particular subject:" there being as much difference between the two, as between "the infallibility of Newton" and "the infallibility of some of Newton's reasonings."

If there be any thing of correctness in the foregoing remarks, one third, and last truth, forces itself upon us, viz. that our author has thrown no new light on the subject of Political Economy. He tells us, "that if he be found unconsciously tripping, he will be happy to be informed of it." I have taken him at his word, and trust to his good sense to receive candidly my honest criticism.

Hoc petimus damusque vicissim.

E. R.

IV.—*On the Dentition of* Sciuropterus—*a genus of* Rodentia.

"In this remarkable character, the Flying Squirrels of Siberia and North America agree with those of the Asiatic islands; but the latter, or at least the best known species among them, differ, according to M. F. Cuvier, in some minute particulars of their dentition. The differences which he has observed and figured, however, appear to be little more than might be produced by detrition of the crowns of the teeth; and we cannot, therefore, regard the genus founded by him upon this single consideration, as by any means completely established."

Gardens and Menagerie Zool. Soc. v. ;. *p.* 186.

The cranium of a species of *Sciuropterus*[1] or *Pteromys*, whichever designation may finally be determined upon, being in my possession, I was induced, by a perusal of this passage, to compare its dental system with that of *Sciurus*: and the following observations are the result of my examination. My specimen, I should premise, was, I believe, from Sumbhulpore; but probably the same genus, if not the very species, may be common to the Archipelago, and to Continental India.

Fortunately, a specific description is not required for our present purpose; for if it were, I have not immediately by me the means of furnishing it: certain circumstances having prevented me from taking the proper notices at the death of the animal, which I had neglected to take during its life. I purchased it from a common *shikari*, who stated, that he procured it in the hills, which, judging from his description, are situated on the bounds of Sumbhulpore: and although in a sickly state, owing to an injury received when caught, it remained in my possession for several months, till at length it died of diarrhœa. In size it somewhat exceeded the *Sciurus maximus*, or Malabar squirrel; the colour was that of the *Chinchilla lanigera*, which animal it also nearly approached in the silky texture of its beautiful fur: the tail was long, and the flying membrane ample. In

[1] M. F. Cuvier applies this term to the flying squirrels of Siberia and North America, but to them his brother, Baron Cuvier, had previously given the name of *Pteromys;* and as no good could arise from the change, both being equally expressive, or inexpressive, I have followed up the idea of Mr. Vigors in the above work, and applied the new term to the oriental genus.

disposition it was very gentle, and a younger specimen, formerly in my possession, became, in a little time, so tame, as to run freely about the house, without evincing any desire to escape. Faithful to the call, jumping on the lap, and licking, or playfully biting the hands of those with whom it was well acquainted. This affectionate little creature never seemed quite happy, but when being fondled and caressed. Unlike to some species of its kindred genera, it never injured the furniture, nor did any mischief whatever; whilst its extreme beauty and grace of form, vying with its loveliness of disposition, well adapted it for the reception of that affection we are all so ready to bestow upon the tribe, to which this interesting little animal belonged.

Incisors.—The incisors of both jaws are of a dark brown colour, unfurrowed, and rather weak for an animal of so large a size: the lower pair have two flat surfaces at the apex, the external one being formed by attrition against the inner part of those of the upper. The latter are very short, and abruptly acuminated from the inside, to form a cutting edge: the surface so produced being somewhat concave.

Molares.—The molares are sixteen in number, four in each side of each jaw, and in the upper the usual rudimentary, or accessory tooth, is placed in contact with the first molar.

Lower jaw.—The molars are formed by two very regular, compressed folds of the enamel, projecting a little on the outer side, and two rather larger folds internally, with irregular convolutions to form the superior surface. On the top of the first molar the anterior exterior fold rises into a prominence, and the other three have a similar projection formed by the anterior interior fold. In size the first molar is the smallest; the second somewhat larger, and the third and fourth are larger still, and equal to one another. In form; the first is rounded before and behind, the second and third are nearly square, being only a very little convex behind; and the fourth is square on the anterior and exterior, and rounded on the opposite sides. Of fangs, the first molar has two, the anterior one being rather longer and more slender than the posterior; the second and third have four fangs each, the two exterior being larger than the two interior; but the fourth molar has two rather small fangs in front, a large and long one behind, and an intermediate minute one on the inner side.

Upper jaw.—The accessory tooth consists of a single prism, fixed in its socket so closely to the first molar, as to seem part of it: whether, as in the tribe generally, this tooth falls out when the animal attains to the adult state, I know not; but my specimen was full grown. The first, second, and third molars are of nearly the same construction, the crown being formed by three folds of enamel stretching across, from the outer to the inner side of the tooth, where they are pinched up, as it were, into a crystalliform pyramidal tubercle; of these folds the first and second are compressed, but the third is open. The fourth grinder is formed in a similar manner, on its upper surface, to the other three; but it is smaller than they are, and rounded posteriorly and internally, instead of being square on three sides, and rounded only internally. The fangs of the whole four consist of two outer and one inner; the former being straight, slightly divergent, and small; but the latter is curved greatly, and divergent, and very large, that of the second tooth having one or more small spines on its inner side, which are received into a corresponding pit in the alveolar process.

In the work which I have above quoted, it is stated, that "in all the other squirrels, the lower incisors are long, directed forwards, and much more narrow and compressed than the upper, which are strongly curved. The molars are four on each side of either jaw, and nearly equal in size, with their crowns surmounted by elevated lengthened tubercles, variously disposed in those of the upper jaw, and in the lower, forming on each tooth, a kind of circular rim surrounding a central depression."

The only specimens of the tribe in my possession, are of the *S. maximus* and *S. palmarum*, and the teeth of both species differ from those which I have attempted to describe, in the following particulars :—

1.—The lower incisors of *Sciurus* are long, extremely sharp, and with a flat internal surface, gradually attenuating them from the base, where it joins the gums to the apex :—but those of *Sciuropterus* are comparatively short, and flattened at the apex by attrition against the upper incisors ; the internal surface being concave.

2.—In *Sciurus* the first molar of the lower jaw is similar to the other three; but in *Sciuropterus* it differs from them, in having the most prominent tubercle of its upper surface on the anterior and outer, instead of the anterior and inner side.

3.—In *Sciurus* the grinding surface of the molars of the lower jaw is smooth, being filled up level, or nearly so, with the folds of the enamel : but in *Sciuropterus* there is a depression, more or less deep, between every fold, giving an appearance of roughness to the tooth.

4.—In *Sciurus* the first molar of the upper jaw is not larger than the last, and it is much less than the second and third : but in Sciuropterus this tooth is much larger than the last, and nearly, if not quite equal in size, to the second and third.

5.—In *Sciurus* the enamel of the molars of the upper jaw is disposed in tubercles (or elevated ridges, with here and there a tubercle), around and upon the crown of the tooth : but in *Sciuropterus* there are elevated ridges of enamel ranged across the tooth : from the outer to the inner side, where they are pinched up, as I before mentioned, to form a pyramidal, crystalliform tubercle.

6.—In *Sciurus* the fangs of the upper molars are generally less divergent than those of the same teeth in *Sciuropterus :* and the inner one is not so large compared with the outer two, nor so much curved as in the latter genus.

The question here arises, can these points of difference be owing to "detrition of the crowns of the teeth ?" The following facts are against this supposition.

Detrition alone could not produce and maintain the change of form shown in the incisors of *Sciuropterus*.

The different arrangement of the enamel of the teeth could not arise from detrition.

Detrition could not effect a change in the relative size of the teeth.

And finally the effects of detrition become more perceptible as the animal advances in age : but my specimens of *Sciurus* were both younger animals than the one of *Sciuropterus*, and consequently their teeth could not owe their comparative smoothness to this cause alone.

Such are the facts which appear strongly to confirm M. F. Cuvier's division of the Oriental Flying Squirrels from those of Siberia and the New World; and it makes not against this division that Baron Cuvier omitted it, unless it can be shewn that he had specimens of each kind before him, when he formed his genus *Pteromys*.

Some stress may also be laid upon Buffon's remark, confirmed as it has been, by succeeding Zoologists[a]; that the animals of the Old World are not found in the

[a] This has latterly been denied, but the examples to the contrary are so few and even so doubtful, that they should be looked upon rather as exceptions than a general rule.

New, excepting towards the north, where the two great portions of the world are united. And this observation will be regarded as correct in a greater or less degree, according to our opportunities of knowing how wonderfully species, genera, and even families, are affected by the influence of locality.

I must conclude by observing that the foregoing remarks, are merely an advertisement, that the settlement of this question is desirable. Indeed, without the means of extended observation, with no good work to consult, and (as the reader must readily have perceived) with very limited practice of description, I could only presume so far, as to point out what is wanting to the science, rather than attempt to supply it myself.

V.—*Miscellaneous Notices.*

I. *A List of Desiderata.*—By the Royal Asiatic Society.

1. A comparison of the languages or dialects existing throughout Polynesia.

2. An account of the early communications between Europe and Asia, whether commercial or military.

3. An account of the institutions of property in land and slaves, and of marriage among all classes of the inhabitants of India.

4. The history of the various settlements of foreigners which have taken place in India from the earliest periods, and embracing both Europeans and Asiatics, with reference to the motives of such colonization, the circumstances attending the various settlements, their effects upon the original inhabitants of the country as regards their religion, manners, customs, and political institutions, and the present condition of their descendants actually existing in India. Under this head would be included the Jews of Cochin, the Afghans, the Parsees of Surat and Bombay, and the Mahommedans of all classes, as well as the natives of different European countries which have been connected with India, as the Portuguese, the Dutch, the French, the Danes, and the English.

5. An account of the most ancient Hindu drawings and paintings, with their probable date.

6. An account of the most ancient buildings in India, with the supposed date of their erection.

7. An account of the worship of demons in India, Ceylon, &c.

8. An account of the astrological system of the Hindus, &c.

9. An account of the temple of Madura in the Carnatic, specifying its dimensions, number of pillars on each side, whether it has a cupola or not; its reputed date; whether it is Jain, Buddhic, or Brahminical; and whether its walls or foundations are composed of very large stones or not. The addition of a ground plan and sections is very desirable.

10. The same particulars relating to two temples at Belgaum, 80 miles East of Goa; and whether their pillars appear to have been turned upon a lathe.

11. Copies of all the alphabets now used in India, *intra et extra Gangem*, and in the Eastern Archipelago, with their value in English letters, and the meanings of their names when they are significant.

12. Copies of ancient Hindu inscriptions, with transcripts in Devanagari.

13. Copies of all the numerals used in Asia, whether formed of letters or figures, with their various forms.

14. Drawings and descriptions of the various kinds of mariner's compasses and zodiacs used in Asia, with the names of the principal winds, of the signs of the

zodiac, the mansions of the moon, and of the cycles of 12 animals and of 60 days or years.

15. Lists of drugs, spices, metals, stones, &c. in the various languages of Asia, written in their respective characters, with their pronunciation and meaning in English.

16. An account of the mode of inheritance among the Nairs by which property descends in the female line.

VI.—*Proceedings of Societies.*

1.—Asiatic Society.

Wednesday, the 6th July,

The President, Sir Charles E. Grey, in the Chair.

A resolution was passed, that residents in the Madras and Bombay Presidencies be eligible as Honorary Members, but that it is inexpedient to admit permanent residents in any part of the Bengal Presidency to the same privilege.

The following donations were presented: Two Pearl Oyster Shells from Valparaiso. Models of the Culinary and Paun Vessels of the Hindus, by Rajah Kalee Krishen. An impression and drawing of a Coin with Cufic characters, found at Baitool, presented by Dr. Carey, on the part of Captain Crawford. A brass equestrian figure, said to be that of Rajah Salya, found in Silwan, in the Futtehpur district, presented by Mr. Prinsep. Read a letter from Mr. Thomason, Secretary to Government, forwarding eighteen Coins, found at Khurrah, in the Futtehpur district, with remarks upon them by Mr. Thomason, and by the Secretary. Meteorological Registers from February to May, were presented by the Surveyor General. A copy of the Nul-Dumun, printed at the Lithographic press, was presented by the Proprietors. Several works were presented by distinguished foreign Societies and individuals.

A letter was read from the Royal Asiatic Society, forwarding a number of queries from the Society[1], also from Professor Milman, and copies of Inscriptions found in Arabia. It was resolved, that the Society's queries should be published in the *Government Gazette*, and those of Professor Milman be referred to Principal Mill and Mr. Tytler, for such answers as they may be able to furnish.

The following papers were then read: An account of Kali Ghat, &c. by Rajah Kalee Krishen. A communication by Mr. Walters, on the population, &c. of Dacca. Observations on the Catalogues of Kah-gyur and Stan-gyur, and other communications on Thibetan Literature, presented by M. De Koros[2].

Mr. Walter's results have already been given in abstract in our March Number.—The following are his observations on the cotton fabrics of Dacca; which used to be so much in request.

' It would be curious to compare the gradual decrease of the population, with the falling off of the manufacture of those beautiful cotton fabrics, for which this city was once without a rival in the world. The first falling off in the Dacca trade, took place so far back as 1801; previous to which, the yearly advances made by the Honorable Company and private traders, for Dacca muslins, were estimated at upwards of 25 Lacs of Rupees. In 1807, the Honorable Company's Investment had fallen to 5,95,900, and the private trade to about 5,60,200. In 1813 the private trade did not exceed 2,05,950, and that of the Honorable Company was scarcely more considerable. And in 1817, the English Commercial Residency was altogether discontinued. The French and Dutch Factories had been abandoned many years before. The division of labour was carried to a great extent in the manufacture of fine muslins. In spinning the very fine thread more especially, a great degree of skill was attained. It was spun with the fingers on a '*Tuckwah*,' or fine steel spindle, by young women, who could only work during the early part of the morning, while the dew was on the ground; for such was the extreme tenuity of the fibre, that it would not bear manipulation after the sun had risen. One *Ratti* of cotton could thus be spun into a thread 80 cubits long; which was sold by the spinners at 1 rupee 8 annas per sicca weight. The *Ruffoogurs*, or darners, were also particularly skilful. They could remove an entire thread from a piece of muslin, and replace

[1] They will be found in the preceding page.
[2] Printed in our present number.

it by one of a finer texture. The cotton used for the finest thread, was grown in the immediate neighbourhood of Dacca; more especially about Sunergong. Its fibre is too short, however, to admit of its being worked up by any except that most wonderful of all machines—the human hand. The art of making the very fine muslin fabrics is now lost—and pity it is that it should be so.'

Physical Class.

Wednesday evening, the 10th August.

Captain J. D. Herbert in the Chair.

A letter from Colonel Torrens, C. B. was read, communicating the permission of his Excellency the Commander in Chief, for the absence of Private Connelly, of His Majesty's 16th Foot, from his Regiment, while employed upon the experimental Boring in Fort William.

Several Geological specimens received from the Reverend R. Everest, were exhibited, illustrative of his observations on the Ramgerh district, read at a former meeting.

A specimen of Plumbago from Ceylon, was presented in the name of the late Bishop of Calcutta.

A paper was read on the Fossils of the Burdwan Coal Strata, by Dr. Falconer, Acting Superintendent of the Botanical Garden at Seháranpúr.

An Analysis of the specimen of Graphite, or Plumbago, from Ceylon, was communicated by the Secretary.

An examination of several varieties of Indian Coal, was also laid before the Society.

Professor Moll's experiment in Electro-magnetism was afterwards exhibited to the meeting.

2.—Medical and Physical Society.

Saturday, the 6th August, 1831.

Messrs. Harvey and Scott were elected Members of the Society.

Several letters and communications were then presented to the Society, and the following papers were read and discussed by the Meeting. Remarks on the employment of blood-letting in the cold stage of intermittent fevers, by Dr. H. Mackenzie, who is stationed near Arrakan, and has extensive opportunities of ascertaining the value of that treatment, concerning which his paper chiefly treats. Dr. M. is no advocate for the indiscriminate use of the lancet, but in all regular intermittents, and where the cold stage is distinct and strong, he speaks most highly of this remedy; and indeed states, that he finds benefit from it in almost all cases where the early period of the paroxysm can be distinctly ascertained: other remedies are used at the same time, and the utility of moderate cathartics is strongly urged, as necessary to insure the success of any other plan that may be tried in agues. Quinine is by no means overlooked; on the contrary, it has been used with the greatest benefit, in conjunction with bloodletting and purgatives. Dr. Mackenzie strenuously advises that all investigations to ascertain the efficacy of venesection, in agues, should have the benefit of the careful personal observation of the Medical men themselves, trusting as little as possible to the report of Native assistants, or the opinions of patients.

Mr. Preston's Report was next discussed: it relates to the efficacy of tying the common carotid artery in bad cases of Epilepsy. The result of one operation appears to have been favorable, in so far as that a plethoric patient, who had been subject to Epilepsy of very severe description for five years, had the operation performed upon him on the 4th February, and had no return of the disease at the date of his report on the 13th April.

Mr. Lindesay's paper on the *Salep Misree*, prepared in the province of Kemaon, would lead us to expect ample supplies of this nutritious article, which is always of high price in the Calcutta market, and often not genuine.

Another Report of Mr. Lindesay's was laid before the Society, containing an abstract of Meteorological Observations, for twelve months, at Lohooghat. As an example of the temperature at that station we may state, that the highest temperature observed at any time in the months of July and August 1830, was 76° 7'—lowest 61° 6'.

Mr. Leslie's Report on the Medical Topography and Diseases of Assam, consists of three parts. The first relates to the localities about Gowhattie, and their influence in causing disease—the second is a history of the diseases—and part three relates to the treatment found most efficacious. An Appendix is annexed, shewing the various degrees of visceral disease in forty-seven cases.

VII.—*Notices of European Science.*

On the Limits of Vaporisation—By M. Farraday, Esq.

There is a paper in the first number of the new Journal of the Royal Institution on this subject, which bearing, as it does on a very interesting theory, our readers will, we doubt not, be glad to see noticed. We allude to the explanation which has been offered of the origin of the Aerolites, in which, it is a necessary assumption that all the ingredients of those singular bodies are vaporisable, more or less, at ordinary temperatures. This opinion had been acquiesced in pretty generally, we believe, and extended even to all matter. Sir H. Davy and Mr. Dalton are mentioned by Mr. Farraday, as two of the most eminent supporters of it; their opinion being that evaporation never ceased entirely, but was in action, however diminished, even at the lowest temperatures, and from the most apparently fixed substances.

An evident corollary from this dogma would be that the earth's atmosphere would have no limit, and consequently that there could be no such thing as free space. But from the regularity of the planetary periods recognised by Astronomers the latter opinion must have been, to say the least, doubtful; and from the following considerations, first brought forward by Dr. Woollaston, the contrary opinion was not only rendered probable, but the actual limits of our atmosphere fixed.

Atmospheric air, like every other portion of matter, gravitates towards our earth, and would in consequence condense into a fluid, were it not for the antagonist principle of elasticity, which occasions it to diffuse itself in every direction into free space. We may consider then the actual condition of our atmosphere as the effect of the adjustment of these two forces; and we see from the phenomena, that the power of elasticity greatly exceeds that of gravity, at the surface of the earth. Elasticity is affected by two circumstances *pressure* and *temperature*, or in other words, the more condensed or pressed air is, the more it tends to diffuse itself and fly off in every direction. Also the higher the temperature of air, the greater its power of diffusing itself. But as we recede from the earth's surface, the pressure as well as the temperature continually lessens; so much so, that at a height of scarcely 4 miles the elasticity is already diminished to ONE-HALF. But in this distance the power of gravity, which tends to oppose the unlimited diffusion of the gaseous substance, is scarcely lessened in an appreciable degree. It is obvious then, that the difference between these antagonist forces is less at that height than at the surface. Proceeding higher, we find the elasticity becoming rapidly less, while the force of gravity is still nearly the same, so that at last we shall reach an elevation where these forces are in equilibrium, and where a particle of air shall be solicited towards the earth by the attraction of gravity, quite as much as it is driven in the other direction by the force of elasticity. Here then, there will be a limit to its diffusion, to its evaporation, and all beyond that will be either a vacuum or occupied by some fluid of greater elastic force. Dr. Woollaston fixed this point at about a height of 50 miles; a height at which the force of gravity would only be diminished about one-fortieth part, while the elastic spring of the air would be probably diminished to one-five thousandth part of what it is at the surface.

This conclusion, which is so clear and convincing, was naturally extended to all matter, and it was thought that there was a limit to the vaporisation of every substance, and consequently that in a temperature sufficiently low there was no body that might not be considered fixed and totally deprived of the power of giving off vapour for the time. Still this conclusion was not at variance with the theory before alluded to; for though most of the ingredients of these singular bodies might be considered *per se* as fixed in the ordinary temperatures of our atmosphere, it was not known what effect the presence of aqueous vapour in the air might produce. It had been remarked in the distillation of certain essential oils, how much more readily they rise in vapour by the addition of a little water in the still, and it was thought that something of the same kind might happen with regard to other substances. Accordingly Mr. Farraday undertook a series of experiments on this subject. He enclosed in a series of phials certain saline substances and certain others in glass tubes enclosed in those phials, but with their mouths left open. The substances in the tubes were dissolved in water, and the phials hermetically sealed and laid by for four years. At the end of that time, the phials were opened, and their contents and those of the tubes examined, but in no case had any thing but water passed from the one to the other.

There were 18 of these bottles, the contents of which and of their enclosed phials is shown in the following table:

No.	*Phial.*	*Enclosed tube.*	*Remarks.*
1.	Solution of Sulphate of Soda, with a drop of Nitric Acid.	Crystals of Muriate of Baryta.	Half the water has passed from the phial into the tube, but no trace of any other change.
2.	Solution of Nitrate of Silver.	Fused Chloride of Sodium.	All the water has passed into the tube; no other change.
3.	Solution of Muriate of Lime.	Crystals of Oxalic Acid.	The water remained in the phial; a very small portion of the Oxalic Acid had passed into the Solution.
4.	Diluted Sulpuric Acid; eq. pts.	Crystallized common Salt.	No change of any kind.
5.	Solution of Muriate of Lime.	Crystals of Oxalate of Ammonia.	A very small quantity of Oxalic Acid was found in the Muriate of Lime.
6.	Solution of Potash.	White Arsenic, in pieces and powder.	The Solution had in three years dissolved the glass, but no trace of Arsenic was found in it.
7.	Sulphuric Acid.	..	.. This was some of the Acid used in these experiments, preserved for comparison.
8.	Dilute Sulphuric Acid; eq. pts.	Muriate of Ammonia.	No change.
9.	Solution of Persulphate of Iron.	Crystals of the Ferro-prussiate of Potash.	Ditto.
10.	Solution of Potash.	Fragments of Calomel.	No change, except by the solution of the glass.
11.	Ditto.	Fragments of corrosive Sublimate.	Glass corroded and the Potash become mild. Crystal of corrosive Sublimate on the lower surface of the stopper.
12.	Solution of Chromate of Potassa.	Chloride of Lead, in powder.	The Chromate of Lead had acted on the glass—result doubtful.
13.	Ditto.	Nitrate of Lead, in crystals.	Ditto.
14.	Solution of Iodide of Potassa.	Chloride of Lead.	No change.
15.	Solution of Muriate of Lime.	Crystals of Carbonate of Soda.	A part of the water passed into the tube—no other change.
16.	Dilute Sulphuric Acid.	Nitrate of Ammonia, in fragments.	The Nitrate moist. The Sulphuric Acid was found to contain Nitric Acid, no trace of which was discoverable in the sample No. 7.
17.	Solution of Persulphate of Copper.	Crystals of Ferro-prussiate of Potash.	No change.
18.	Solution of Acetate of Lead.	Iodiate of Potassium.	The Acetate dry. A little Acetic Acid in the tube and Iodide of Lead in the bottle.

From these experiments, Mr. Farraday concludes "that there is no reason to believe that water or its vapour confers volatility, even in the slightest degree, upon those substances which alone have their limits of vaporisation, at temperatures above ordinary occurrence, and that consequently natural evaporation can produce no effects of this kind on the atmosphere."

"It would also appear that Nitrate of Ammonia, Corrosive Sublimate, Oxalic Acid, and perhaps Oxalate of Ammonia, are substances which evolve vapour at common temperatures."

Meteorological Register kept at the Surveyor General's Office, Calcutta, for the Month of August, 1831.

Day of the Month.	Minimum Temperature observed at Sunrise.					Maximum Pressure observed at 9h. 50m.					Observations made at apparent Noon.					Max. Temp. and Dep. of M.B.Ther. obs. at 2h. 40m.					Minimum Pressure observed at 4h. 0m.					Observations made at Sunset.					Rain-gauge No. 1.	Rain-gauge No. 2.
	Barometer reduced to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.		
1	29,467	80,9	1,1	s.	cis.	,487	84,8	3,9	cm.	cus.	,459	84,7	3,	cm.	cy.	,404	87,5	4,8	cm.	cus.	,406	82,5	1,1	cm.	cus.	,393	52,7	1,3	cm.	cus.		
2	,407	79,8	1,4	s. e.	n.	,425	82,	1,7	s. e.	n.	,401	85,3	4,4	s. e.	cu.	,318	86,5	4,3	s. e.	cn.	,334	85,5	3,8	s. e.	cu.	,344	82,	2,1	s. e.	n.	0,35	0,40
3	,396	80,7	1,3	do.	cus.	,421	85,5	5,6	do.	cu.	,402	87,8	7,1	cm.	do.	,380	86,3	5,1	do.	cis.	,350	86,5	5,1	do.	do.	,358	82,	1,6	do.	cu.		
4	,397	80,	1,6	s. w.	cy.	,429	85,7	4,	cm.	do.	,410	85,9	4,	s. w.	do.	,354	86,5	3,8	do.	cn.	,346	86,	3,9	do.	do.	,372	85,	3,6	do.	cis.	0,20	0,22
5						,442	83,5	1,6	s. e.	cus.	,421	84,	2,	s. e.	cus.	,380	85,8	3,1	do.	cus.	,377	83,5	2,3	do.	cns.	,404	81,5	1,1	do.	n.		
6	,476	79,3	1,2	s.	n.	,539	83,3	2,	cm.	do.	,531	84,8	4,1	do.	cis.	,485	85,7	4,	do.	cu.	,473	85,7	3,7	do.	cu.	,505	83,3	2,6	do.	do.		
7	,559	81,	1,1	s. e.	cy.	,606	87,5	6,1	do.	do.	,581	89,3	7,4	do.	cus.	,544	90,5	8,4	do.	do.	,529	88,	4,1	do.	cis.	,548	84,	3,6	do.	ci.	0,88	0,95
8	,589	82,3	0,9	do.	cus.	,631	88,3	4,4	s. e.	cu.	,619	82,8	1,7	do.	rn.	,572	83,7	1,6	do.	cus.	,562	83,5	1,8	do.	do.	,579	82,7	1,3	cm.	cis.		
9	,601	80,8	1,4	do.	rn.	,621	83,5	3,1	do.	do.	,595	86,7	5,6	do.	cu.	,538	85,7	3,3	cm.	n.	,519	84,7	3,	do.	cus.	,497	83,	3,1	s. e.	do.	0,05	0,08
10	,527	80,	1,1	s. w.	n.	,543	82,	2,1	s. w.	ci s	,529	85,	3,9	s. w.	cus.	,466	86,3	4,4	s. w.	cu.	,446	85,	3,1	s. w.	do.	,474	79,7	1,3	s. w.	n.		
11	,479	79,5	1,6	do.	rn.	,527	81,5	2,8	do.	do.	,507	82,5	3,4	do.	n.	,471	76,5	1,1	do.	rn.	,454	78,9	1,5	cm.	rn.	,452	78,	1,9	cm.	rn.	1,47	1,65
12	,462	80,8	1,4	cm.	cy.	,495	82,3	0,9	cm.	cus.	,452	85,3	2,9	cm.	cus.	,391	85,3	4,1	cm.	cns.	,388	84,5	3,1	do.	cus.	,412	78,7	1,3	do.	n.	0,65	0,68
13	,481	80,3	1,9	s.	cus.	,530	84,5	3,4	do.	cis.	,521	84,5	3,3	do.	cis.	,488	87,8	6,1	s. c.	ci.	,488	85,8	4,7	s. e.	ci.	,497	81,7	1,8	do.	cus.		
14	,538	79,7	1,3	s. e.	rn.	,584	82,	1,6	s. e.	cus.	,554	83,	2,1	s. e.	cus.	,498	82,	1,1	cm.	n.	,499	82,	1,1	cm.	cus.	,501	81,5	2,1	do.	ci.	0,35	0,38
15	,550	79,7	1,	cm.	do.	,587	80,8	2,4	do.	cy.	,592	80,	1,3	do.	n.	,554	82,5	3,1	s. e.	cis.	,534	82,3	2,4	s. e.	cis.	,555	83,3	3,9	s. e.	do.		
16	,656	79,5	1,1	do.	do.	,701	86,3	4,2	cm.	cu.	,689	80,5	1,1	cm.	rn.	,624	82,5	2,4	cm.	n.	,509	81,6	0,7	cm.	n.	,535	80,9	2,5	do.	n.	2,10	2,25
17	,691	80,8	1,9	s. e.	cu.	,720	85,5	4,3	s. e.	do.	,702	89,5	7,3	s. e.	cu.	,644	85,	4,3	s. e.	do.	,508	84,8	4,1	s. e.	cis.	,611	82,5	1,1	do.	cis.		
18	,657	79,7	1,3	cm.	rn.	,717	86,7	5,3	cm.	ci.	,706	88,8	8,1	cm.	do.	,646	87,7	5,5	cm.	cu.	,639	86,7	5,3	cm.	cu.	,653	83,7	2,6	do.	do.	0,20	0,25
19	,695	80,	1,6	n. e.	cus.	,728	84,	4,3	n. e.	cu.	,697	86,	5,6	n. e.	do.	,646	86,	7,8	n. e.	cis.	,627	85,6	5,5	n. e.	cis.	,614	84,	2,3	n. e.	cis.		
20	,674	79,5	1,1	do.	cy.	,717	85,	3,8	do.	cis.	,672	88,7	7,5	do.	cis.	,630	87,8	6,1	do.	n.	,604	80,8	1,4	do.	n.	,624	80,5	2,1	do.	cy.	0,43	0,45
21	,662	79,9	1,5	do.	do.	,712	86,5	4,8	do.	cu.	,688	82,5	1,6	do.	n.	,620	84,	3,6	do.	cus.	,609	83,9	3,1	do.	cus.	,626	82,	1,6	do.	n.	0,80	0,94
22	,647	79,7	0,8	do.	cus.	,662	84,5	4,8	do.	do.	,631	88,3	7,1	do.	cu.	,562	89,6	6,7	do.	cu.	,544	83,5	2,8	do.	rn.	,537	84,	3,6	do.	cis.		
23	,531	79,7	1,3	do.	rn.	,566	86,5	5,6	do.	do.	,530	82,	1,9	do.	rn.	,444	88,	6,3	do.	do.	,437	80,5	1,1	do.	do.	,425	82,	2,6	do.	cus.	0,20	0,27
24	,433	79,5	1,1	do.	n.	,444	81,3	1,9	do.	n.	,394	79,5	1,1	do.	do.	,342	80,5	1,4	do.	n.	,339	80,3	1,4	do.	cy.	,325	79,5	1,1	do.	n.	0,10	0,15
25						,483	82,8	2,7	s. e.	cus.	,502	80,5	1,6	s. e.	cy.	,506	79,8	0,9	s. e.	rn.	,492	78,6	1,2	s. e.	n.							
26	,698	79,7	1,3	s. e.	cus.	,777	85,6	3,9	do.	cis.	,777	86.7	4,8	do.	cu.	,705	88,5	6,4	do.	cu.	,703	84,5	4,1	do.	cus.	,706	83,	3,1	s.	ci.	0,88	0,90
27	,760	79,3	0,2	s.	cy.	,795	86,7	5,	s.	cu.	,766	87,3	6,6	s.	do.	,688	89,8	6,8	s.	do.	,669	87,8	5,7	s.	cu.	,656	84,	2,6	do.	cus.	0,30	0,35
28	,612	80,7	1,3	s. e.	cu.	,752	87,7	4,8	do.	do.	,692	89,	5,1	s. e.	do.	,617	90,5	6,4	s. e.	do.	,622	90,5	6,6	s. e.	do.	,641	87,	4,3	s. e.	ci.		
29	,680	82,9	1,5	do.	ci.	,722	89,5	6,1	s. e.	do.	,583	90,5	8,4	do.	ci.	,605	90,5	8,1	do.	do.	,603	87,	5,3	do.	cis.	,614	86,	3,9	s. w.	do.		
30	,656	80,5	1,1	do.	cus.	,689	87,8	5,1	cm.	do.	,674	90,8	8,4	cm.	cu.	,650	82,	2,6	cm.	rn.	,628	80,3	0,9	cm.	n.	,630	81,	1,6	s. e.	cis.		
31	,675	79,9	1,5	s.	cy.	,724	85,3	3,4	s.	cis.	,694	86,7	6,	s.	cis.	,650	84,5	2,8	s. e.	cis.	,636	83,	1,8	s. e.	cis.	,647	82,	2,6	do.	do.	0,42	0,45
Mean,	29,578	80,2	1,3			,606	84,8	3,7			,583	85,4	4,5			,532	8,5	4,4			,512	84,	3,1			,525	82,4	2,3			9,38	1,03

Abbreviations. In the column "wind," small letters have been used instead of capitals; *cm.* means *calm.* In the column "aspect of the sky," *cy.* is *cloudy*; *cl.* *clear*; *rn. rain*; *ci. cirrus*; *cu. cumulus*; *cs. cirro-stratus*; *cus. cumulo-stratus*; *cc. cirro-cumulus*; *n. nimbus*. The Rain-gauge No. 1, is on the ground. No. 2, is on the roof of the house, 45 feet above it.

GLEANINGS

IN

SCIENCE.

No. 33.—*September*, 1831.

I.—*On the Organic Remains found in the Himmalaya.—By Capt.* J. D. Herbert, *Dep. Sur. Gen.*

[Read before the Physical Class Asiatic Society.]

THE more elevated portions of the earth's surface have always in a particular manner attracted the attention of geologists, in consequence of the greater developement in which rocks are there found. The level plains are every where composed of vast accumulations of the more recent debris, which conceal in a great measure the nature of the materials forming the crust of our globe: in mountainous countries only it is that the nature and order of the strata can be observed. In level countries these are hid from our view by the thick coating of rubbish with which the destructive agencies always at work have gradually covered them.

The greater the elevation the greater has been supposed to be the interest attached to geological investigations; yet this is not always the case. When the Wernerian theory was in vogue, the occurrence of marine organic remains at great elevations was necessarily considered a point of considerable interest; but since other views (to say the least, equally probable) as to the possible origin of the present inequalities of the earth's surface have become current, the occurrence of such phenomena at this or that elevation has ceased to form a discussion of the same interest.

But though the question of the altitude at which shells are found has lost much of its original interest, it does not follow that no interest of another kind may not attach to it. In fact, from the zeal and perseverance with which the history of fossil remains has been recently pursued in Europe, many points of inquiry have sprung up which are calculated to interest the geologist in a very high degree. By comparing the shells found in the same rocks at different places and again in different rocks, much of the obscurity which had concealed what is called the order of superposition in the newer strata has been dissipated, and a strong light thrown on this most interesting branch of geology. In this way fossil remains have come to be considered as the most certain means of determining the true place of a formation in the general order of superposition; and mineral composition (in which indeed it was always known there was great latitude), is again frequently altogether overlooked. Thus the lias of the Alps could never be recognised by a common observer as the same formation with the lias of England; but the fossil remains found in both being identical, and some of them peculiar to that member of the newer strata, no doubt is left of their correspondence in order and position, at least in the mind of the experienced geologist.

The application of this test to rocks in the same neighbourhood must at once be admitted as legitimate; that it may be extended even to rocks of the same country most will concede; but in pushing the principle still farther, it will become a subject of consideration what is the postulatum on which the deductions from it rest. In applying it to rocks found on opposite sides of the globe and in climates the most different, do we not assume that similar animals must have lived in widely separated localities, in climates sometimes directly opposite? Again, what do we mean by similar animals? Does the term include the *same species*, or merely different species of the *same genus?* Here are questions which can only be answered by an extensive induction. If answered affirmatively, they would afford a certain clue to the investigation of many curious facts in distant countries; but they unfortunately require for their answer those very facts they are intended to illustrate. Geologists have perhaps too hastily adopted the least troublesome view of the question, and have, I think I may say, assumed what should have been the object of their inquiry. It has in this way, for instance, been attempted to connect the strata of the Himmalaya in which organic remains are found, with the secondary and tertiary strata of England. Geology is not however yet ripe, for the admission without question of the opinion on which this conclusion rests; and many more facts must be collected before it can be viewed as even probable. In a question of this nature, in which very distant localities are concerned, we should find mineral composition, notwithstanding its latitude, a safer guide; for as Humboldt observes, the rocks are the same in every climate, but not so the organic productions whether animal or vegetable. What is meant is, that though rocks oscillate much, their oscillations are performed round a mean type, which is the same in every country however different the locality. Even the oscillations preserve a certain resemblance; and however great the varieties may be of a rock found for instance in one country, similar types will be found wherever else that rock is extensively developed. But the case with organic productions is very different. Amongst them the instances are few of an individual adapted to live in different climates; and even in the same climate, how often do we observe individuals confined to a limited range, where the arrangement of nature has been undisturbed by man? Perhaps however the opinion, which would advocate the comparison of mineral composition as a means of determining the identity of the supposed member of any formation, is applicable with less modification to the primary and secondary than to the tertiary class of rocks; although I conceive we are far from being able to pronounce positively, without a much more extensive collection of observations than we can yet command.

The tertiary strata in Europe have been fully studied, owing to the abundance and variety of the organic remains found in them; but we have as yet few notices of these strata in other parts of the globe. These tertiary strata have hitherto been found in countries of moderate elevation: it is not unlikely then, should the conjecture which traces them in the Himmalaya mountains prove to be well founded, that the examination of them at such enormous elevations may be attended with the discovery of various particulars of interest, and it is much to be desired that the subject could be prosecuted with that energy which its importance warrants. But for this very reason I would argue against our receiving too easily the opinion, which from the examination of a few shells would at once jump to the conclusion, that such a rock belongs to the lias formation of England, such a one to the oolite, &c. and rest satisfied with this conclusion, as if no more were to be learned. As a stimulus to inquiry; as a means of engaging in it those who have an opportunity by observation of supporting or overturning such an opinion; we need not object to its circulation; but we should be careful to take it for what it is worth and for no more. We should not adopt as a dogma to be believed, that which should rather be considered as a query to excite discussion and examination.

An accurate and complete history of the organic remains which have yet been discovered in the Himmalaya, would be a useful memorandum for the geologist. To make it really useful, however, it ought to contain drawings of every remain, and particularly full and accurate information as to the locality, which should be fixed physically and geologically. The execution of such a work is to this extent however I fear nearly impracticable; for of the remains found many have been sent to England, and are doubtless distributed beyond the power of an unassisted individual to trace. As however it is important to make a commencement, I shall here throw together such particulars as I have had the means of learning, in hopes that my imperfect account may stimulate others to supply my deficiencies, and particularly to correct (if I have made any) my mistakes.

I may commence with a very general and cursory view of the geology of these mountains, so as to show what is the real bearing of the question of organic remains, and what is its real interest.

The Himmalaya mountains may be geologically divided into 3 distinct zones; which in their fully developed character are sufficiently well defined, though it may often be difficult to trace the exact boundaries.

On first approaching them from the plains, sandstone is the rock met with. It is of an argillaceous and frequently conglomerate character, containing immense quantities of rounded stones. It is distinctly stratified, and dips pretty regularly to the N. E. the inclination of the strata being seldom more than 20° or 25°. To what formation of Europe this sandstone is analogous, appears to be still doubtful. I am myself inclined to think it must correspond with the newer red sandstone, but my want of acquaintance with European rocks, except in books, of course leaves my opinion open to dissent. This sandstone seldom attains an elevation of more than 3500 feet above the sea, or 2500 above the plains at its feet.

To the sandstone succeeds the zone of schists. These are at first argillaceous, afterwards micaceous, and latterly talcose and chloritic. This description however must not be taken too literally; for there are often beds of argillaceous or talcose or chloritic schist in the middle, while micaceous schist may be found on either border. But the above is the general arrangement. This zone attains great elevation. Its lowest level may be about 1500, its highest 7 or 8000. These schists are always stratified, but it has appeared to me that the stratification is more irregular and more difficult to trace than in either of the other zones. Beds of limestone and potstone are found in this tract, and towards its superior limit beds of hornblende schist. In the former occurs the copper mines of these mountains. The mica slate of course often passes into quartz rock, which sometimes covers a great extent of country. It is frequently intersected by veins of a porphyritic rock, composed of quartzose arenaceous base, with irregular crystals of hornblende disseminated.

This tract is physically remarkable for attaining its greatest elevation on its southern and northern extremities, while between it is of less height, forming in fact, if the mean surface only be considered, a sort of trough or basin. A peculiarity of geological structure accompanying this is the disposition along this lowest level of granitic tracts or *nuclei*, each of comparatively small extent, frequently putting on the appearance of veins, and distributed at intervals along the line from the Kalee to the Sutluj. Generally these granitic *nuclei* being in the lowest tract, are themselves not very high; but an exception is found in the Chúr mountain, which attains the elevation of 12 000 feet, and forms the summit of a very lofty, extensive, and well defined range. Gneiss is occasionally met with on the borders of these patches of granite, but never extensively; and beyond it again succeeds the micaceous schist.

The third zone is that of the Himmalaya proper, the snowy range itself; and it is composed, without an exception that I know of, of gneiss. The stratification is always marked, generally regular, and like the sandstone dips to the S. W. The consequence is, as has been often noticed by travellers, that the plainward faces of these mountains are steep and precipitous, while those to the N. E. are of easy declivity. Professor Jameson describes the stratification of great mountain ranges as dipping on each side towards the summit, but nothing of this kind occurs in the Himmalaya. It has been also said, I believe by the same authority, that all lofty mountain ranges are granitic; but neither is this true of the Himmalaya: the highest peaks are every where composed of gneiss, the strata of which may be clearly distinguished, when bare of snow, through a telescope. Granite has no where been found except in veins, and these veins are generally small with one exception. This is at Wongtoo on the Sutluj, where the granite is of some extent, though still, as I satisfied myself, but a large vein.

The gneiss is of very various character, as far as colour and grain are concerned, though always very regular, consisting of the usual ingredients united in the usual proportions; garnets, schorl, kyanite, carbonate of lime, green quartz, and hyacinth, are the most ordinary imbedded minerals. A speck of native gold has been found in a specimen from one of the granite veins.

If we now consider what precedes, we shall perceive the interest attaching to the question of organic remains. 1st, None have ever been found in the sandstone, with the exception of small patches of lignite pretty generally distributed through it. This is so far in conformity with its character in Europe, where few if any organic remains have been found in it. Nor do I know of any having ever been detected in any of the schists, which it is evident from the above description belong to the primary class of rocks. The argillaceous schist does however, where in contact with the sandstone, put on very much the appearance of gray-waeke, and a very great proportion of it is well defined gray-waeke schist, in which rock organic remains have been found in Europe. And though I have above stated, that no organic remains are to be found in this rock, I must not omit to mention, that Dr. Govan has described a limestone occurring in the gray-waeke slate as containing organic impressions; though no details on this subject have ever been laid before the public. Recently too the same gentleman has transmitted to a friend in Calcutta a portion of the same rock, said to contain an impression of a lizard's tail. The resemblance however was, I think, but faint, and the general opinion appeared to incline to scepticism with regard to the real value of this organic remain. But with every deduction made on these scores it would perhaps have been only more correct to have said, that organic remains have been found *very rarely*, if at all in this rock.

Granting even the veritable character of these remains, they are found only on the southern limit, and at no great distance from the sandstone, where it may be supposed the rock has not its primary character yet fully developed. But in the superior part of this zone, and in the gneiss zone, nothing of the kind has ever been detected.

The gneiss zone being stratified and dipping at no great inclination to the N. E. the consequences to be expected are, that in proceeding to the north eastward the same succession of strata would be found, but at greater elevations. And this is the fact, although the development of the rocks to the north is not equal in extent to those on the south side. Micaceous schist with its associates gradually give way to gray-waeke slate or gray-wacke, which rocks are found at very great elevations: limestone with organic remains is found in beds in these rocks, and at such an elevation, that the tertiary strata may be expected to occur at very great heights, and even the superficial deposits which have been called *diluvium*. It may be proper here to note, as the source of many erroneous ideas on the geology as well as physical character of the Trans-himmalayan countries, that the term *plateau* or *table land* cannot with any propriety be applied to such part of them as we have any means of visiting, or even of viewing at a distance. This subject I have fully discussed in my report of the survey in which I was engaged by order of Government: it may be sufficient here to state, that the country is mountainous and uneven, intersected by deep ravines, the beds of torrents, or by river gorges of great depth and steepness, and that any thing like a plain or moderately undulating valley of a mile square is not to be found. In fact, when it is considered that the tract in question is occupied by the Sutluj and Indus with their branches, it may well be supposed to be any thing rather than a plateau.

The occurrence then of the organic remains we have lately had before us, would seem to be some warrant for our expecting the tertiary strata much nearer to the zone of gneiss, than judging from the analogy on the southern side we should expect to find them. As a consequence of this proximity to the crest of the highest chain of mountains in the world, and the small inclination of the strata, they must be situated at higher levels than these rocks have yet been observed to occupy. As a corollary we may also expect, that the superficial and most recent deposits will be found at a great elevation; and in this way there may certainly be a central plateau or table land far beyond our frontier, of which however we can scarcely expect ever to have a glimpse.

Having thus cursorily illustrated the physical structure and geology of the tract in question, I proceed to notice the several occurrences of organic remains with which I am acquainted.

The first notice of organic remains from the Himmalaya mountains was I believe derived from the fact of the Gunduk river bringing down, with the stones in its bed, specimens of *Ammonites*, the *Saligrami* of the Hindus. As nothing was known at the time of the geology of the mountains, the fact attracted little notice, and indeed was only known perhaps to those who interested themselves in the history and nature of Hindu observances. The next occurrence in point of time was the fact learned by Europeans resident in Kemaoon, of the occurrence of fossil bones as well as of *Ammonites* in the interior of the snowy range, and their circulation in commerce as an article of export. These bones were called *Bijli ca har*, lightning bones, as the expression may be translated; and they were valued, not only as charms, but as medicines; belonging in the latter case to the class of absorbents. As they consist chiefly of carbonate of lime, it appears that they were not unfitted for this office. Who was the first discoverer of these bones, and appreciated the interest belonging to them in Europe, I cannot positively say; I rather think however it was Captain S. Webb, then surveyor in Kemaoon. He took home a collection of them, which from an incidental notice in the *Reliquiæ Diluvianæ* we learn was inspected by the Rev. Dr. Buckland, whose speculations on the subject of bones found in caves excited so much interest some years ago. Mr. Traill, Commissioner in Kemaoon, subsequently made what appeared to me a very interesting and valuable collection, which was presented to Mr. H. T. Colebrooke. These I had an opportunity of examining, and I shall here state what occurred to me, as well as what I could learn of their locality, &c.

They consisted of bones of sizes, including crania or fragments of crania of different animals. One specimen, which was a very perfect one, was a cranium apparently of a goat or deer, the cavity of the skull being occupied with a congeries of crystals of calcareous spar. In like manner, the larger bones had their cancellæ filled with these crystals, which appeared to have taken the place of the medullary substance. All these bones were completely mineralised, being converted into carbonate of lime, with occasional incrustations of an arenaceous or coarser carbonate. Dr. Buckland says of those he examined (the bones taken home by Captain Webb), and of which he referred several to a species of horse and a species of deer, that they were unchanged except by the loss of their animal ingredients, being dry and absorbent like grave bones. Mr. Traill's collection was evidently of a very different nature: the mere handling them was sufficient to convince any one of the complete change they had undergone.

Sometime afterwards I was fortunate enough to make some acquisitions of the same kind by Mr. Traill's assistance, and as far as I could understand derived from the same localities. These, as they were described to me, were on the northern face of the ridge which separates the basin of the Ganges from that of the Sutluj, and not far from the town of Dumpu. This ridge is several days journey beyond the line of snowy peaks forming the zone of greatest elevation. On one of the passes examined, the Uta Dhura, elevated 17000 ft. was found a bed of limestone containing organic remains though not well defined—such a limestone as in Europe would be called transition. This limestone belongs to a gray-waeke schist, which succeeds a micaceous schist, following in order the Himmalaya gneiss; yet these bones were asserted to have been brought from a spot not 5 days journey to the north of this, and considerably elevated above the bed of the Sutluj. I am sorry I have not the means of submitting this collection to the Society, but the accompanying two specimens may give some idea of the nature of these remains. One appears to be a fragment of a bone of a large animal—it is, as is evident from its weight, completely mineralised. The other is a specimen of silicified wood. Whether it came from the same place I know not, but the collection contained several similar specimens.

From the same people from whom these bones were obtained, great numbers of *Ammonites* and of *Belemnites* were obtained. The former when unbroken were ellipsoidal shaped masses of a black iron clay, approaching to the nature of clay slate. Outside they are perfectly smooth, as if rounded by attrition, but on breaking them the impression of the *Ammonites* is discovered. Many of them, however, which externally were not distinguishable from the others, yet contained no impressions in their interior. Concerning the locality of these or of the *Belemnites*, I never could get any clear information beyond the fact of their being found North of the range before-mentioned, which, as it is the boundary of the Honorable Company's territory, was likewise that of my investigations.

With the exception of these particulars, all that we know or have heard of organic remains in the Himmalaya, we owe to the spirit and persevering enterprize of Dr. Gerard. His repeated visits to the different places where these remains are to be found must have made him fully acquainted with all the circumstances. As one of the most interesting of his collections has been recently under the consideration of the Class, and as all his letters accompanying them have been read at our meetings, it would be at once useless and impertinent in me attempting a history of his labours and discoveries. I may however state, if it be only to connect these collections with the others, that they consist of *Ammonites* and *Belemnites* like the others, and in addition of *Orthoceratites;* that like them they come from beyond the region of the schists, which succeed to the Himmalaya gneiss in going northward; and that, in addition to the above, there are what I have seen in no other collection, rocks apparently formed entirely of shells, and containing several species in the most perfect preservation. These latter I need not say are those which have been made the subject of a recent report read before the Class. Dr. Gerard has however, I believe, never met with any bones.

I may conclude this meagre notice with the expression of a hope, in which I am sure the Class will join with me, that Dr. Gerard will shortly be able to communicate to us the particulars of his discovery as to locality, &c. and that by this means there be assured to him the honor of being the first discoverer, which considering his indefatigable zeal in the examination of the tract in question and the many years of his life he has devoted to it, we should be sorry to see snatched from him by a later observer, who was indebted for his knowledge of the phenomena, and his examination of them, to the liberal and communicative spirit which Dr. Gerard has always manifested.

Note by the Secretary.—The accompanying plate, has been etched from the more finished drawings of Dr. Gerard's fossil shells, prepared to be printed with the Rev. R. Everest's memorandum upon them in the Asiatic Researches. These organic relics are generally in so mutilated a state that few of the characteristic types are discernible, and the difficulty of naming them is increased by the want of works of reference on fossil conchology. Much uncertainty therefore still prevails in the names assigned, and it is hoped by circulating the figures in the GLEANINGS to elicit further opinions on the subject from those who make conchology their peculiar study. Those also who reside among the hills may, by seeing what species the cabinet of the Society possesses, be better able to select fresh varieties, and complete in time this interesting series of Himmalayan fossils. We address ourselves more particularly to Dr. Gerard, to whom we already owe so much, and who has promised a geological section of the Spítí valley, in which they were discovered by himself.

References to Plate XVII.

1. (*a*) Numerous blocks of gray siliceous limestone—(or calcareous tufa, containing 50 per cent. of reddish sand), filled with shells and casts of a small inequivalve eared bivalve, resembling the small *Pecten* of the York lias.

b and *c* are mutilated specimens of a larger variety of *pecten*, probably the same shell in a more advanced state.

2. (*a*) An unequivalved bivalve shell with a deep furrow on the back, the substance of which is generally changed into crystalline carbonate of lime, and in a single specimen into ironstone; it is imbedded in a hard slate of a dark gray: the lower valve is frequently crushed as in figure 2 (*b*). Mr. Everest supposes

them to belong to the genus *Producta,* and compares them to the *Producta Scotica,* depicted in Ure's Geology.

3. Specimens of a plaited variety of *Terebratula,* some detached, others imbedded in a matrix of bluish gray limestone (containing 6½ per cent. of pure white sand). These shells differ little from those so abundantly found in the inferior oolite near Bath

4. Many detached specimens of an equivalved transverse bivalve, transversely striated, and the valves crenulated on their interior margin (*c d.*) Its external shape is similar to that of a short variety of *Unio* to which it was at first referred, but Mr. Everest points out the absence of lateral teeth and ridge, and inclines to refer it to the genus of fossil *Trigonia.* Some larger varieties resemble the *Venus* and *Donax.* Many of the shells have undergone considerable pressure. The figure *b* and *c* are too triangular in the drawing; the lower part should be more rounded.

5. Small very transverse equivalved bivalves of a black colour, belonging apparently to the genus *Modiola.*

6. A variety of *Arca.* The drawing somewhat too thick.

7. Imperfect fragment of a large shell, which may be a species of *Donax?* or *Ostrea?* Mr. Everest supposes it an *Inoceramus?*

8. This and several of the following specimens are varieties of *Ammonites,* of which the specific names cannot be assigned for want of books and plates of reference. It resembles the *Ammonites stellaris* of the lias in Ure's Geology.

9. Resembles the *Orbulite* or the *Nautilacea* of Lamarck.

10. Bears a strong resemblance to the *Nautilus pompilius* of the same author. Parts of the white original shelly substance adheres to the dark gray cast, and exhibits minute transverse striæ on the interior surface, which are less marked on the interior cast—the substance of the shell is exceedingly thin.

11 and 12. Shew the distinct characteristics of the two commonest species of *Ammonites:* they are frequently mineralized by pyrites and iron clay.

13 and 14. Represent the rounded nodules when first broken; they belong to the same species as fig. 12. The annular ridges divide off into loops on the back of the whorls, (*Ammonites vertebralis* of Sowerby?)

15. A species of *Cirrus.*

16. This shell corresponds very closely with the plate of Sowerby's *Ammonites subradiatus* given in Lamarck, which is a fossil of the Bath oolite.

17. A variety of *Ammonites* not determined.

18. *Helix:* resembles the *Turbo ornatus* of the lower oolite, (Sowerby.)

19. Cast of a patelli-form shell.

20. The drawing of this figure is faulty; the cone has too large an angle. It appears to belong to the family *Turbinacea,* genus *Turritella.*

21. Undetermined, perhaps *Conus marmoreus?* L.

22. *Orthoceratites;* enclosed in a nodule of iron clay.

23. Detached *Orthoceratites.* This shell does not differ from the English one.

24. *Belemnites,* common and of all dimensions; the furrow is deeper than in most of the English specimens.

25. Fragment of the back of a testudinous animal.

Himmalayan Fossil Shells from Dr. Gerard. Sootatoo.

II.—*On the Duration of Life in the Bengal Civil Service.*

To the Editor of Gleanings in Science.

SIR,

Under the impression that questions in Political Arithmetic are not foreign to the object of your work, and that they will prove interesting to many of your readers, I venture to send you the following statements regarding the duration of life, amongst the class of residents in this country, who constitute the Bengal Civil Service.

I am,

Your obedient Servant.

J. T.

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1. Official returns subsequent to 1790, which have been carefully examined and verified by every test that could be applied to them, present the following results. They are thrown into a tabular form for convenience of reference.

1	2	3	4[1]	5[2]	6
Number of Seasons.	Number of writers appointed in those seasons respectively.	Period of years subsequent to entering the service.	Number who left the service in each period.	Number who died in each period.	Number who remained in the service at the end of each period.
1790 to 1828,	852	1	0	2	850
1790—1827,	809	2	0	9	800
1790—1826,	762	3	4	26	732
1790—1825,	714	4	7	37	670
1790—1824,	685	5	15	42	628
1790—1823,	670	6	19	51	600
1790—1822,	646	7	25	52	569
1790—1821,	633	8	30	58	545
1790—1820,	620	9	35	68	517
1790—1819,	603	10	39	77	487
1790—1818,	584	11	42	85	457
1790—1817,	569	12	45	87	437
1790—1816,	551	13	47	89	415
1790—1815,	533	14	46	93	394
1790—1814,	507	15	54	93	360
1790—1813,	498	16	59	95	344
1790—1812,	486	17	62	97	327
1790—1811,	476	18	63	100	313
1790—1810,	464	19	66	103	295
1790—1809,	452	20	72	108	272
1790—1808,	436	21	75	109	252
1790—1807,	419	22	79	108	232
1790—1806,	395	23	86	106	203
1790—1805,	366	24	84	105	177
1790—1804,	341	25	93	105	143
1790—1803,	311	26	93	99	119
1790—1802,	289	27	91	100	98
1790—1801,	262	28	85	95	82
1790—1800,	246	29	85	93	68
1790—1799,	217	30	79	84	54
	15396		1580	2376	11440

[1] The term "who left the service," includes all whose names have been struck off the list, in consequence of a residence in England of upwards of 5 years, acceptance of the pension, dismissal from the service, or any other cause.

[2] All are entered who died, whilst their names remained on the list, whether at the time resident in India, or temporarily absent from it.

2. Some illustration may be necessary to explain the several positions in this table: thus, out of 762 writers, who were appointed during the seasons from 1790 to 1826, in the period of 3 years, after entering the service, 4 left it, 26 died, and 732 remained in the service at the end of the period. Again, out of 246 who were appointed in the seasons, from 1790 to 1800, during the period of 29 years, 85 left the service, 93 died, and 68 remained in the service at the end of the period. It is useless to extend the computation beyond the period of 30 years, for the numbers would be so small, that they would lead to very fallacious results.

3. It may fairly be assumed that the mean age of writers, on their arrival in the country, is 20 years. For investigating the duration of life, the number of those who leave the service may be thrown out of the calculation. We shall then have several ratios, the first term consisting of the number who enter the service at the commencement of any period, minus those who leave it during that period, or the difference between each entry in column 2, and the corresponding entry in column 4, and the second term, the corresponding number, who survive at the end of such period, as entered in column 6. These ratios may be reduced to a continuous series, by adapting them to any convenient standard. Price's Northampton Tables are those most commonly in use, and we will therefore take as the standard 5,132, the number of persons assumed in those tables to be living, at 20 years of age. The following will be the result:—

Age.								Annual decrement of life.	Periodical Averages.
21	852	:	850	::	5132	:	5120	12	
22	809	:	800	::	5132	:	5075	45	
23	758	:	732	::	5132	:	4956	119	65
24	707	:	670	::	5132	:	4862	94	
25	670	:	628	::	5132	:	4810	52	
26	651	:	600	::	5132	:	4729	81	
27	621	:	569	::	5132	:	4702	27	69
28	603	:	545	::	5132	:	4638	64	
29	585	:	517	::	5152	:	4535	103	
30	564	:	487	::	5132	:	4431	104	
31	542	:	457	::	5132	:	4327	104	
32	524	:	437	::	5132	:	4279	48	75
33	504	:	415	::	5132	:	4225	54	
34	487	:	394	::	5132	:	4152	73	
35	453	:	360	::	5132	:	4078	74	
36	439	:	344	::	5132	:	4021	57	
37	424	:	327	::	5132	:	3953	68	
38	413	:	313	::	5132	:	3889	64	81
39	398	:	295	::	5132	:	3803	86	
40	380	:	272	::	5132	:	3673	130	
41	361	:	252	::	5132	:	3582	91	
42	340	:	232	::	5132	:	3501	81	
43	309	:	203	::	5132	:	3400	101	143
44	282	:	177	::	5132	:	3221	179	
45	248	:	143	::	5132	:	2959	262	
46	218	:	119	::	5132	:	2801	158	
47	198	.	98	::	5132	:	2540	261	
48	177	:	82	::	5132	:	2377	143	190
49	161	:	68	::	5132	:	2167	210	
50	138	.	54	::	5132	:	2008	159	

4. The last terms of the several proportions constitute the required table of the duration of life. The annual decrement is irregular, and admits of adjustment from the periodical averages, as entered in the last column. Beneath are exhibited,

in one view, the table in the rough as calculated above ; the adjusted table, in which the irregularities have been distributed over the whole series of years, as equally as possible, with reference to the periodical averages ; and the corresponding portion of Price's Northampton table.

Age.	Bengal Civil Service Rough Table. Number who Complete that Age.	Bengal Civil Service Rough Table. Number who Die in the interval.	Bengal Civil Service Adjusted Table. Number who Complete that Age.	Bengal Civil Service Adjusted Table. Number who Die in the interval.	Price's Northampton Table. Number who Complete that Age.	Price's Northampton Table. Number who Die in the interval.
20	5132	12	5132	63	5132	72
21	5120	45	5069	64	5060	75
22	5075	119	5005	65	4985	75
23	4956	94	4940	66	4910	75
24	4862	52	4874	67	4835	75
25	4810	81	4807	68	4760	75
26	4729	27	4739	69	4685	75
27	4702	64	4670	69	4610	75
28	4638	103	4601	70	4535	75
29	4535	104	4531	71	4460	75
30	4431	104	4460	72	4385	75
31	4327	48	4388	73	4310	75
32	4279	54	4315	75	4235	75
33	4225	73	4240	77	4160	75
34	4152	74	4163	79	4085	75
35	4078	57	4084	81	4010	75
36	4021	68	4003	83	3935	75
37	3953	64	3920	85	3860	75
38	3889	86	3835	87	3785	75
39	3803	130	3748	89	3710	75
40	3673	91	3659	96	3635	76
41	3582	81	3563	110	3559	77
42	3501	101	3453	130	3482	78
43	3400	179	3323	150	3404	78
44	3221	262	3173	175	2326	78
45	2959	158	2998	198	3248	78
46	2801	261	2800	198	3170	78
47	2540	143	2602	198	3092	78
48	2377	210	2404	198	3014	78
49	2167	159	2206	198	2936	79
50	2008	0	2008	0	2857	0

5. The comparison is curious, as shewing that up to the age of 42 the Bengal Table is more favorable to life than the Northampton ; that at 43 years of age, it is as nearly as possible the same, and after that age, far more unfavorable. In this respect, actual observation bears out the common remark, that the climate of India induces premature old age.

6. The table is remarkable, as it shews the effects of an Indian climate on European constitutions, under the most favorable circumstances. Arriving in the country at the most advantageous age, subject to little exposure, with incomes sufficient to command all the comforts of life, and with facilities for renovating impaired health by temporary removal to another climate, the decrement of life in the Civil Service must undoubtedly be less than amongst any other class of residents in the country. A more extended comparison, therefore, with the tables commonly known in Europe, may not be uninteresting. Out of 60 persons supposed to be living of the age of 20, the following table shews the number who would survive at the expiration of each successive interval of 5 years, according to the several tables specified.

	Number who survive at the age of						
	20	25	30	35	40	45	50
Carlisle Tables,	60	59	56	54	51	47	44
DeParcieux,	60	57	54	51	48	47	42
Dr. Halley's Breslaw Tables,	60	56	53	49	44	39	34
Price's Northampton ditto,	60	55	51	46	42	37	34
Price's London ditto,	60	55	50	45	39	33	27
Bengal Civil Service,	60	56	52	47	42	34	23

The annual per-centage of deaths between the ages of 20 and 50, stands as follows :—

Carlisle Tables, .92 per cent.
DeParcieux, .95 ditto.
Breslaw Tables, 1.40 ditto.
Northampton ditto, 1.47 ditto.
London ditto, 1.79 ditto.
Bengal Civil Service, 2.03 ditto.
To these may be added, from very accurate computations,
Bengal Army, 2.95 ditto.
Madras Army, 3.25 ditto.

7. The Honorable Court of Directors have lately granted some valuable boons to the Civil Service :—the absentee allowance for 3 years to those who are obliged to return to England, on account of certified ill health, the furlough allowance for three years to those who have resided 10 years in the country, and the pension of £1,000 after 25 years' service. The effect of these rules can be but imperfectly foreseen. They will probably lessen the mortality, from the age of 20 to 40; increase it from 40 to 45, by the inducement they will hold out to endanger a broken constitution, for a few more years, in hopes of obtaining the pension; and materially lessen it subsequently to the age of 45.

Note *by the Editor*.—We thank the author of the above contribution, and agree with him that the subject is one of high interest, and deserving of further investigation, which we trust it will receive from himself. We observe he is in possession of some calculations respecting the chances of life in the Military Service of Bengal and Madras, and we hope he will transfer them to our pages. We would also suggest enquiry into the proportions between the premiums charged by the Life Insurance Office in India, and those which are charged in London, making allowance for the Government duty in England, and for the profits divided among the share-holders. Some interesting results appeared upon the analysis of the risks in the Oriental, which the Secretaries of that office exhibited to the proprietors about three years ago, when the term of the former Society expired; and in consequence various modifications in the system were adopted, which it is understood, have greatly affected the profits. The principal alteration was a resolution to reject all risks from Madras and Bombay, as it was found that while the Bengal risks separately had yielded considerable profit, the whole of it was absorbed by losses in the other presidencies.

The statement confirmed the general result of our author's tables in respect to the hazardous period between the ages of 40 and 50.

We have not very carefully examined his tables; but they appear to require further illustration in some particulars. It would have been desirable to give in a separate column (between two and three) the number of writers appointed in each year, which column would have furnished more exact data than column two for calculating the mortality at each period of service; as, for instance, suppose that in ten years, from 1799, there were 217 appointments, (quere, arrivals?) of which 20 occurred in the first year, and two died in the course thereof; the mortality would not be two in 852, but two in 20, or 10 per cent.?—and although at the end of the 10 years it might be 77 in the aggregate, (if the deaths in the 5th column be calculated from 1790, instead of backwards from 1828, which we suspect to be the case,) this could not be taken as the mortality incident to so many residents of 10 years, but merely as a proximate average for 217 lives of five years' residence. It would seem also that the accuracy of the results must be affected by the 4th column in a degree proportionate to the relation between the number stated therein, and the number of deaths and survivors in the service at every stage; for, if we throw them out of the calculation by deducting them from the number of appointments, we may, by continuing the series, arrive at some period when the figures in columns two and five will be equal, and column six will be blank, although there may be living some 20 or 30 retired civilians enjoying their "otium cum dignitate" and a green old age, which with respect to half of them, might have endured if they had remained in India. The objection here taken will be more palpable, by supposing the Civil Fund in complete operation, and that every survivor of 22 years residence takes advantage thereof; (it is unnecessary to complicate the calculation by assuming a proportion of furloughs.) At that period, our correspondent's table gives 232 survivors, which added to 79, (the number stated to have quitted the service,) gives us 211, to be deducted from 419, the aggregate number of appointments. Hence we obtain the proportion of 208 appointments to blank survivors, instead of 340 to 232, as given in our correspondent's second table. It appears to us therefore that his results are far too favorable for the chances of life during the first few years of residence, and perhaps a little too unfavourable towards the close of his series. But we perceive still other difficulties in the way of a correct result, which will be obvious to our intelligent contributor, who may not have materials from which to trace the deaths in the service, each to its proper year, reckoned from the arrival of the individual, which seems to be the only way to ascertain the influence of the climate upon his constitution.

III.—*Chemical Analyses.*

[Communicated at the Meeting of the Physical Class Asiatic Society, 10th August 1831, by J. Prinsep, Esq. Secretary.]

A mineralogical cabinet is of comparatively little use, unless the composition of the substances it contains is satisfactorily determined: it should therefore be the constant duty of those in charge to examine the new specimens contributed occasionally from various quarters, before the interest excited by their novelty is abated. This observation does not apply to the generality of geological specimens, of which the nature is well known; but to local varieties, mineral waters, metallic minerals, and substances whose chief claim to notice lies in the knowledge of their composition. With this view, I beg to put on record the following rough analyses made since our last meeting. The water of the Katkamsandí hot spring, the Gazipúr *kankar*, and the arenaceous iron ore were received from the Rev. R. Everest, and are alluded to in his paper[1]. The graphite was handed to me by Dr.

[1] Published in a former number of the GLEANINGS.

Spens on the part of the late lamented Bishop of Calcutta, who took every opportunity during his visit to the various places of his extensive diocese to bring forward and encourage objects of commercial, agricultural, and scientific interest.

The varieties of Coal were chiefly obtained from the cabinets of the Society; unfortunately I was unable to certify the genuineness of some other fragments, which should otherwise have been added to the list.

1. *Katkamsandi Hot Spring.*

Specific gravity of the water on arrival in Calcutta 1000.22; smell of sulphuretted hydrogen, which disappeared on exposure to the air.

700,000 grs. evaporated to dryness and redigested in distilled water, left a gritty deposit weighing 0.52 grs. which before the blowpipe melted into a yellowish glass:—it rendered borax opaline: and was set down as a mixture of silex, sulphate of lime and oxyde of iron.

The solution yielded bare traces of sulphuric acid and iron:—with nitrate of silver, a compound precipitate was thrown down of muriate and carbonate: the quantities were altogether too small for stricter investigation; there was no sign of magnesia. The contents are therefore carbonic acid, sulphur, silex, alkaline muriate and sulphate, and iron.

2. *Gázipur Kankar.*

Hard nodular: used as a building cement, and for road making.

Composition—Water of absorption,	1.4
Carbonate of lime,	72.0
Carbonate of magnesia,	0.4
Silex,	15.2
Alumine and oxyde of iron,	11.0
	100.0

3. *Iron Sand from Ránigani.*

This seems to be a stalagmitic deposit, or incrustation, of oxyde of iron over granitic sand,—resembling in the manner of its formation the *kankar*, or calcareous tufa of this country. It may be remarked, that the natives are said always to apply the term *kankar* to this ore, as well as to the nodules of lime *kankar;* but this may perhaps be a corruption of the word *khangar*, or melted slag of brick-earth, to which the ore bears a strong resemblance. The ferruginous matter was probably derived, in the shape of a carbonate, from the mineral springs of the volcanic hills in the neighbourhood.

Composition—Protoxyde of iron,	49.0
Silex,	37.2
Alumina,	1.9
Water and carbonic acid,	11.2
Loss,	0.7
	100

No signs of acid nor of sulphur were discovered on heating red some of the mineral in a glass tube; pure water alone was given off.

4. *Graphite from Ceylon.*

The specimen of plumbago brought from Ceylon by the late Bishop of Calcutta, is of the species called *Scaly Graphite.* Its texture is micaceous, disposed in flat prismatic fibres, which are evidently crystalline, and appear to have an acute rhomboidal cleavage; but from their flexibility, it is not easy to take any measure of the angles, and under the microscope the facets of the laminæ appear rounded and uneven. The laminæ can be split with facility, and are somewhat tough and unelastic: their lustre is bright grey metallic, resembling specular or micaceous iron ore, and they soil paper with the usual streak of blacklead.

The mineral is found apparently in small lumps of an inch or two in diameter; and judging from the impurities adhering to the surface of the nodules, the gangue, or parent rock was probably gneiss: the fibres seemed in some specimens to be cut off by a transverse vein of quartz.

The specific gravity of a fragment, first deprived of as much air as could be separated by immersion under water in vacuo, was found to be 2.37.

100 grains heated under the muffle of an assay furnace, required several hours for their incineration; and when they appeared to be reduced to an ochreous ash, solution in nitromuriatic acid proved that a number of the scales had still escaped the action of the fire: before the blowpipe, the substance was equally refractory.

The loss of weight, after complete incineration, was 62.8 grs. The oxyde of iron was separated from the ash by means of nitromuriatic acid, and the earthy residue analysed by fusion with potash in the usual method: the composition thence deduced was as follows:

Carbon,	62.8	Carburet of iron ? 68
Iron,	5.4	
Silex,	21.0	Earthy impurity 32
Alumine,	9.3	
Lime,	0.2	
Magnesia,	0.1	
Manganese, a trace, and loss,	1.2	
	100	100

Suspecting from the large proportion of earthy impurity in this analysis, that some of the matrix had remained mechanically mixed with the graphite, I selected some of the fibrous crystals with care, and submitted them again to the fire: The results proved that it was the case:

1. The graphite uncleaned left, as above, iron and earth, per cent. 37.2
2. Roughly cleaned, left a residue per cent. 18.5
3. Crystals selected with care, ... 6.0
4. Another trial left the very small proportion of 1.2

The two last residua did not entirely dissolve in muriatic acid, indeed the former yielded 0.3 of silex on analysis; it is difficult therefore to assign a definite composition to graphite, and almost justifiable to suppose that the presence of iron itself is not indispensable therein. In chemical works, the amount of iron in the carburet is made to vary from 5 to 10 per cent. but I find in the last edition of Ure's Dictionary, that "the researches of Karsten have proved beyond a doubt, that graphite is merely a peculiar form of carbon:" in proof of which the graphite of Barreros in Brasil is said to leave hardly any ash when burned.

In the present instance it is clear that the earthy impurities are merely accidental, and, as might naturally be expected from its crystalline form, the mineral itself is quite pure. The ore however would require careful dressing before it could be converted to any useful purpose in the arts, and it differs essentially from the quality of plumbago preferred for making pencils, which is described as a compact close-grained sectile graphite of great purity. Having been favored with a fragment of the Borrowdale mineral, from an English cabinet, I was anxious to make a comparative examination of it; but I was checked at the outset by the corrosion of the platina capsule upon which the incineration was to be effected. Copious fumes of sulphur, and of a white oxyde were given off, and a crust was formed on the platina, which proved to be an alloy of bismuth and lead.

The sulphurets expelled amounted to 10 per cent.; the residue after burning was 52, so that the carbon in this specimen, apparently so well adapted for making pencils, was less than 40 per cent.! Its specific gravity was so high as 3.16, the cause of which was explained by the presence of the metals.

The graphite of the Himmalaya has been fully described by Doctor Abel and by Captain Herbert, as to its external characters. From its low specific gravity (2.27) I was led to suppose that it would prove more pure than the crude Ceylon mineral, and this opinion was confirmed on submitting a portion to the same treatment: The results of a rough analysis gave.

Carbon,	71.6
Iron,	5.0
Silex,	15.0
Alumina, &c.	8.4
	100.0

Another opportunity of making a comparison with English graphite was afforded me by the arrival of a supply of finely pounded "black lead," for the use of the Calcutta Mint, purporting to be of superior quality. Here again however I was disappointed, for an analysis of 100 grains yielded the following results:

Hygrometric moisture expelled from the powde,..	2.7
Carbon burnt off with difficulty,	53.4
Iron taken up by acid,	7.9
Earthy impurities,	36.0
	100.0

There is so far satisfaction in finding the English specimens deficient in purity to such an extent, that it inclines us to a more favorable opinion of the Ceylon and Himmalayan varieties, and proves that they may be applied to all the purposes at least for which the former are imported into India.

The Ceylon graphite has only been known commercially four or five years: the Government had shipped small quantities of it to England by way of trial, and it answered so well that they were induced to receive it, amongst other articles, in lieu of revenue at a fixed valuation, when they were suddenly surprised at the quantity of this novel currency offered in payment! A large heap was thus accumulated, and as the island abounds with the mineral, and there are no padlocks upon the mines, as in Cumberland, it might soon effectually destroy the income of the Borrowdale company, if introduced largely into the English market. The natives of Ceylon make no use of it. It might be well worth while to import some into Calcutta for a trial of its mechanical uses, now that the application of machinery is increasing daily. Some of the picked fibres ground between two smooth surfaces of glass did not produce the slightest scratch, whereas the pounded black-lead from England immediately scratched the glass, and was audibly gritty under friction.

5. *Varieties of Indian Coal.*

My process of analysis, with respect to the specimens of Coal, was merely directed to the determination of the percentage of the aqueous and volatile matter, and of the earthy residue or ash; the proportion of coke or carbon in each specimen was deduced from the loss in burning.

100 grains were first dried on a sand bath to expel the water :—(this operation was imperfect, inasmuch as it is always uncertain whether the loss on drying should be esteemed mere hygrometric moisture, or whether a part may not be derived from a partial decomposition of the coal : in most cases two trials were made, and the agreement between them was very good, unless the heat was carried so high as to commence the expulsion of smoke.) After being weighed, they were charred in a well closed crucible of silver or platina, and the loss ascertained. The coke was then incinerated by exposure to free air under a muffle at a temperature of about 1800°, and the ashy residuum was lastly submitted to the balance.

The Coals under examination may be divided into four varieties :

1. *Cannel Coal.* Comprising the Burdwan, the Sohàgpúr and the Hoshangabad coal: also specimens from Silhet, Ava, and Manipúr.

The distinctive characters of this coal as it occurs in India, are as follows : specific gravity above 1.3, and under 1.4 ; massive, colour jet black, resinous lustre, fracture even, fragments trapezoidal : does not soil : burns with bright flame cakes slightly on coking and assumes metallic lustre[1] : leaves much larger ash than good English sea coal, and gives out more gaseous matter. It is therefore less suitable for coking, and for close furnaces, though well adapted for blaze fires. It occurs in seams from 1 to 9 feet in depth, and generally under shales and coals of inferior quality. The coal from Palamú differs considerably in quality from that of Burdwan, but will be found perhaps to assimilate more closely to it, when the lower seams are thrown open : of two samples obtained from Captain Sage, ex. off. at Dinapoor, one had partially a glossy surface, the other was dull and of slaty fracture : much gas was given out, but with little or no flame. A specimen from Sohàgpúr, contributed by Capt. Franklin, has a higher lustre, and resembles more closely the Burdwan coal : it is accompanied as usual by seams of slate coal. The Silhet or Laour coal, on the contrary, appears more bituminous than that of Burdwan ; and disengages jets of flame, becoming soft and adhesive like common English pit-coal : it is of a browner colour, foliated texture, and resinous lustre ; one species is friable readily between the fingers, dull brown-black colour, amorphous, and leaves a brown streak on paper : they both burn fiercely in the forge : some very hard slate-coal or bituminous shale accompanies the Silhet specimens. The Ava coal is of very good quality ; I am however doubtful of its locality, some specimens being labelled, *Tank-kiouk*, and others *Kuenduen* river, in the latter case it should perhaps be classed with the lignites.

2. *Anthracite, or Slate-coal,* comprehending specimens from Baghelpúr, Chanda (near the confluence of the Warda and Nerbada), Sohàgpúr, &c.—It generally accompanies the other coal, and in fact every variety from true coal to mere shale or slate may be met with in the same locality. Sometimes one, sometimes the other predominates. This species abounds in vegetable impressions ; specific gravity above 1.4 ;—fracture slaty ;—cross fracture conchoidal ; colour grey black ; no lustre :—soils the fingers ; inflames readily, gives little heat, and leaves a slaty white ash, varying in weight from 20 to 50 per cent. of the coal. It is of little use as a fuel, but might perhaps be turned to profit for the gas which it gives out in great abundance.

3. *Lignite,* from the Derah Dún valley, in the Himmalaya, and from the mountain passes between Manipúr and Ava :—also in the shape of fossil almonds from

[1] Apparently from the formation of a thin coat of plumbago on the surface : in some cases the platina crucible was entirely lined with thin scales of this substance which were at first supposed to be ferruginous until tried by the blowpipe.

Travancore. The composition of all of these agrees in the quantity of volatile matter given off, consisting in great measure of aqueous vapour. They all shew the woody fibre, particularly after charring, when their resemblance to wood charcoal is complete : specific gravity variable according to the texture, which is sometimes massive, with high lustre resembling jet, and at others fibrous : colour brown or black : lustre resinous or dull ; fracture even : no vegetable impressions yet discovered : occurs in insulated masses, or in very thin seams in the sandy grit on the flank of the Dera Dùn valley. To ascertain the nature of the volatile matter expelled, I heated 10 grains of the pounded lignite in a bent tube over mercury : at first much water came over, then a yellow bituminous liquid, and at the same time abundance of gas was extricated, of which 4 cubic inches were collected, when the experiment was arrested by the fusion of the glass tube. The gas proved to contain 30 per cent. of carbonic acid ; the remainder, mixed with oxygen, exploded with a faint blue flame, shewing that little or no olefiant gas is afforded by this coal. It is not found in sufficient abundance to be worked with advantage.

4. *Glance Coal.* Under this head I have inserted two specimens of Chinese coal, brought round by the Forbes steamer from Canton. In appearance they differ exceedingly, though nearly alike in composition ; No. 1 being of perfect glance lustre, iron grey colour, brittle, low specific gravity, fracture rectangular with shining facets. No. 2 is slaty, dull and earthy, streak brown black ; specific gravity higher than that of slate coal ; leaves considerable ash : they both require a high temperature for their combustion, give no flame whatever, and are consequently found to be totally unfit for the boiler furnaces of the steamer. The first sort seems, however, admirably adapted to take the place of coke in close furnaces ; indeed, it agrees closely in composition with the coke made from English coal at the Mint.

The coal from New South Wales is not included in the above description, since it belongs so entirely to another part of the globe. Indeed it so closely resembles in external character, as well as in composition, the English sea coal, that I at first imagined some mistake had been made in taking the samples, and I went purposely to verify them in the store-yard of the Hon'ble Company's Commissariat, where a quantity of this coal is lying for sale. It is reputed to have less strength as a fuel than the English coal, and to be unfit for making coke ; but this is contradicted by the result of its analysis. It gives out rather more volatile matter, but the residual ash is equally small, and of the characteristic brown colour of the English coal ash : the slate-coals generally leave a white ash.

The following table comprises the results of the several analyses. The fourth column, containing the water expelled, is kept distinct from the three which follow it under the head of composition, as it is usual to include all the volatile products together. Should the water be looked upon as hygrometric, the percentage of carbon and ashes must be increased to obtain the true composition of the coal : thus the Baghelpur slate coal after deducting 10 per cent. of water contains

$$\begin{aligned} &\text{Volatile matter, } 22 \times \tfrac{100}{90} = 24.4 \\ &\text{Carbon, } \ldots\ldots\ 40.5 \times \text{ditto} = 45.0 \\ &\text{Ashes, } \ldots\ldots\ldots\ 27.5 \times \text{ditto} = 30.6 \\ &\qquad\qquad\qquad\qquad\qquad \overline{100.0} \end{aligned}$$

From the last column in the table, it will be seen how totally unfit are most of the Indian coals for the purpose of making coke. The Burdwan coke, with the exception of one specimen, would contain nearly a quarter of its weight of earthy impurity; the Silhet would be still worse: the anthracite of Baghelpur would be nearly half earth:—some of the mountain coal from Ava would yield a coke of better quality, but of very little density. The Chinese glance coal alone forms a remarkable exception to this unfavorable conclusion against oriental coal, and deserves to rank at the head of the list in respect to its purity as a coke, although in specific gravity it does not come up to the character of the English fuel, neither has it the spongy texture which must contribute much to the glowing combustion of the latter. It will be remarked, that the ashy residue on the analysis of English coke (No. 2) much exceeded what should have been expected from the composition of the coal whence it was formed; this may be explained by supposing either that portions of the ash, probably the alkaline salts, are volatilized along with the gaseous matter when suddenly decomposed at a high temperature;—or that considerable variation exists in the quality of the material charged in the coke oven. whatever may be the cause, the same deterioration might be looked for in the coking of Indian coal, which would tend to lower them still more in the scale of comparison.

Table of Indian and other Coal analysed at the Calcutta Assay Office.

Number of Specimen.	Denomination.	Specific gravity.	Water expelled on sand bath.	Composition.			Percentage of ash in the coke made from each coal.
				Volatile matter, including water.	Carbon.	Ashes.	
1	English pit coal,	1.273	1.5	29.0	69.4	1.6	2.3
2	Ditto on the large scale,	.....	..	25.0	73.0	2.0	2.6
3	New South Wales coal (average)	1.277	3.3	38.0	60.1	1.9	3.1
4	Burdwan coal,	1.334	8.0	39.5	45.9	14.6	24.0
5	Ditto, another specimen,	.....	8.2	41.5	45.2	13.3	22.5
6	Ditto, (from *China-kúri,*)	1.340	8.0	32.5	61.1	6.4	9.5
7	Manipúr coal, *Tank-kiouk,*	1.361	6.2	39.3	49.7	11.0	18.1
8	Towa or Hoshangabad ditto,	.....	?	27.0	58.0	15.0	20.5
9	Silhet brown coal, (from *Laour,*)	1.398	10.1	44.4	41.1	14.5	26.1
10	Ditto, lighter colour—slaty,	1.380	2.8	58.8	28.6	12.6	30.5
11	Ditto, soft friable bituminous,	1.348	7.1	42.2	41.0	16.8	29.0
12	Kasya hills (*Chirra púnji*), best,	1.310	7.0	37.1	62.0	0.9	1.5
13	Ditto .... slaty,	1.520	12.3	38.4	53.4	8.2	13.3
14	Ditto brown friable,	?	36.0	63.6	29.2	7.2	20.0
15	Palamú slaty coal,	1.482	9.1	37.4	52.1	10.5	16.8
16	Ditto, without lustre,	1.419	7.1	36.4	54.1	9.5	14.9
17	Warda Nala Anthracite,	1.457	7.8	43.8	33.7	22.5	40.0
18	Baghelpúr ditto,	1.540	10.0	32.0	40.5	27.5	40.4
19	Sohagpúr ditto,	.....	6.0	25.0	29.0	46.0	61.4
20	Silhet bituminous shale,	2.042	..	22.0	26.0	52.0	66.0
21	Ditto, (*Chirra púnji,*)	2.187	6.3	23.0	6.6	70.4	91.4
22	Ava Jet coal, (*Kuenduen* river,)	1.363	8.0	40.0	54.1	5.9	9.9
23	Ditto Lignite,	1.276	5.0	54.5	43.0	2.5	5.5
24	Himmalayan ditto,	1.343	?	51.0	40.2	8.8	17.9
25	Ditto, dull,	1.458	21.0	56.0	37.5	6.5	14.8
27	Travancore fossil seeds,	.....	?	52.0	45.0	3.0	6.2
28	Chinese glance coal,	1.282	3.0	7.0	91.6	1.4	1.5
29	Ditto, earthy, blind coal,	1.888	0.9	7.0	79.3	13.7	14.7
30	Coke from English coal,	1.600	0	2.0	91.5	6.5	6.7
31	Coke from Burdwan coal, (*China-kúri,*)	0,820	0	0	97.0	21.0	21.0

The following are extracted from Mr. Mushet's Table, in Ure's Chemical Dictionary, to complete the comparison.

	Sp. Gr.	Vol. matter.	Charcoal.	Ashes.
Cannel Coal, Derbyshire, ...	1.278	47.0	48.4	4.6
Ditto, Butterly,......................	1.264	42.8	52.9	4.3
Ditto, Scotch, ...	----	56.6	39.4	4.0
Welsh furnace coal,....................	1.337	8.5	88.0	3.5
Kilkenny coal, ...	1.602	4.3	92.8	2.9
Ditto slaty coal, ...	1.443	13.0	80.5	6.5
Stone coal found under basalt, ...	----	16.7	69.7	13.6

Note—As many of our readers may wish for further information concerning the localities of the coal alluded to in the foregoing paper, we subjoin a reference to different numbers of the Gleanings, which will supply the deficiency.

1. A full account of the Burdwan coal field will be found in vol. i. p. 261.

2. The Chinakúri stratum has been lately discovered by a gentleman in the Burdwan district, and it promises to be a valuable acquisition.

3. The Palamú and Sohagpúr coal district is described in vol. ii. pp. 217, 218.

4. The Silhet coal is alluded to by Mr. Jones in vol. i. p. 284.

5. An account of the Hoshangabad or Towa Nala coal is inserted in the present number, along with a plan and section.

6. The so called Baghelpùr coal was discovered in 1829 by Captain Turner: "In a seam near Patsandah, to the west of Rajmahl, and in the same range of hills: there is a good road from Colgong to Patsandah during the hot weather, and during the rains a hill stream is navigable for a considerable part of the way. Patsandah is distant 25 miles from Colgong, the nearest point on the Ganges." The coal is loaded there at 4 annas per maund; but what has been hitherto extracted, has proved very bad.

7. The Chanda coal is only known from specimens brought by natives, and apparently picked up in the bed of a dry *Nala*.

8. The Himalayan lignite is described by Captain Herbert in the first volume of the Transactions of the Physical Class of the Asiatic Society.

9. Of the Manipúr coal, we have Dr. Richardson's notice in the proceedings of the same Society, dated the 20th April 1831. Gl. vol. iii. p. 125.

IV.—*On the Crocodilia.*

To the Editor of the Gleanings in Science.

Sir,

Perhaps the most successful mode of eliciting information concerning the Crocodiles of India, would be to lay before your readers an account of the species which have already been described, and which are regarded as distinct by the first Naturalists, and then to state the characters chiefly to be relied on as specific distinctions; I therefore send you as correct an account as my limited means of information have enabled me to draw up, and I trust it may prove useful by enabling those who have not paid any particular attention to Zoology, to direct their observations and inquiries into the proper channels.

Crocodiles in Cuvier's distribution of the animal kingdom form a family which he places at the head of the Saurian Reptiles, though by Blainville, (and in this he is followed by Latreille, Gray, &c.,) they are considered as a distinct order under the denomination *Emydo Sauria*. In the following observations we shall consider them as a family containing three genera, the latter corresponding to Cuvier's sub-genera.

Family Crocodilia.

Body elongated, covered with large osseous scales, those of the back being crested in the middle: feet four, with five toes before and four behind, the three inner with nails: hind feet entirely or partially webbed: teeth numerous, pointed, forming a single row in each jaw: tongue fleshy, flat, and attached almost entirely to the bottom of the mouth; tail flattened on the sides, with a strongly dentated crest, double at the base, but single towards its extremity.

The following table will at a glance enable any one to determine to what genus any of the family belongs.

			Genera.
Teeth	nearly equal, muzzle slender, very long and rather larger at the top,		*Gaviala.*
	unequal: 4th lower tooth on each side received	into a groove in the upper jaw,	*Crocodilus.*
		into a hole in the upper jaw,	*Alligator.*

Genus 1. *Gaviala.*

Snout slender, very long, and rather larger at the tip: teeth nearly equal, the 4th of the lower jaw on each side received into a notch in the upper jaw: hind feet webbed to the toes and dentated on the external side, two small holes in the skull behind the eyes.

1.—*G. Gangetica*, Cuv. (*longirostris*, Schneid.) Teeth $\frac{58}{50}$, head very broad behind, and forming a rectangular figure, a third broader than its length; orbits very wide and far apart. Cranial holes large, length of the snout about an eighth of that of the body, two little scales only behind the head, followed by four transverse ones, which are continued to those of the back. Habitat, India. 12 to 18 feet.

2.—*G. tenuirostris.* Skull longer, but not so broad as the last, with the snout in nearly the same proportion. Upper surface of the skull forming a square behind the orbits, which are longer than broad and little apart: the back of the skull defended by two pairs of oval scales followed by four casinated scales, placed transversely, and eighteen dorsal bands; 2½ feet long.

N. B. Cuvier, in the last edition of the 'Animal Kingdom,' gives the following note, 'Add the little Gavial (*Croc. Tenuirostris, Cuv.*) Faujas. loc. Sit. pl. XLVIII; if, indeed, it be a distinct species.' That the small Gavial is a distinct species, there can be no doubt, if marked differences in the size and proportions of the parts forming the head, to say nothing of the rest of the body, are to be regarded as specific characters. Besides, what can the small Gavial be, if not a separate species? either a dwarf or a young animal: it may be the former, but certainly is not the latter. I have a skull in my possession, the bones of which are much more consolidated than they are in the cranium of a G. Gangetica of double the length, and the latter is beyond dispute a young animal. I may return to this subject on a future occasion, but avoid saying more, as it is not my intention at present to do more than record the opinions of others.

Genus 2. *Crocodilus.*

Head oblong and flattened; teeth unequal, the fourth on each side in the lower jaw received into notches in the upper: in other respects like the Gavials.

1. *C. vulgaris*, Cuv.—Nilotic Crocodile. Length of the head double the breadth, sides nearly straight, giving it an irregular triangular appearance. Cranial foramina broader than long; muzzle irregular and rough, especially in old animals. Immediately behind the skull on a transverse line are four little crested scales, then comes the nuchal plate composed of six crested scales: these are followed by two single scales, and afterwards by 16 transverse dorsal rows, the anterior 12

of which have each six crested scales, whilst the remainder, which are situated between the thighs, have but four in each; besides these, there is on each side a longitudinal row of seven or eight crested scales. The lateral ridges of the tail do not become distinct till the sixth row, and then form two crests, which unite on the seventeenth or eighteenth row, so as to form a single ridge, which consisting of eighteen rows, is continued to the end of the tail. In consequence of the regularity of the scales, ridges, &c. M. Cuvier says, that the back of the Nilotic Crocodile appears as if paved with quadrangular stones. The scales of the neck and back are wider than long, and those of the belly have a pore which is more or less distinct. Colour of the back is a greenish bronze, speckled with brown, whilst that of the belly is of a greenish yellow. Length is said sometimes to exceed 30 feet; habitat—the Nile, Senegal; and according to Hardwicke, the Ganges.

Cuvier remarks "that the different crocodiles exhibit some variations of details in the muzzle, and in the lateral scales of the neck. But as to this point, and still more as to the muzzle, the varieties must be much more numerous: and M. Geoffroy acknowledges that *nothing is more fugitive than the forms of crocodiles.* So much is this the case, that I cannot venture to elevate to a specific rank some crocodiles sent from Bengal, by Duvaucel, although their head is more convex than the rest of this genus."

The *C. suchus*, *C. marginatus*, *C. lacunosus*, and *C. complanatus*, of Geoffroy are regarded by Cuvier as varieties of the Nilotic crocodile.

2. *C. biporatus*, Cuv. *porosus*, Schneider. The head differs from that of the Nilotic Crocodile only by two projecting crests or ridges, which extend from the anterior edge of the orbit nearly parallel along the snout, and are then gradually lost. Scales of the back oval, their long axis being from before backwards. The first row has four, the following have six, then there are three rows with six, and three with four scales—the entire number of rows being 17. In young individuals, there are pores to all the dorsal scales. The ventral pores are also very obvious in this species, and hence Schneider has given it the trivial name of *porosus*. Habitat—all the rivers which flow towards the Indian ocean. Cuvier received from Calcutta a skeleton 17 feet in length.

3. *C. acutus*, Cuv. *Haytian Crocodile.* The snout is longer than that of any true Crocodiles, and prominent at its base. Breadth of the head at the articulation of the jaws is comprized twice and a quarter in the length: length of the cranium is little more than a fifth of the total length of the head. On the middle of the muzzle, a little in front of the orbits, is a rounded convexity more or less sensible; scales on the back and neck very similar to those of the C. *vulgaris*, but on the back they form four longitudinal ridges, of which the middle two are not much raised, whilst the outer are very prominent, and some of them scattered very irregularly: and there are not more than 15 or 16 transverse rows to the root of the tails. In the tail are 17 or 18 rows before the union of the two crests, after which there are 17. The middle ridges terminate at the 18th or 19th row. The head is to the length of the body as 1 to $7\frac{4}{10}$. Attain the length of 16 feet and more. Habitat —St. Domingo.

4. *C. rhombifer.* Forehead very much arched laterally, from the anterior angle of each orbit a soft straight crest passes, which quickly meets its fellow, and with the inner edge of the two orbit forms a kind of lozenge incomplete behind. The extremities are covered with very strong crested scales; country unknown. Cuvier has only seen two specimens of this animal.

5. *C. galeatus*, Cuv. *Siamese Crocodile.* Two bony crests, one behind the other, on the middle of the skull: in other respects resembling the Nilotic Crocodile;

habitat—rivers of Siam; only known from the account of the French missionaries.

6. *C. biscutatus*, Cuv. *Black Crocodile*, Adanson. Nape, armed with two large pyramidal scales in the centre, and two smaller ones in front. Muzzle less elongated than in the Haytian Crocodile, though more so than in the other species.

7. *C. cataphractus*. Cuvier saw a specimen of this species in the Museum of the College of Surgeons in London, but as is too frequently the case with the Zoological collections, which grace or rather disgrace our metropolis, no note respecting its origin had been preserved. Muzzle longer and narrower than in the Crocodile of St. Domingo, but it is the armour of the neck which more particularly characterizes it. After two oval isolated plates come five scaly bands, continuous with each other and with the scales of the back, formed each of two large square scales. The two first are very broad, the following three diminish gradually, and altogether they form a cuirass as solid as that of any Cayman or Gavial.

Genus 3. *Alligator*.

Muzzle broad and obtuse, the fourth tooth in the lower jaw on each side received into notches in the upper, hind feet semipalmate, and all the feet without indentations.

1. *A. lucius*. Muzzle parabolic, depressed, scales of the neck four. N. America.

2. *A. Sclerops*. A transverse ridge between the orbits, neck armed with four bony bands. Guiana and Brazil.

3. *A. palpebrosus*. Palpebræ bony, neck armed with four bony bands. Guiana.

4. *A. trigonatus*. Palpebræ bony, neck armed with irregular triangular carinated scales. Guiana.

This paper having extended much beyond the length I anticipated when commencing it, I shall not, as was my intention, make any observations upon the characters which may be regarded as specific, more especially as they are given in detail, in the description of some of the animals. Very little has been said concerning the Caymans or Alligators, as they have as yet been found only in America. It may be as well to state, that the above observations are taken chiefly from the article 'Crocodile,' in the Encyclopedia Metropolitana, and from the 'Fossil Remains' in Griffith's translation of Cuvier.

Your constant Reader,

W.

V.—*Climate of the Valley of the Nerbudda.*

To the Editor of the Gleanings in Science.

Sir,

In No. 16, for April 1830, is a notice of the climate of Barelly: you perhaps may deem it interesting to have a similar statement of the climate of the valley of the Nerbudda.

I have the pleasure to annex a table for 5 years, being the most perfect of every month that I possess. The first year was observed at Nursinghpoor[1], a station situated south of the Nerbudda, about 50 miles from this, in a south westerly direction. The remaining year was observed at Jubbulpoor, situated according to Capt. Franklin in Lat. 23° 10′ 40″. N. Long. 79° 58′ 15″ E. at an elevation of 1500 feet.

[1] This station is called Gurrawara in the Army List.

February 1820 was the coldest month I ever experienced in this part of India, during a residence of upwards of 10 years.—On the 4th, 5th, 20th, and 22d of that months the thermometer was at and below 32°. In the same year you will observe that the lowest of the maxima for May is 68°. the most unusual day I have ever witnessed in the hot winds, the morning being cloudy with showers to noon, and from thence to 8 P. M. constant drizzling rain from N. E. remainder gradually clearing.

The coldest and clearest weather on the Nerbudda is from E. and N. E.—In the cold season westerly winds bring clouds and increased temperature.

North westers are almost unknown in this part of India. The nights in the hot season are generally cool, and in the rains particularly so.

I remain,

Your's Obediently,

George G. Spilsbury.

Jubbulpoor,
1*st May*, 1831.

Maximum and Minimum Range of the Thermometer for 5 years on the Nerbudda.

		Nursingh-poor. 1820. Gurrawara.			1823. Jubbulpoor			1825. Jubbulpoor.			1828. Jubbulpoor			1829. Jubbulpoor		
		Lowest.	Highest.	Medium.	Lowest.	Highest.	Medium	Lowest.	Highest.	Medinm.	Lowest.	Highest.	Medium	Lowest.	Highest.	Medium.
Jan.	Minimum,	32	78	55	40	60	50	..	..	..	40	60	50	40	61	50½
	Maximum,	71	84	77½	74	85	79½	..	..	..	65	82	73½	67	83	75
Feb.	Minimum,	29	68	45½	40	60	50	45	62	53½	42	60	51	40	58	49
	Maximum,	62	88	78	68	88	70	65	86	75½	69	87	78	68	89	78½
Mar.	Minimum,	47	72	59½	48	70	59	43	66	54½	52	70	61	52	72	62
	Maximum,	86	104	95	78	100	89	71	104	87½	79	105	92	72	100	86
April,	Minimum,	62	78	70	62	82	72	65	81	73	61	80	70½	58	82	70
	Maximum,	84	104	94	96	105	100½	98	109	103½	96	108	102	91	105	98
May,	Minimum,	68	80	74	69	82	75½	70	84	77	69	87	78	76	88	82
	Maximum,	88	110	89	95	108	101½	102	113	107½	91	113	102	99	110	104½
June,	Minimum,	71	80	75	72	84	78	72	88	80	75	86	80½	72	90	81
	Maximum,	85	110	97½	88	110	99	81	114	97½	76	115	95½	74	107	90½
July,	Minimum,	72	78	75	74	76	75	71	78	74½	75	82	78½	72	76	74
	Maximum,	79	93	86	78	96	87	83	94	88½	79	93	86	77	90	83½
Aug.	Minimum,	73	77	75	70	76	73	72	78	75	74	79	76½	71	77	74
	Maximum,	80	94	87	80	88	84	82	98	90	77	89	83	79	92	85½
Sept.	Minimum,	69	77	73	69	76	72½	69	75	72	72	78	75	71	76	73½
	Maximum,	82	95	88½	76	90	83	80	91	85½	81	90	85½	82	93	87½
Oct.	Minimum,	56	72	64	50	74	62	58	75	66½	60	76	68	54	75	64½
	Maximum,	88	98	93	79	88	83½	74	91	82½	72	89	80½	78	92	85
Nov.	Minimum,	49	62	55½	43	68	55½	46	70	58	45	67	56	42	63	52½
	Maximum,	79	92	85½	74	85	79½	75	89	82	72	83	77½	77	84	80½
Dec.	Minimum,	36	55	45½	37	54	45½	33	47	40	44	57	50½	37	59	48
	Maximum,	71	86	78½	69	83	76	68	75	71½	69	77	73	68	80	74

VI.—*Note on the Influence of the Moon on the Sap of Trees; and the proper time for felling Timber for Ship-building or other important purposes. By Captain* Geo. Twemlow, *Bengal Artillery.*

If an Indian wood-cutter were told to cut down timber during the time when the moon approached the full, or at any time when the sap was perceptibly up in the tree, he would say ‘ Maharaj, excuse me, do not order it so, the timber would be useless, and would soon be full of insects, and be subject to rot.’ In fact, nothing short of actual force would induce him to commit what he would consider a gross act of folly.

The British legislature, with a view perhaps to secure the best bark for tanning, order Government timber to be felled when the sap is in the tree; the consequence of which is, that ships built with such timber are in a few years subject to dry rot and to destruction by insects, whereas ships built in India of timber cut down when free of sap, are known to be far more durable. With reference to this subject it may be mentioned, that the writer of this paper had occasion some years ago, in his capacity of acting field engineer, to erect temporary sheds for the public stores of a division of the army about to cantoon; time pressed and the rainy season approached; he therefore gave orders to the head carpenter of the department to proceed forthwith into the jungle on the north bank of the Nerbuddah river, and to cut down a sufficient number of trees; the carpenter protested against the measure, and alledged that the moon being nearly at the full, every tree cut down at that period of its increase, would assuredly be destroyed by the *goon*, or wood insect, and by rot. However his statement not being fully credited, and as time was valuable, the wood was felled before the wane had commenced, to the astonishment of the natives, who all firmly believed that the timber would be worse than useless. And so it turned out, for soon after the roofs were finished, a white dust was observed to drop out of the timbers, and before the close of the year the roof fell in, and had to be rebuilt.

It will be found that the natives all over India invariably watch for the time when the sap is out of the tree, both with reference to the moon, and to the season, and it is believed that to this in some degree is owing the prime quality of the Indian teak and other woods; though no doubt it is greatly attributable to the dry situation in which the trees grow.

It may be interesting to ascertain what notions prevailed on this subject (so important as regards the British Navy) amongst the ancient Romans; we are informed, that they had great regard to the age of the moon when felling timber for important purposes,—that they generally cut timber during the wane of the moon,—never during the increase, or approach to full; because trees were then found most to abound with sap, the chief source of putrefaction.

If bark is essential in England for the tanneries, might it not be stripped off whilst the tree is still standing, or particular trees be appropriated to that purpose? for if it should admit of proof that the best season for the bark is the worst for ship timber, surely ships should not be sacrificed to good leather.

Since the sap is the cause of rot, would it not be practicable in these wonderful times to draw out either by heat or properly constructed suction pumps, all the sap, and then to force into the vacuated pores an infusion of charcoal and sulphur, or any other preserving mixture which might have the effect of deterring the approach of insects, and of preserving the wood from rot?

The writer of this paper has made inquiries regarding the practice pursued at Nassuck on the Godavery river, where much timber is cut; he has been informed, that the wood cutters fell the trees during the moon's dark period, and drag it in, or remain at home when the moon's influence is dreaded, and that they choose the season when the tree is most void of sap.

Let us not be blinded by the splendour of our present knowledge, but institute practical experiments to prove whether or not the natives have reason in their method.

It may be, that the sap of a tree has its springs and neaps, as much influenced (proportionately) as the water of the ocean: and this may lead those who have not experienced the baneful effects of the moon on a feverish temperament to acquiesce in the actuality of the moon's influence on all fluids.

The trial by the barometer is not an appropriate trial, because metals are affected differently from fluids and wood—but place a joint of meat within the influence of the moon at full, and observe how quick will be the progress of putrefaction, compared to what would occur to a similar joint exposed during a dark night.

Philosophers have calculated, that the attracting influence of the moon acting on the tides of an ocean is about four times greater than that produced by the sun. If the moon so influences one fluid, may it not act on the human blood, the sap of trees, or any other fluid, proportionately?—at all events, it may perhaps be considered, that the subject is deserving of notice.

Aurungabad, April 6, 1831.

P. S.—Might not an essential oil or concentrated cake of an astringent property (fit for tanning leather) be extracted from the extensive Baubul, Neem, and other forests of Hindoostan and the Deckan, at a rate, and of a kind to admit of its exportation to Europe for tanning leather, and with a view to extend the preserving influence of the astringent principle to timber (after it is felled) by the application of an essential oil extracted from the bark?

The trees cut down in the Indian forests, whilst procuring the extract of the bark, might be converted into charcoal, or preserved for use as timber, and it might perhaps be possible to make Tar from it.

In the event of the feasibleness of the project being recognized, any person who might attempt it, would of course ascertain all particulars regarding acts of parliament, prohibiting the importation or use of tanning ingredients, or duties thereon.

Note *by the Editor*.—Regarding the interesting subject of our correspondent's communication, we have also received the following letter. We hope that some of our friends will be stimulated to undertake a series of experiments to determine the actual fact of the moon's influence on the sap, before proceeding to speculations on its cause, and mode of operation.

To the Editor of the Gleanings in Science.

Sir,

Perhaps many of your readers are not aware that the natives have a notion, that bamboos and babool trees cut down during the light half of the moon are more subject to be weevil eaten than those cut down during the dark half. Whether it is so or not, I am not capable from experience of giving an opinion; but the fact might be easily ascertained by those who are interested in the sale and purchase of timbers, and the investigation might lead to some useful experiments, which would ultimately be the means of preventing the timber in our houses from going so rapidly to decay. As a small spark can produce a conflagration by contact with combustible materials, it may not perhaps be too much to expect that this trifling hint, followed up by the scientific, may be of use to the world in general.

I remain, your's obediently,

X. Y. Z.

Upper Provinces, 19th July, 1831.

VII.—*Description of the Hydraulic Heart for irrigation and draining.* *By* H. Piddington, *Esq. Foreign Sec. Agr. Soc.*

[Translated from the 25th No. of Annals of Science and Agriculture of the Havannah, for the Horticultural and Agricultural Society of India.]

The Agricultural Society of Paris, in March 1827, awarded to M. Doudier its gold medal for the useful modifications of this machine invented by him, which render it applicable to agricultural purposes.

The Hydraulic Heart consists of a horizontal cylinder, part of the circumference of which is cut out, and upon this part is fixed a chest, in the sides and cover of which are valves for the admission and expulsion of the water. The interior of this apparatus is divided into two parts by a partition fixed to the cover, and which at its lower edge terminates in a moveable flap, which turns on an axis in the centre of the cylinder.

On the upper part of the chest is a head terminating in a pipe for carrying the water raised.

Pl. XIV. fig. 3. Lateral elevation of the Hydraulic Heart.

4. Vertical section of the same.

5. General elevation of the machine on a smaller scale, to show the mechanism for moving the flap.

The same letters refer to the same objects in all the figures.

A. a cylinder of copper, 8 inches in diameter and 10 long, placed horizontally; about one fourth part of its circumference is cut out, and a rectangular based chest B, the sides of which are cut to fit the cylinder, is fitted upon it.

The two ends of the cylinder A and of the chest B are closed, and, at the part corresponding to the axis of the cylinder, two holes with leather collars are left to allow the moveable axis B to pass through them.

C (fig. 4.) The fixed partition resting on the sides of the chest and on the axis E.

D. A moveable flap or wing fitted to the axis E, filling up exactly the space formed by the ends of the cylinder and the concavity of its inner circumference.

The edges of this flap are fitted with slips of copper, which press against the sides by means of springs, and thus diminish the friction.

E. The axis on which the flap D is fixed.

The interior of the apparatus is thus divided into two variable cavities, between which no communication can take place on account of the partition and the flap D.

The admission valves, a a a a, are fitted in the sloping sides of the chest Ba as the expulsion valves, b b b b, are upon its cover; they should be of a size to allow the water to pass freely.

F. The head of the apparatus, terminated at its upper part by the rising pipe G.

H. A pulley with a double groove fitted on the axis B; two chains fixed to the ends of a lever I (fig. 3) are passed round each of the grooves of the pulley H.

This apparatus, fitted into a simple frame-work to keep it upright, is wrought by the oscillating motion of the lever I, which, by its chains and the pulley H, give the same motion to the flap D, which thus describes an arc within the cylinder, whose length will be determined by the proportion of the lever to the diameter of the pulley.

The moveable flap, reducing alternately the capacity of one side of the cylinder, drives out the water through the expulsion valves, b b, on the one side, while that on the other is driven in by its own weight at the admission valves a a, and this reversed immediately by the oscillating motion, produces the same effect on the other side, which thus gives a considerable stream of water.

It is easy to calculate the force of this machine, which will raise at every stroke of the lever a volume of water determined by the arc described by the flap D, its radius and the length of the cylinder A. The force required to move it will be as its velocity, and the weight of a column of water whose base is equal to the flap D, and its height that of the rising pipe.—Means should be taken to prevent any substances in foul water from clogging the valves.

VIII.—*Hints on the use of Conducting Rods for Lightning.*

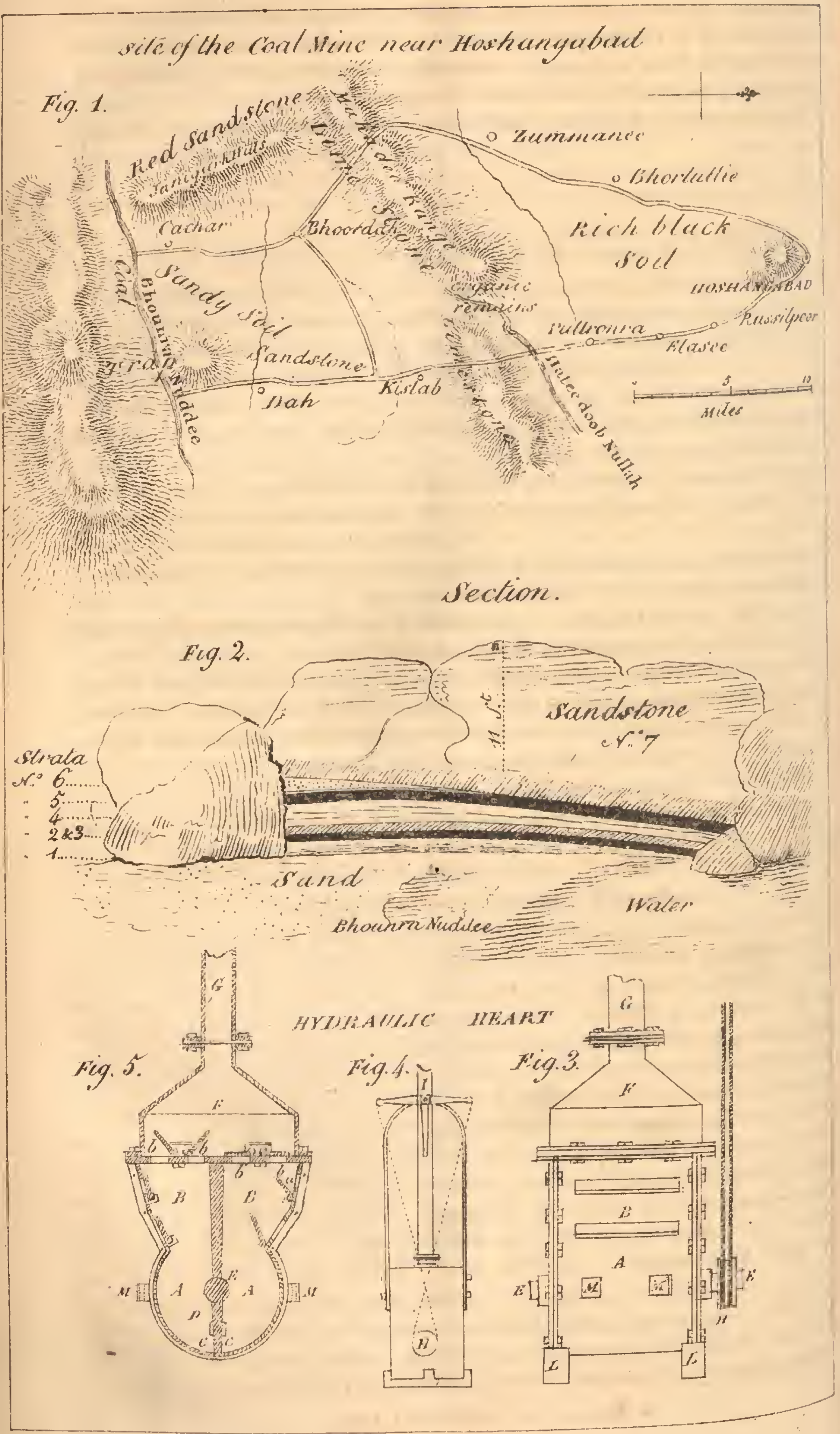
The violence of thunder storms, and the numerous accidents that occur in Bengal, render it an object of great importance to endeavour to prevent as much as possible the occurrence of fatal consequences from lightning. At this season few days pass without bringing us accounts of its fearful ravages.

In this neighbourhood, within the last month, I have heard of six houses having been struck by lightning, which killed one man, and knocked down four others; besides doing considerable damages to the premises. For these reasons I am led to suppose, that a few hints on the best method of averting this evil may not be uninteresting to your numerous readers, and may direct the attention of others to this important, and too much neglected subject.

This may be accounted for, by some people being incredulous as to their efficacy, and others, from ignorance, neglecting to erect them. So that we find many large houses both public[1] and private without them. In some instances, I understand, the rods have been removed, from the erroneous supposition that they were dangerous appendages, and likely to attract the lightning to the building, which would in all probability otherwise escape. Nor is the idea without some appearance of truth, not from the inefficacy of the preventive means, but from the careless manner in which the conducting rods are constructed and allowed to get injured, when they may convey the lightning in an improper direction. The inutility of rods, when not well erected or allowed to get out of repair, was strongly impressed on my mind a few days since, when examining a house which had been struck by the electric fluid a short time before, although there was a conductor about 30 feet from the part which had been struck. In this case a high semicircular verandah close to the river attracted the electricity. It demolished part of the cornice, divided itself and descended along two of the pillars : in one of them near the centre, a hole was found, to where it came to the level of an iron rail near the bottom. There it divided by the attraction of the iron on each side, and the pillar fell from this point. It then passed through other pillars on the same level, leaving a smoked appearance, and a square hole, about a quarter of an inch each way; descended to the ground floor, burst open and shattered several doors, and knocked down two servants. Such an example may be supposed to militate against the use of conductors; but on examining the situation and state of the rod, it immediately explained its inutility. The pointed extremity was broken off, and the part which should have been above the house was completely bent over the parapet. The rod was fastened to the building by strong pieces of iron, and its inferior extremity fixed in a large stone. This proves the necessity of attending to the careful

[1] The large dome of Government House in Calcutta may be instanced, as a remarkable example. Elevated above the buildings in the neighbourhood, it forms a powerful conductor of electricity, on the top of which is placed a figure of Britannia studded with iron prongs, as if to defy her Father's thunder. Can such a habitation be considered safe ?

[illegible]



J.B. Tassin's Lith.^c Press, 99 Durrumtollah. Calcutta.

construction and preservation of rods, from the influence of the weather. When this has been done, there appears to me, from the numerous facts on record, no truth better established in Natural Philosophy, than that of rods, when properly constructed, preventing the fatal effects of lightning.

The following remarks on the best kind of conducting rods may not be considered useless.

1st. A bar of iron, 2 inches in diameter, gradually diminishing in size to its upper extremity, and sufficiently long to extend 4 or 5 feet above the highest part of the building, and terminating in an inch of pointed platina, or a foot and a half of gilt copper, which retains its fine points. The thick end of the rod is to terminate in a thinner piece of 10 or 12 feet long, which after passing through a cylindrical cavity of brick-work filled with charcoal, is to extend from the building in the direction of a well or river, and terminate in several points. To defend this termination of the rod from rust, and to convey the electricity more readily to the ground, the charcoal will be found useful. The conductor is to be fixed to the building by a thick block of wood, so as to raise it about two feet from the surface.

2dly. The extent to which these rods defend buildings is said to form a circle with a radius the length of the conductor. So that a building of 140 feet in diameter may be defended by a rod of 70 feet[a]. When two conductors are required on the same house, the upper part may be made to branch off along the building, having several points on the top raised from it.

3dly. The part of the house which is highest and nearest to any body of water is to be preferred for the erection of conducting rods.

The erection of such rods will not cost more than from 20 to 30 rupees: as they form a certain prevention against the dangerous, and destructive effects of lightning, it may be naturally asked—why then should any one endanger his life and property when it can be avoided on such easy terms?

June, 1831.

IX.—*Notice of Coal near Hoshungabad. By* J. Finnis, *Esq.*

[Read at a Meeting of the Physical Class.]

The Coal strata are observable on both banks of the Bhoora Nuddea, near a high hill called Jamgurh, about 33 miles south of Hoshungabad, and 8 miles south of Bhoorda, the head of a Pergunnah in the Baitool district, on the west of the road going to Baitool. The river apparently has cut its way through the bed, thence runs eastward, and empties itself into the Towah; in which river the coal was first discovered, and which gave rise to the supposition, that the coal was to be found somewhere on the banks of the former river. I make no hesitation in saying, that the discovery will not prove of any benefit to trade, owing to the poorness of the coal, its scarcity, its out of the way situation, and the difficulty of working it. The rough sketch I have the pleasure to send, (Pl. XIV. figs. 1 and 2) with the specimens, will aid you in comprehending my descriptive account of the position of the several minerals. The bed extends N. and S. dips to the W. and does not appear E. of the ghaut. Length from the ghaut to where it disappears 16 feet.

No. 1. The earth on which the coal bed lies; its depth could not be well ascertained, owing to the water of the river coming in: it is however above one foot.

No. 2. A very thin stratum, two inches thick, of coal; does not extend far west, and appears to pass into No. 3 bituminous shale, a stratum four inches in thick-

[a] Annales de Chimie, xxvi. 1824.

ness. No. 4, Iron stone and shale; lies next above No. 3, and is five inches in thickness. Resting on 4, is a stratum of coal in such very thin plates, that it was difficult to obtain any specimen larger than No. 5, a three inch stratum. No. 6, ochry brown iron ore, lies immediately above No. 5, commences where the coal first appears, and only continues visible for a few feet, a five inch stratum.

Above all is a stratum of sandstone 11 feet high, which shoots up above the alluvial soil, and overhangs the coal bed, which the current has worn away.

X.—*Proceedings of Societies.*

1.—Asiatic Society.

At a Meeting held on Wednesday, the 7th September, 1831. G. Swinton, Esq. in the Chair.

Messrs. Burnouf, Lassen, and Langlois, were unanimously elected Honorary Members.

Mr. J. Colvin, proposed by Mr. J. Prinsep, seconded by Mr. Wilson.

Mr. De Noye proposed by Captain Troyer, seconded by the Rev. Dr. Mill.

The Secretary submitted the annual account with Messrs. Mackintosh and Co. shewing a balance in favour of the Society of Rupees 10,147 9 10; also the Collector's report of collections and outstanding bills on the 31st of August, 1831.

Read a letter from Mr. Da Costa, requesting subscription to a Persian Translation of the Elements of General History.

Resolved, that the Society decline subscribing.

For the Museum.

A specimen of China Grass, from Cuttack, and also a species of Country Cochineal, were presented by the Rev. Mr. Garrow.

A model of a Kettle, by Raja Kaleekrishen.

A skin of a large Snake, by Mr. Davis.

For the Library.

The 7th volume of his Ottoman History was presented in the name of Mr. Von Hammer.

The third number of *Vijara* presented by Professor Ottman Trant.

Several numbers of the Journal Asiatique from the Editors.

The following Books received from the Booksellers:—

Hardwick's Zoology, 3 numbers; Cabinet Cyclopædia; History of France, vol. 2; Western World, vol. 1; Herschel's Natural Science; Mission to the Calmuk Tartars.

The Meteorological Registers for June and July, from the Surveyor General's Office.

Resolved, that the thanks of the Society be communicated to the donors of the above contributions.

Some Persian Coins, collected by Colonel Wilson, and others by Lieut. Conolly, were laid on the table, with drawings by Mr. J. Prinsep.

An abstract of the *H,Dulva*, or first portion of the Kah-Gyur, was presented by Mr. Csoma de Kooroos, of which a notice by the Secretary was read to the meeting.

Colonel Wilson's collection comprises

1st. Thirteen silver coins of the Arsacidæ dynasty, with the usual symbols and inscriptions. *βασιλευς βασιλεων Αρσακης ευεργετης δικαιος επιφανος φιλελληνος.* Most of them could be recognized in Vaillant's work on the Numismatic history of the Arsacidæ. It was supposed that one coin bore the name of 'Mithridates' in Phœnician characters, but nearer inspection shews it to be merely the word *βασιλεως* badly executed.

2d. Two silver coins having on the obverse a Grecian head—on the reverse, a species of sceptre, encircled with a wreath, with the words on one *ευκλδιων* (perhaps *ευκλειων*) *τιμοθεος*; on the other *αγυκα διων—λαμυλος.* A Timotheos Dionysos reigned in Heraclia Pontica, A. C. 356 (Pinkerton, II. 302.)

3d. Six silver coins of the Sassanidæ dynasty; a crowned head and Pehlavi inscription on the obverse, the fire altar and two attendant priests on the reverse.

4th. Also some Alexandrine and Roman coins: one having an equestrian figure on one side, and on the other a man riding upon a dolphin, which could not be traced in any work of reference in the Society's Library.

Lieut. Conolly's collection consists of one gold coin of the Sassanian dynasty, with the head and fire-altar very rudely executed: four gold coins with inscriptions in ancient Kuphic characters, but too much obliterated to be decyphered by any but an experienced medallist. Also two silver coins of the Khalifs of the race of Ommieh: on the most legible of the two, the inscription informs us, that it was struck at *Wasit* in the year 129 Hij. (A. D. 746).

In Hallenberg's *Numismata Orientalia* are described several coins of the same period, the legends of which precisely correspond with those before us: the nearest in date is of the year 126 Hij. (A. D. 743). Merwan the twenty-first Khalif and fourteenth of the race of Ommieh came to the throne in 127 Hij. and was killed in 132 Hij. being the last of that family. *Wasit* the town, on the Tigris, at which the coin was struck, was so called, says the same authority, from being half way *(middle)* between Basra and Kufa: it was built by Ibn-Gjuzi A. H. 75, and remained the seat of the Khalifat (or at least of the coinage) until the Abbas succession, when the capital was established at Mohamediah, or Baghdad, as proved by coins struck in the year 137 Hij.

2.—Medical and Physical Society.

At the meeting of the 3d September, Messrs. Shean, Foley, and Watson, were elected Members, and J. N. Casanova, M. D. of Cadiz, was elected a Corresponding Member. A communication was then laid before the meeting from Dr. D. Stewart, of Howrah, stating the case of a boy who had received a severe injury of the head, with extensive fracture, and deep depression of a portion of the skull. A diagram descriptive of the injury, and two portions of bone removed by trepanning, accompanied the communication. The case was remarkable, in consequence of the fracture of the inner table of the bone running to a distance of nearly half an inch from that of the outer table. On this account some deviation from the usual mode of operating was requisite. Prior to the operation, the patient was quite insensible, and the worst symptoms were present; after the operation, he spoke in a composed and rational manner; and all the bad symptoms disappeared.

The following communications were also submitted. A case of dislocation of the neck from a fall, which proved fatal next day, by Mr. Twining. Preparation from a subject, in which diseased hip joint followed a severe injury on board ship. Case of a native woman, who was so severely lacerated by a tiger that it was necessary to remove the arm at the shoulder, by Mr. J. Blackwood. Account of a singular nervous affection to which the Malays at Pinang are subject, by Mr. Boswell. Case in which the operation of lithotomy was followed by tetanus, and the patient was cured, by Mr. F. H. Brett; and a case of fungus tumour in the orbit of a native, extirpated successfully, by the same.

The following communications, formerly presented to the Society, were then read and discussed by the Meeting; viz. Mr. Galt's case of fever. This occurred in a Sepoy, who came to Hospital after an illness of a month's duration, and died suddenly of rupture of the heart. The case was remarkable, from the laceration taking place at the apex of the organ. There were appearances about the heart, indicating chronic disease of long duration. Dr. R. Tytler's communication contained an account of a Hindoo, who was bitten in the foot by a Cobra de Capello. At the end of three hours the man became convulsed, and scarcely sensible. Ammonia, brandy, and laudanum were administered, and the wound was scarified. The patient recovered, but his limb remained swollen for some days. Mr. Preston's case of strangulated Hernia occurred in an European, on whom the operation was performed after the patient had been suffering symptoms of strangulation for ten days, during the first six of which he avoided coming into Hospital. The bad symptoms ceased soon after the operation was performed, and the patient recovered in a few days. Rajah Kalikissen's communication is a translation from an Oriental work on the Pulse. The precautions, which are directed in native medical works, to be observed in feeling the pulse, for the purpose of obtaining useful information regarding the patient's state of health, and the nature and tendency of any existing disease, are minutely but fancifully described. The whole account has relation to imperfect notions of the old doctrines of the Humorrhal pathology, upon which the system of Bengallee pathology and practice would appear to be founded. Each modification of the pulse described, is referred to a morbid condition of one or more of the different humours, to which the attention of the Physician is almost exclusively directed. Accordingly, as one or more of these may be supposed to be affected, so is the Physician's opinion, diognosis, and mode of treatment guided. The essay is a curious record of one branch of a system, which still, to a considerable extent, exists in this country.

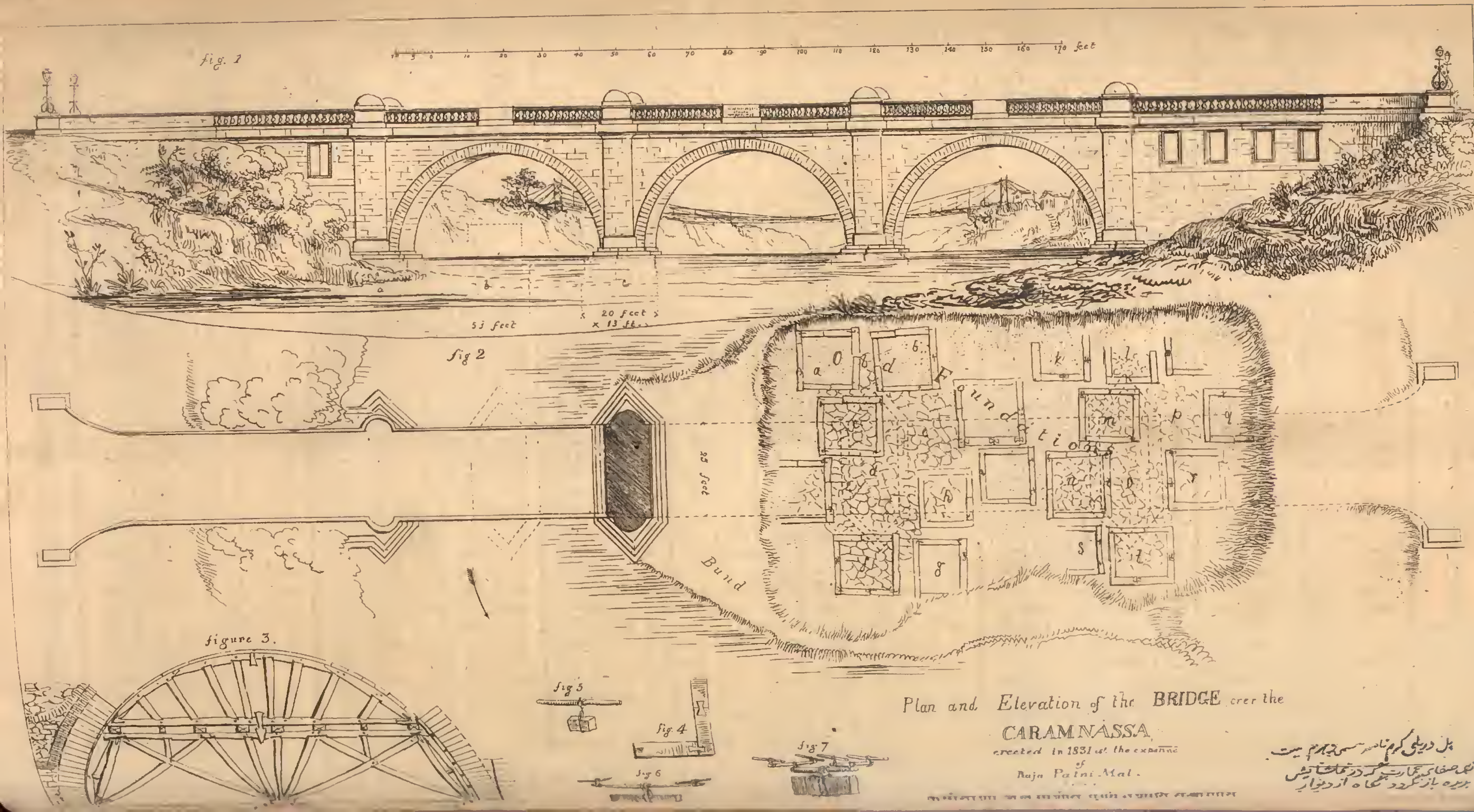
Meteorological Register kept at the Surveyor General's Office, Calcutta, for the Month of September, 1831.

Day of the Month.	Minimum Temperature observed at Sun-rise. Barometer reduced to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Maximum Pressure observed at 9h. 50m. Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.
1	29,659	78,5	2,1	cm.	rn.	,734	78,9	1,5	cm.	cis.
2	,658	77,	1,6	do.	n.	,726	82,3	2,2	do.	cu.
3	,660	79,5	1,1	s. e.	cus.	,729	81,6	1,9	s. e.	cus.
4	,645	79,3	1,7	do.	do.	,645	87,	4,3	do.	
5	,626	79,3	1,2	do.	n.	,651	86,3	5,4		cu.
6	,644	80,3	1,2	do.	cu.	,675	86,6	5,2	do.	do.
7	,641	80,	1,6	n. e.	do.	,678	86,5	5,6	n. e.	do.
8	,583	79,7	1,	do.	do.	,688	88,	6,9	do.	do.
9	,636	80,7	1,3	s. e.	do.	,698	76,7	2,3	s. e.	rn.
10	,733	79,5	1,1	do.	cy.	,732	86,5	3,9	do.	cu.
11	,735	79,	1,6	cm.	cus.	,787	84,3	3,4	cm.	do.
12	,758	77,8	1,4	do.	rn.	,780	78,5	1,6	do.	cis.
13	,663	77,7	3,	do.	do.	,710	85,3	4,3	s. e.	cu.
14	,663	79,5	0,6	do.	cus.	,703	87,	5,8	do.	do.
15						,733	88,	7,6	s. w.	ci.
16	,657	82,7	1,3	s. e.	cu.	,675	90,	7,6	s. e.	cu.
17	,635	79,3	1,6	do.	cus.	,646	87,	4,6	do.	do.
18	,662	79,8	1,4	do.	do.	,680	83,5	3,1	cm.	n.
19	,696	79,5	2,4	n. e.	do.	,730	84,5	3,4	n. e.	cus.
20	,683	79,	1,6	do.	n.	,741	85,	3,3	do.	cu.
21	,690	78,7	1,	do.	do.	,741	80,5	1,1	do.	rn.
22	,708	80,5	1,6	s. e.	cus.	,717	86,5	6,1	s. e.	cu.
23	,665	80,7	1,3	do.	cis.	,701	86,5	5,8	do.	do.
24	,610	77,9	1,5	n. e.	n.	,644	84,5	3,8	n. e.	cus.
25	,591	79,5	2,1	do.	cy.	,645	80,7	1,8	do.	n.
26	,620	79,5	1,1	do.	cu.	,661	85,5	5,6	do.	ci.
27	,668	78,9	1,5	do.	cus.	,730	84,	3,3	do.	cu.
28	,758	77,9	2,5	do.	do.	,828	80,3	2,2	cm.	cus.
29	,735	78,5	1,6	s. w.	do.	,834	83,7	4,	s. w.	cu.
30	,757	78,3	1,4	n. e.	do.	,794	85,8	4,6	n. e.	do.
Mean	29,670	79,3	1,5			,715	84,4	4,0		

Day of the Month.	Observations made at apparent Noon. Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Max. Temp. and Dryness observed at 2h. 40m. Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.
1	,699	80,8	1,7	cm.	cis.	,649	85,	4,	s. e.	cu.
2	,678	86,	4,9	s. e.	cu.	,617	87,7	6,	do.	do.
3	,707	82,9	2,8	do.	cus.	,627	83,5	2,4	do.	cus.
4	,618	90,3	6,9	do.	cu.	,534	82,	1,6	do.	rn.
5	,632	88,8	7,6	do.	do.	,563	91,3	8,6	do.	cu.
6	,646	89,5	7,8	do.	do.	,568	99,3	9,2	do.	cus.
7	,647	88,7	7,	n. e.	do.	,593	89,3	7,9	n. e.	cu.
8	,643	90,5	8,8	do.	do.	,592	88,5	7,1	do.	n.
9	,695	77,9	2,5	s. e.	rn.	,631	81,	1,9	s. e.	cus.
10	,712	88,7	7,	do.	cu.	,670	83,9	4,8	do.	n.
11	,750	80,9	2,5	cm.	n.	,730	78,9	1,5	cm.	rn.
12	,738	84,3	3,6	do.	cis.	,685	82,5	1,8	n. e.	n.
13	,682	79,	1,9	s. e.	rn.	,621	83,8	2,1	s. e.	cus.
14	,689	87,8	6,4	do.	cu.	,625	90,5	8,8	s. w.	cu.
15	,711	90,5	8,1	s. w.	ci.	,627	91,5	8,8	do.	cis.
16	,634	91,5	8,4	s. e.	cu.	,561	85,7	3,	s. e.	n.
17	,620	89,3	6,4	do.	cis.	,575	79,5	1,1	cm.	do.
18	,670	83,7	2,8	cm.	cus.	,652	80,5	1,1	do.	rn.
19	,696	80,9	1,2	n. e.	rn.	,640	79,3	1,2	n. e.	n.
20	,700	86,	4,3	do.	cu.	,649	85,3	3,9	do.	cis.
21	,694	84,5	4,1	do.	cus.	,623	86,5	5,8	do.	cu.
22	,686	88,	7,6	s. e.	cu.	,599	89,5	8,1	s. e.	do.
23	,652	89,3	7,6	n. e.	do.	,576	90,3	7,9	n. e.	do.
24	,590	88,	6,8	s. e.	cis.	,518	88,	6,8	do.	ci.
25	,616	80,9	2,5	n. e.	n.	,535	83,5	3,1	do.	cis.
26	,629	88,3	5,9	do.	cus.	,595	79,8	2,1	do.	n.
27	,701	79,3	1,2	cm.	n.	,679	77,9	1,5	cm.	rn.
28	,787	79,	1,9	do.	do.	,719	79,5	2,4	do.	cis.
29	,781	87,8	8,1	s. w.	cu.	,711	87,3	7,4	s. w.	cu.
30	,765	88,7	7,6	n. e.	do.	,677	89,5	8,8	n. e.	do.
Mean	,682	85,7	5,2			,621	85,1	5,0		

Day of the Month.	Minimum Pressure observed at 4h. 0m. Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Observations made at Sunset. Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Rain-gauge, No. 1.	Rain-gauge, No. 2.
1	,622	84,5	3,2	cm.	cis.	,634	84,	3,6	cm.	cis.		
2	,607	83,7	3,	do.	do.	,614	82,3	1,6	do.	do.	0,35	0,32
3	,599	84,3	3,6	s. e.	cu.	,605	82,	2,9	s. e.	do.	0,14	0,10
4	,527	81,	2,1	do.	cus.	,519	80,	1,6	do.	cus.		
5	,564	80,7	1,3	do.	rn.	,581	82,	1,6	do.	cu.	0,25	0,22
6	,574	82,3	1,6	do.	n.						0,90	0,85
7	,574	89,	7,8	n. e.	cus.	,601	83,5	1,9	n. e.	cus.		
8	,586	82,3	3,6	do.	cis.	,580	83,	2,1	do.	cis.		
9	,594	81,8	1,4	s. e.	n.	,615	81,	1,1	s. e.	do.		
10	,671	81,3	2,9	do.	do.	,672	81,7	2,8	do.	do.	0,55	0,52
11	,691	78,5	2,1	n. e.	rn.	,707	78,3	1,9	n. e.	n.	0,09	0,05
12	,659	81,3	2,4	cm.	cis.	,647	81,5	1,6	cm.	cu.		
13	,602	85,5	4,8	s. e.	ci.	,622	82,	2,3	s. e.	ci.	1,44	1,30
14	,604	88,7	6,	s. w.	cu.	,624	86,3	3,9	s. w.	cl.		
15	,627	90,	6,9	do.	cis.	,620	85,	3,6	do.	do.		
16	,558	85,7	2,8	s. e.	cus.	,594	83,5	2,4	s. e.	cu.		
17	,575	78,7	1,3	cm.	n.							
18	,650	79,9	1,7	do.	rn.	,651	79,3	1,	cm.	rn.	0,45	0,40
19	,622	84,5	4,6	n. e.	cus.	,634	80,9	1,5	n. e.	cus.	0,10	0,07
20	,631	84,5	4,1	do.	cis.	,638	82,5	2,1	do.	cis.	0,12	0,10
21	,624	84,7	4,6	do.	cu.	,623	82,3	1,9	do.	cu.		
22	,591	88,3	7,6	s. e.	do.	,584	80,7	1,8	s. e.	cus.		
23	,552	89,3	7,9	n. e.	do.	,577	86,5	5,6	n. e.	ci.		
24	,509	85,	4,1	do.	cus.	,546	82,	2,1	do.	cis.		
25	,552	84,	4,6	do.	cu.	,573	82,7	2,3	do.	cu.	0,07	0,05
26	,598	78,4	1,4	do.	rn.	,595	80,5	1,8	do.	cis.	0,45	0,42
27	,652	77,	1,6	cm.	do.	,689	76,	1,3	cm.	do.	0,37	0,32
28	,692	79,	2,1	n. e.	cus.	,708	78,3	1,9	do.	do.		
29	,707	85,	4,6	cm.	do.	,724	84,5	4,1	do.	cl.		
30	,677	87,3	6,4	n. e.	cu.	,661	84,	2,6	n. e	do.		
Mean	,639	83,5	3,7			,623	82,0	2,3			5,23	4,72

Abbreviations. In the column " wind," small letters have been used instead of capitals ; *cm.* means *calm.* In the column " aspect of the sky," *cy.* is *cloudy ; cl.* clear ; *rn.* rain ; *ci.* cirrus ; *cu.* cumulus ; *cs.* cirro-stratus ; *cus.* cumulo-stratus ; *cc.* cirro-cumulus ; *n.* nimbus. The Rain-gauge, No. 1, is on the ground. No. 2, is on the roof of the house, [illegible] feet above it.



Plan and Elevation of the BRIDGE over the CARAMNASSA, erected in 1831 at the expense of Raja Patni Mal.

GLEANINGS

IN

SCIENCE.

No. 34.—*October*, 1831.

I.—*The Caramnassa Bridge.*

We feel pleasure in bringing to the notice of our readers, that a substantial bridge of stone has been recently erected over the Caramnassa river at Nobatpúr, on the high road from Calcutta to Benares, and that it was thrown open to travellers in the month of July of the present year.

The Caramnassa takes its rise among the Rotas hills, and flows into the Ganges between Ghazipúr and Buxar: it partakes of the character of most of the hill streams, in being nearly dry, during the hot months; and in being subject to sudden and impetuous floods, in the rains. The breadth of the channel from bank to bank at Nobatpúr is 300 feet; the winter stream is about half as broad; and the perpendicular rise of the water is nearly 30 feet, bringing it close upon the level of the surrounding country during the rainy season.

The waters of this river have, from time immemorial, been considered impure by the Hindús, upon the authority of their *Purans*, and other sacred works.

Gaotama Rishi, in his account of the sanctity of Gya, inculcates, that "by the touch of the water of *Karmanásá*, all virtuous works are instantly destroyed;" indeed such is the purport of the name itself. The *Pudma-puran* gives the following history of the origin of the severe denunciation against this unfortunate river.

Ravana, the monster demon of Hindu romance, who ruled in *Lanka*, the supposed capital of Ceylon, had carried off *Sita*, the bride of *Rama*, and was in consequence besieged in his fortress by that heroic demi-god, at the head of a powerful army of *Hanumans.* He endeavoured to propitiate *Siva*, to aid him at this juncture, and so far succeeded through the intercession of the goddess *Devi*, that the safety of *Lanca* was promised, provided *Ravana* should succeed in transporting thither a *lingam* or emblem of Siva, which he should find on the *Kailása* mountain, without allowing it to touch the ground on its journey.

Ravana accordingly set out for Kailása, and having obtained the *Siva lingam*, returned without delay. When he had got as far as *Bydyanáth*, or the hill of Byjnath, *Varuna* and *Indra* concerted together an ingenious artifice to thwart his purpose. *Indra* approached, and accosted him in the semblance of a holy brahman; while *Varuna*, the deity of waters, passed invisibly into his belly, and produced so grievous a commotion therein, that he was constrained to pause on his journey, and call upon the counterfeit brahman to assist him by holding the *lingam* for a moment. *Indra* joyfully took the image from his hands, and set it upon the ground, where it instantly became fixed and immoveable. *Varuna* mean time had so filled the capacious interior of the demon with water, that its discharge produced a lake which was hence called *Karmanása.*

Under these circumstances, it is not surprising, that true believers should attribute defiling qualities to the stream, and avoid contact with it, especially after performing a pilgrimage of purification to *Gya*, *Pryag*, *Kashi*, or *Jaganáth.* Many pious Hindus have accordingly conceived the laudable project of throwing a bridge across the river, but from the ill success attending their attempts, a superstitious dread has by degrees prevailed, that some calamity would fall upon the head of any who should undertake the hazardous task.

Upwards of a century ago, in the reign of Aulemgìr, the Subadar of the Benares district attempted to erect a bridge one mile to the south of the present structure, but failed. Some of the materials are still to be seen in that part of the river. About 60 years ago, Rai Bhára Mal, the *diwan* of Himat Behádur, commenced a similar work very near to the present site, but with equally bad success. In 1780, Ahila Bai, the celebrâted Marhatta princess, deputed agents to erect a bridge upon the spot, but probably they were engaged upon her numerous embellishments of the ghats at Benares until her death in 1795, as nothing seems to have been done here. Again during the residency of Mr. Duncan, Nána Farnavìz, minister of the Poona state, set to work in earnest upon the construction of a bridge; after labouring at it for ten years, and expending, (according to current report 14 lakhs, but in reality) between 2 and 3 lakhs, his death put a sudden stop to its prosecution. He had, however, overcome the principal difficulties, which consisted in laying secure foundations in a soil formed of deep oozing sand. A vast quantity of materials was also collected, many of which were afterwards carried off by the zemindars and villagers of the neighbourhood and used in their houses : a handsome well was erected with a portion of them ; but this appropriation was less to be regretted, as such a work is equally useful to travellers as the bridge itself.

A few years since, the Government went to the expence of erecting a rope suspension bridge of 300 feet span, for the accommodation of foot passengers and the dâk runners : it lasted well and is still in existence ; but not having been repaired for two years, it is now considered to be dangerous. It was contemplated at one time to replace this rope bridge by one of iron, and a proper person was deputed to examine the spot; but this plan finally gave place to the more worthy object of which we now announce the completion.

On the 9th June, 1829, Rai Patni Mal of Benares, well known for the numerous temples and ghats erected by him at Máthura and Bindrábun, volunteered to complete the bridge commenced by Nána Farnavìz ; contrary to the instances of his family, who were alarmed at the prospect of some personal calamity ensuing therefrom, and as much perhaps at the prospect of sinking a vast sum in what was considered a fruitless project, he remained staunch ; although at the very outset his wife's demise might have been esteemed an evil omen ; and his offer was encouraged by Government, without however committing itself to any of the *terms* he proposed, which were, 1, permission to use the materials formerly collected ; 2, assistance from the police in procuring carts, &c. ; 3, the services of the Secretary to the Benares Committee of improvements, who had furnished a design for the new bridge ; 4, a remission of the heavy duties on Chunar stone ; and 5, a confirmation of the title of '*Raja Behadur Néknam,*' which had been conferred upon him by the king of Delhi, during Mr. Seton's residency. The 4th boon was rendered unnecessary by opening a quarry expressly for the work, on the sandstone hills, 14 miles to the S. W. of Nobatpúr: the exactment of the duty would nearly have doubled the cost of the stones, had these been brought from the Chunar quarries.

Concerning the plan and progress of the work, a brief notice will suffice. Of the former, plate XVI. will serve to give a tolerably correct idea[1]. The original native bridge was to have had seven arches of 17 feet span: to take advantage of the piers already built it was determined to throw two of these into one, making three equal arches, which with the piers should occupy precisely 200 feet in span. The semicircular form was preferred on account of the great rise of the river, the necessary height of the road way, the symmetry of the elevation, (since for more than 8 months of the year, the level of the water remains 2 steps below the spring of the arch as shewn in the sketch,) and the convenience of cutting the stones to one model. The span of the arches is 53 feet, and the depth of the voussoirs 3 feet. A vault of brick is laid over them to prevent any infiltration of water through the joints from above. To the piers is given a section of 30 by 13 feet: the roadway is 25 feet wide, and perfectly horizontal. The centering consisted of 6 frames, each composed of four pieces (fig. 3.) so as to be as light as possible; for it must be remarked, that no machinery could be employed in the construction:—every stone was to be raised and posited by direct human labour:—figures 5, 6, and 7 are intended to exemplify one instance of this in the simple native mode of carrying stones: the number of men is increased according to the weight to be lifted, and from the combination of levers, the weight necessarily bears equally upon the supporting shoulders of all the *pesrajes* or carriers; with a *sangar* of 16 men they readily move a stone of as many maunds, or about fourteen cwt.

Early in 1829, operations were commenced by embanking the western half of the river, as represented in fig. 2; the two piers required on the east being already provided or needing but slight alteration, and the stones of the intermediate pier of the old structure serving, on removal, for the third new pier.

Upon clearing the sand it was found, that coffer dams or *kothi* of stone had been laid down all across the river for a breadth of 60 feet, so as to convert the whole bed as it were into a solid rock. Most of these reached through the sandy stratum, 20 feet deep, and rested upon the firm clay below[2]. Some of them were already filled up either wholly or in part with masonry, so that there was but little difficulty in completing as much of the space as was judged sufficient for the support of the new piers. Such *kothis* as remained unfinished were therefore cleared of sand to as great a depth as could be attained, or until the under masonry was met with, and were then filled with *dhoka*, or grouting of rough stones and *kankar* lime, the latter of which forms an excellent hydraulic cement, as was sufficiently proved by the difficulty of breaking away the old masonry; three courses of squared stones brought the piers to the bed of the river, and six more to the spring of the arches. In April 1830, the first arch was turned, and the two others commenced; but a sudden rise of 26 feet in the river, in the course of one night, carried away the whole of the centerings, fortunately without any material damage to the masonry. The two remaining arches were thrown over in the hot season of 1831, and by dint of great exertion the roadway was made passable by July; the

[1] We have heard from the Raja, that he has deviated from the original plan here engraved in two respects: first, by omitting the semi-domes over the recesses on the piers; and secondly, by substituting a plain parapet for the balustrade on the wing walls; his corrections arrived too late to be attended to, the plate having been previously struck off.

[2] These *kothis* are constructed of long stones united together by wooden wedges, (as in fig. 4,) forming square chambers of about 15 feet diameter; they rest upon a wooden frame or *jamwat*, which is sunken through the sand by the process of under-digging, as practised by the well-diggers of Bengal.

stones of the parapets and balustrades are now prepared at the quarries, and will be set up as soon as the road shall become passable for carts.

The estimated cost of the bridge, exclusive of what had been laid out by Nána Farnavìz, was Rs. 100,000, a sum which has not probably been exceeded under the careful management of the Raja, whose son, Rai Ram Kishen, acted throughout as executive superintendent on the spot. The friendly aid and advice of Captain Grant, executive officer of the Benares division, on all technical points, and matters of architectural taste, is particularly alluded to in the Raja's communication to us. He frequently visited the work, and saw that it was properly executed, so that on the removal of the centres, there was no sensible sinking of the crown of the arches: the whole detail of the construction was however confided to native masons, and we hear the execution does great credit to their head mistree's skill and exertions.

The Caramnassa bridge may well serve to wind up the series of useful improvements undertaken through the public spirit or philanthropic piety of Patni Mal. We think it but justice to his character, to make known the many other works accomplished by him, and to hold him up to his countrymen as an example worthy of imitation, while among the rulers of India the bare mention will be sure to draw upon him a full portion of the respect which such patriotic acts should ever command. We can but spare space for a brief notice of each.

In 1802, he rebuilt the temple of *Dirag-Vishnu* at *Máthura*, at an expence of Rs. 70,000. During that and the following years also, he was engaged upon the construction of the *Siwtal*, a magnificent stone tank at *Máthura*, which cost not less than 3 lakhs of rupees.

In 1803, he rebuilt the temple and well of *Bharbadéswar*, for Rs. 10,000.

In 1804, he constructed a splendid well or *Baoli* at *Jwala-mukhi*, where pilgrims were much troubled for want of water, having to carry it thither from a distance of 24 miles: it occupied 2 years in building, and cost Rs. 90,000.

In 1805, he constructed three ghats at *Kurukshetr* and *Lakshmi-kund*, near Patiala, at an expense of Rs. 35,000.

During the year 1806, in the neighbourhood of *Haridwar*, he spent Rs. 90,000 upon several ghats and temples.

In 1809, he erected a handsome serai or *katra* of stone, near the temple of Radha Ram Thakur at *Bindraban*, for the convenience of travellers, at an expence of Rs. 60,000.

In 1810, he expended Rs. 50,000, in the embellishments of *Kalkajì*, a place much frequented by the Hindus of Delhi.

In 1821, on a visit to Gya he devoted Rs. 7000 to the repair of many of the sacred places there.

And finally in 1831, he completed the Caramnassa bridge, and it is no disparagement to say, that this last work is calculated to be of more lasting utility and celebrity than all that preceded it.

P. S. Since writing the above we have learned with pleasure, that the Right Honorable the Governor General has been pleased to confer upon Patni Mal the title of Raja, and that he was invested with the *Kheláat* appropriate to his rank on the 15th October, at Benares, by W. A. Brooke, Esq. the venerable representative of the Governor General at that place. Lord William Bentinck has also been pleased to direct, as a further testimony of his approbation of such laudable undertakings, that a drawing shall be made of the new bridge at the expence of Government, to be sent to England for the purpose of being lithographed by an eminent artist, that copies of it may be distributed among the Raja's friends, as well as among other natives of distinction throughout India.

II.—*Determination of the Latitude of Kartigora in Kachar.* By Lieut. T. Fisher, *Dep. Asst. Qr. Mr. Gen.*

The full account of the double altitude instrument, given in the memoirs of the Astronomical Society of London, with the notice in the 1st No. of Gleanings in Science of the particular instrument with which the annexed observations were made, preclude the necessity of again describing it.

It may however be as well to remind the reader, that this instrument is intended to supersede the employment of a level as a zero, and consists of two separate vertical circles, to be used contemporaneously (or very nearly so), in the measurement of the angle formed by a heavenly body, and its image reflected from a trough of mercury or other horizontal surface. Thus, while the telescope of one circle is pointed to a star, that of the other is directed to its image, and after their separate readings have been registered, the positions are reversed, the elevated telescope being depressed to the image, and the depressed telescope elevated to the object; and new readings obtained, completing the measurement of the angle on each circle, compensating for the error in collimation, and for any change in the position of the zero points, which may have taken place in the interval between the two observations: either the corresponding times or azimuths must of course be noted with the altitudes, in order to reduce them to the meridian.

To save the labour of this last reduction, the observations contained in Tab. No. 1, were made so near the meridian, as to render it unnecessary; the contact of the wire and object being completed in the one telescope about eight or ten seconds before the transit, and that in the other about the same time after it. The reversed observations in this case are necessarily made on a subsequent night, which is a disadvantage, as there is a chance that in the intermediate time unequal changes may take place in the positions of the micrometers; this risque, however, does not appear from experience to be very great, provided the interval be not considerable. It may also be easily detected by noting occasionally the differences of each pair of micrometers when directed to a fixed mark, the position of the instrument being at the same time verified by means of the telescope under the horizontal circle.

When single altitudes only are taken, the level on one of the telescopes is used as a zero, the telescope being directed to a fixed mark, and the reading on its circle being carefully noted, with a view to detect any changes that may take place in the position, either of the instrument bodily, or of the micrometers severally.

The advantages of the instrument are sufficiently obvious; besides enabling us to dispense with the level, and thereby cutting off all its uncertainties, we have a complete set of observations on two circles, independent of each other, except as regards the small differences that depend on any change in the zero points, and consequently each set may be estimated at twice the value of one made with a single altitude instrument.

The only objection to which the construction appears liable, is the shortness of the transverse axis, which it is difficult to keep level, as very small inequalities in the pivots produce sensible effects on it, and the circle is consequently liable to be thrown out of the vertical; which in measurements made near the zenith, or at a considerable distance from the meridian, may be productive of some error. Practically, however, this disadvantage has not been found so great, as might have been expected from theory; and it should be observed, that the error arising from this cause may be compensated, where the latitude only is sought, by observing pairs of stars, which have nearly equal meridian altitudes, but are on opposite sides of the zenith.

I. Observations made with Dollond's Double Altitude Instrument at Kartigora.

Star.	Date 1831.	Therm.	Az. readg.	Elev. Tel.	Microm.	Circle A.	Microm.	Circle B.		
	Feb.	°	°			° ′ ″		° ′ ″		° ′ ″
Sirius,	23	66	0	A.	2	48 41 26.7	1	48 36 31.7	Appt. Alt.	48 38 41.6
					3	39 23.5	4	36 13.0	Refr. —	49.3
	25	69	0	B.	2	35 09.0	1	41 31.5	True Alt.	48 37 52.3
					3	38 01.0	4	41 18.0	N. P. D.	106 29 44.0
Means,		67.5				48 38 30.1		48 38 53.6	Latitude,	24 52 23.7
Sirius,	26	66	180	B.	2	48 41 04.5	1	48 37 08.0	Appt. Alt.	48 38 38.6
					3	38 27.0	4	37 06.0	Refr. —	49.7
	Mar. 2	61	180	A.	2	36 43.7	1	40 30.5	True Alt.	48 37 48.9
					3	38 09.0	4	40 00.5	N. P. D.	106 29 44.3
Means,		63.5				48 38 36.1		48 38 41.2	Lat. north,	24 52 26.8

Star.	Az. rg.	Mean Readings of Circle A.	Mean Readings of Circle B.	True Alt.	Latitude.
	°	° ′ ″	° ′ ″	° ′ ″	° ′ ″
β Aurigæ,...... ..	180	69 57 43.2	69 57 17.4	69 57 10.1	24 52 23.6
Ditto, ...	0	57 18.2	57 38.1	57 07.7	52 21.3
Procyon,........	0	70 46 43.3	70 47 01.8	70 46 33.1	52 20.1
Ditto, ...	0	46 48.3	47 02.8	46 36.1	52 17.1
Ditto, ...	180	46 49.4	46 59.6	46 35.3	52 17.9
Ditto, ...	180	46 49.6	47 00.1	46 35.6	52 17.1
α Hydræ	180	57 12 07.6	57 12 20.9	57 11 38.5	52 19.8
				Mean Latitude North,	24 52 20.8

II. Single Altitudes taken with Dollond's Double Altitude Instrument at Kartigora.

Date.	Axis.	Therm.	Names of Stars.	Mean Rdg. of micr. 1 & 4.	Level and change of microm.	Cor. Ref.	Mean cor. Altitude.	Latitude deduced.
1831.				° ′ ″	″	° ′ ″	° ′ ″	° ′ ″
Jan. 9	W	66	Polaris,	26 27 35.	0	1 52 7	26 27 36.86	24 52 20.46
10	E	66		26 31 22.12	+ 2			
11	W	66	α Ceti, ..	68 34 55.5	+ 1.5	22 15	68 32 41.10	24 52 25.50
12	E	63		68 31 08.	+ 7.5			
11	W	66	α Persei,	65 35 49.5	— 2.5	25 52	65 37 07.22	24 52 18.81
12	E	68		65 39 22.	— 3.5			
12	E	60	Capella,	69 05 43.12	+ 5	21 82	69 3 26.36	24 52 22.84
13	W	62		69 01 56.25	— 8			
12	E	60	α Orionis,	72 27 48.62	+ 7.5	17 81	72 29 37.49	24 52 18.07
13	W	62		72 32 32.035	— 9			
17	E	57	Capella,	69 05 52.5	+ 4	21 96	69 03 25.54	24 52 22.44
18	W	59		69 01 42.5	— 4			
17	E	57	ν Orionis,	71 16 51.	— 4	19 2	71 18 52.42	24 52 19.35
18	W	59		71 21 29.25	+ 7			
17	E	57	ξ Orionis,	63 03 37.75	— 4.5	29 11	63 05 07.52	24 52 20.88
18	W	59		63 07 33.	+ 7			
17	E	57	α Orionis,	72 27 34.5	+ 6	17 93	72 29 32.32	24 52 22.86
18	W	59		72 32 04.0	+ 8			
Apl. 7	W	69	Regulus,	77 57 19.	— 7.5	11 84	77 55 00.16	24 52 16.74
15	E	74		77 53 12.62	0			
7	W	68	α Ursæ Majoris,	52 11 41.12	+ 4.75	43 10	52 12 36.43	24 52 22.69
19	E	76		52 15 00.2	— 7			
							Mean Latitude North,	24 52 20.98

These observations cannot be considered a fair test of the accuracy attainable with the instrument, because the accordance in the results depends partly on the exactness with which the N. P. distance of the stars used has been determined, respecting which it is known there is a good deal of uncertainty (to the extent in some instances of five seconds) among even the Greenwich stars (see Pearson). Perhaps the most satisfactory proof of the instrument's power would be drawn from a comparison of a number of measurements made of angles on different part of the circumference by observing several stars repeatedly, but this requires more leisure than I can at present devote to the subject.

[Note.—Lieut. Fisher's first table continues in the form of the two sets at the head of the list throughout his series of observations; but as the printing of it at large, would have occupied a considerable space, we have ventured to abstract the remainder, and put its contents in such a shape as still to shew the power of the instrument, the variation in the readings of the two telescopes, and the calculated latitude from each observation.

In the second table also we have omitted the two columns containing the readings of the microscopes, and that containing the North Polar distances of the stars, which latter may be found, if required, from the corrected altitude and deduced latitude.—Ed.]

III.—*Of the Evolution of Rent, and the Distribution of Revenue, after the appropriation of tracts of Land.*

Before the more scientific employment of capital, which accompanies man's increasing knowledge; and before that concert and co-operation of many individuals, which the employment of capital implies; man's power, we have seen, is but small, of obtaining a clear surplus for his own peculiar use; whether the land he cultivates happens to be particularly fertile, or particularly the reverse.

In an infant society, in a country where population is scanty, the capability of the soil to yield nutriment to such quantity of useful vegetable germs as is ultimately found supporting a vastly increased population, is utterly unknown, and those who originally appropriate certain portions of the soil, realize no income from their possession beyond what is obtainable by every one, who is willing to appropriate unoccupied tracts, and to put seed into the ground when cleared.

The incomes of men, in such circumstances, can be known only as the recompense of the labour they bestow; for the small tract of land which each can take into cultivation, with his limited ability to clear and dress it, is capable of yielding a net increase, only equal to the supply of his urgent wants; and every one is free to make new appropriations of uncleared tracts, as the necessity occurs for an extension of cultivation. The possession of the soil can therefore at this time, secure no peculiar advantages to its occupant[1].

As the numbers of men increase, and with them their power of labouring, and of taking, with the aid of capital, larger tracts under their care; and as the wealth

[1] In the above I am of course making no allowance for such varieties in the quality of the soil as cannot fail to exist in all extensive tracts: neither shall I in the following reasonings. The general principles elucidated, will thus stand on a well determined basis, and the discussion will be thus rendered less involved; and after we have ascertained the effects, on the development of rent, of limitation in extent, which is an attribute of the soil, we can determine the intermediate effects of variation in quality, which is an accident.

of society increases, and, with it, the knowledge of productive arts; the progressively increasing numbers will be enabled, not only to work, with a power equal to their greater numbers, but with an efficiency, through the more effectual aid obtained from capital, which sets free an income continually increasing in a greater proportion than the numbers increase, who are actually employed in the production of food. The revenue of the society will then, as we have seen, be divided under two heads: it will be known as the wages of labour, and the profits of the stock of capital employed.

But during the time that these increases of income, and evolvements of distinct profits, have been taking place; another separation of particular income from general revenue may also have been on foot, under particular circumstances of proprietorship in the soil, and if the custom had come to prevail, amongst individuals, of keeping considerable tracts in their possession.

We have seen, that each successive improvement, in the mode of applying capital to cultivation, raised profits from that rate to which they, of necessity, have a tendency to sink, to some higher point; whence it was the decided interest of the productive, and indeed of all classes, that they should experience such reduction as is brought about by the more extended employment of capital. To those however who, besides being the possessors of capital, are proprietors of certain portions of the soil, provided they appropriate the same extent of surface as before, to their own exclusive use, the power has been secured of continuing to realize the same constant rate of profits, from the employment of the same amount of capital: such amount of capital, I mean, as had been actually sunk in cultivation at the time when the rate of profits had experienced increase. We have seen that cultivation could only be extended, as population increased, and offered an effectual demand for increased quantities of food;—that it could never be the interest of the cultivator to bring so much food to market as served only to sink its price, while the demand experienced no increase, calculated to counteract, on the aggregate of sales, the loss incident on each particular sale; in short, that the introduction of improvements in agriculture does not lower the price of food; because such an event would impoverish cultivators. If then, after the introduction of an improved process, the rate of agricultural profits be raised, as we have supposed in a previous section, it is evident, that if the capitalist, there adverted to, were proprietor of the soil, he might always realize, on a capital of 114 measures, a gross return of 220 measures; or a rate of profit of about 88 per cent.; and this is an advantage enjoyed by him, not because he is capitalist only, but because he is a proprietor of the soil also.

Now if, at this time, the average rate of profits, obtained in other branches of business than agriculture, was somewhere about 25 per cent. and if there was difficulty experienced in obtaining productive employment for all the capital that might be accumulating, it is not improbable that mere capitalists would willingly offer to advance their accumulations, to be allowed to cultivate this tract; consenting to pay to the land-owner, the difference between the 25 and 88 per cent. realized; and in this event, provided it were sufficient in amount for his support, the landlord would enjoy the difference at his ease, under the denomination of the rent of his land.

But it is also probable, that as population increased, and offered an effectual demand for more food, it might be to the advantage of the capitalist to sink a greater capital than 114 measures in actual production: his object will now be, first to realize a gross produce equal to the payment of his labour and seed, or 114 measures; and secondly, to realize sufficient for the payment of his rent, or 78 measures;

and lastly, to increase his own net profits from 28 measures to some larger quantity. If he sunk 200 measures in actual production, and the result obtained were in the gross, 320 measures; then he would have succeeded in effecting what he proposed, viz. his own enrichment: for there will be, for the repayment of capital, 200 measures; of rent 78; and for profit 42 measures; total 320. The rate of net produce obtained, for the use of both landlord and capitalist, will have fallen from 88 to 60 per cent.; and the rate of net profit actually falling to the capitalist's share, will have fallen from 25 to 21 per cent. Should he again find that a sale could readily be effected, if more food were brought to market; and, with this view, sunk 50 additional measures of corn productively, or 250 measures in all; and if he realized a gross produce of 373 measures, he will still have effected what he aimed at: for his productive capital, there will be 250 measures; for his rent, 78; and for net profits, 45 measures; total 373. His rate of net profits will now have sunk from 21 to between 18 and 19 per cent., and the proportion of net produce, going to the formation of rents and profits conjointly, will have sunk from 60 to between 49 and 50 per cent.

Now suppose any additional outlay yielded no increase of return for the exclusive use of the capitalist, which more than counterbalanced the trouble of superintendence; then the net increase, going to the use of the farmer and owner of this land, would permanently be about 60 per cent. on the capital sunk. If, however, the average of profits were lower than 18 or 19 per cent. in other branches of business, although no greater capital could with advantage be sunk upon this land, still offers might be made to the landlord, of a higher rent, by those who were anxious to invest their new accumulations in production. If the average rate of profits were 10 per cent. the landlord would eventually be able to demand from his tenant a rent of 98, in place of 78 measures; and failing to obtain it, he would transfer the farm to another. Now it must not be supposed, that in contemplating this fall in the rate of the farmer's peculiar profits, and this reduction of his aggregate gains, I am at all impugning the principle, formerly laid down, that the rate of net return must, in agriculture, be that which holds, when agriculturalists find any increase of outlay tend to no adequate increase of their aggregate profits; for here it is evident, that although the farmer consents to the lowering of his net receipts; and although, by this fall, his aggregate of gains is reduced, in the present case, from 45 to 25 measures; still the aggregate of produce, actually set free for the enrichment of landlord and farmer, by the expenditure of so much capital as is employed, is not altered in the least; it has only come to pass, that because accumulations of capital were in progress, and because it so happened, that the general rate of profits in manufactures was comparatively low, the owners of capital preferred seeing their funds employed, and bringing them a regular income, to seeing them lying idle, and bringing no income; and that they thought it to their interest to be permitted, by the landlord, to use his land for this purpose, even when they had to pay him more for this privilege, than others had done before. It is by no voluntary act of the farmer that his profits are reduced in their aggregate amount; and although others may supplant him in consequence of their eagerness to obtain productive employment for their accumulations, still it is not the case, that more capital has been thrust into employment than served to increase production in the aggregate; and that, from this cause, the aggregate of profits has been reduced: for when new tenants offer the landlord a greater rent for the use of his possession, they merely bring their capital to fill the place of the former tenant's capital; and the extent of production is unchanged.

If all lands were of the same degree of fertility, and equally well situated with respect to markets, and if the same improvement had been introduced in their cultivation, which was adopted in the tract under consideration; it is evident, that the same extension of cultivation and the same evolvement and increase of rent would have generally taken place, provided the amounts realized under that denomination were sufficiently great to form the independent means of support to the proprietors of the land: and that every tract from which, by the introduction of the improved agricultural process, an increased gross reproduction was obtained, would be yielding profits equal to the average profits obtained in manufactures; rents to the landlords, increasing with the increasing desire of capitalists to make their new accumulations productive; and wages, increasing in the aggregate, in proportion to the increasing number of labourers, whom the capitalists, with the concurrence of landlords, had found it to their advantage to bring into employment.

One of the leading principles upon which we have reasoned in this essay is, that wherever a quantity of food sufficient for the support of a man is obtainable, with an exertion of so much labour as man is able to make, there a man will be found in being. Now, in the very outset of the career of enrichment, it may be true, that a man, without the aid of implements, and without sufficient command of capital to enable him to work in agriculture, efficiently, and in due season, might barely raise from the soil, with his utmost exertion, what sufficed for his maintenance. But this is not the case after capital has come into operation, and after fitting and scientific arrangements have been made with regard to the treatment of the soil and seed. The employment of spades, for instance, in due season insured, in the illustrative case already given, to the persons making use of them, if they themselves continued to labour, a much greater quantity of food than sufficed for their actual support. Still, however, the principle is true, that a sufficiency of food will call a being into existence for its consumption. Let us suppose then, that this cultivator found more needy persons than himself in existence, and offered them a sufficiency for their support, on the condition of their devoting their continued labour to his purposes. The food he formerly raised himself, he now raises through their means; and the quantity realized, if all were offered in exchange for labour and its results, would inevitably exchange for a greater quantity of labour than had been necessary for its production.

The advantage here pointed out, would originally be enjoyed by all who had so much capital to sink in cultivation as served for this end, whether land were, or were not, still lying waste for future appropriation; and the results of this advantage we have, in the last section, been treating as the profits of the stock of capital thus invested. But if there were greater difficulties of any kind to be encountered in breaking up and clearing new tracts, than in proceeding in the regular routine of cultivation in old lands, and if, at the same time, there were many capitals under accumulation, there would be an immediate evolvement of rent properly so called; that is, there would be found many persons willing to offer the proprietor of the cultivated tracts a remuneration out of the proceeds thence realized, merely on the condition of his allowing them the use of land.

It is easy to say, unappropriated land existing, no-body would set to work as farmers, under existing proprietors; each would at once run to unoccupied tracts, and become himself not only capitalist, but landlord also. But many more persons must be possessed of capital enough for carrying on the routine of improved cultivation than can be possessed of what would serve for breaking up new lands; and as, therefore, there must be a greater demand for old than for uncleared tracts, the persons already in possession of these cultivated tracts will enjoy advantages superior to those, who propose to appropriate an equal extent of new land; and this difference in their circumstances will immediately be known, by the readiness with which other poorer capitalists would offer rent for permission to make use of the land. Those who are possessed of sufficient capital will of course proceed to the new tracts; and when these are brought on the footing of the old ones, these persons will be in the same circumstances as the owners of the old lands, and will have the option, as these had, of accepting rent, or of continuing in their own persons the double office of landlord and farmer.

But although, for the sake of shewing distinctly the gradual rise and progress of the different incomes of the mere labourer, the capitalist, and the landlord, I have started with the supposition that, in the first instance, the food realized was only a recompense for the labour actually sunk in obtaining it, and although, in the veriest infancy of knowledge, this might have been the case in many parts of the world; still when in the more favored regions, we come to consider the extraordinary fecundity of every species of useful plants and animals; when we contemplate the goodness of God towards us, in placing at our command, as the means of our subsistence, living germs which of themselves work that wonderful yearly increase by which we are enabled to enrich ourselves, it will be natural to suppose that in the better soils and climates the food of man will always, after due knowledge has been acquired, have been obtainable, with much less than man's unremitting exertion; and that the persons possessed of the land must, consequently, always have had a command of greater labour than was sufficient for the mere work of agriculture. We may grant therefore, without doing violence to the principles with which we started, that after the knowledge of applying capital in the most ordinary manner to production, and after the modes of its practical application have become known, it will be found, that the continuous labour necessary for producing food is much less than the food obtained in return will suffice to support. But this food will, notwithstanding, command as much labour as can be supported by it whilst it lasts; because of the inevitable law of population, to which man is subject; and owing to which, there must ever be poor labourers springing into being, ready to offer their continuous and unceasing exertions, for what suffices to yield them continued support; and although the employment on the soil of very small capitals in the most obvious and simple ways, may be in the power of almost every one in a new and under-peopled country, and may suffice for yielding the merest necessaries of life; still this may be far from securing to the indigent, as ample a supply of food, as those already in the possession of clear tracts of land can afford to give: a command of the labour of the indigent, must therefore, I apprehend, be very shortly secured to the proprietors of tracts already in tillage. The power of obtaining more food than supports the labour with which it is obtained, must be an advantage enjoyed only by the owners of cultivated tracts and holders of sufficient capital; and on these accounts, wherever the land is rendered capable of yielding quantities of food, bearing a large proportion to the labour sunk, it will be found, whether rent be paid or not to a distinct class of land-owners, that the elements of this denomination of income do really exist; for the land-owners and capitalists must be in better circumstances than those who are not possessed of the soil, and of accumulations wherewith to bring new tracts into tillage. And in consequence, it eventually comes to be a matter of choice with them, provided their possessions are sufficiently extensive, whether they will themselves keep capital in employment or not; many being necessarily ready to offer them rent for the use of that which is already in a fit state to be the matrix, in which alone that reproduction and increase goes on, which not only yields wherewithal to reproduce the capital, and support the labour bestowed upon it, but a considerable excess besides.

The rent of land then proceeds from these circumstances; that man necessarily springing up wherever a subsistence is obtainable, can be supported by the proceeds of reproduction in larger numbers than are necessary for actual co-operation with the principle of reproduction. Now, had the Almighty acted differently towards his creatures; had he seen fit to ordain, that under the most favourable circumstances, a mere sufficiency for the support of the requisite labour should be given off in agriculture, then it is clear, that rent never could have existed; and that however eagerly men might have desired to be possessed of food, it could never have more than repaid the labour actually necessary in its production.

In this case there could have been no secondary wealth whatever; the labour necessary for producing the food which supported the agriculturists being just supplied from the whole produce, there could have existed, not only no separate class of landlords, but no means even of supporting the labourer while engaged in producing any items of secondary wealth. It is impossible then, that after agriculture is understood at all, there ever should exist a time when the produce of equal labour in agriculture and manufactures would be exchanged on equal terms; the produce of agriculture must have been the result of less labour than it could support, while the produce of manufactures must merely have served to maintain the labour bestowed; and the difference between the two must have formed the elements of rent, as well as the means of furnishing support to the class of manufacturers: without rent then, or rather without the rudiments of rent, there could have been no wealth in existence, except food: and wherever wealth of a secondary nature is found, there the price of food must have been comparatively high as contrasted with wrought wares.

I have deemed it necessary to shew in different points of view, and to dwell thus long upon what appears to me the true nature of the source of rent; for the theories now in vogue trace it to a very different origin. They attribute its existence only to the later periods of production, and to the increasing intensity of desire alone, on the part of a dense and increasing population, for the possession of food; as if its superior value had not always existed: and not adverting to this most important circumstance, that the difference between the proceeds of equal labour in agriculture and in manufactures, which they reckon the high price of food, as contrasted with other products, proceeds from the law of population, which must ever have been in force, coupled with the peculiar productiveness of food, from man's inevitably springing into being wherever nourishment is to be had, although less than man's utmost labour suffices to raise this nourishment; while every other product, which may be offered for this sufficiency of food, must be the result of a man's unremitting labour, for the time the food he obtains in exchange is calculated to yield him support. It is very true, that but for the existence of men in needy circumstances, and not connected with agriculture, such an interchange as this could never be effected; and therefore, the high price of food, estimated in other products, is certainly attributable in part to intensity of demand. But they overlook the most important part of the subject, that but for the peculiar productiveness of that which constitutes food, this difference in the relative prices of food and other products could never have existed, even if the demand for food were more intense than it has ever been known to be in the most populous countries; and having made this one false assumption they proceed, erroneously of course, in all their subsequent reasonings. If demand alone suffice to raise the price of food in one instance, it must effect the same object ever after; and thus they argue, that as population becomes more and more dense, the demand for food becoming more and more intense in consequence, the result must be a continually rising price of food with every increase of population; and with the first rise in the price of food, the rents of the landlords having begun to be formed, they subsequently experience continual increase with every succeeding rise. And hence a landed gentry is placed in the most odious of lights, as fattening on the increasing necessities of the poor.

Now, although I most freely grant, that intensity of demand for food must exist, before it can command either more, or as much, labour as has been sunk in its production; still I insist, that it is owing to this intensity of demand only, when coupled with the peculiar fecundity of food—with its being able, in fact, to support man for a longer time than he must be engaged in aiding in its growth—that rent has existence; and that intensity of demand alone could never create rent: and I further insist, that increases of rent, in place of being obtainable from increases of intensity of demand for food alone, proceed from improvements in man's powers of co-operating with the prolific principle in this business of reproduction, in such manner, as shall, in a still further degree, alter the difference between the labour necessarily expended on food, and the labour the food will support when obtained; coupled of course with that intensity of desire for food which ever must be in existence, so long as man is subject, as we allow him to be, to the influence of the principle of population.

I shall hereafter advert to circumstances under which appearances may seem to warrant the conclusions of these reasoners, that the price of food, and with it rent, grows only with the growth of population; and shall here call the attention to what appears very generally to be overlooked in disquisitions regarding rent; namely, that the constitution of society must be peculiar, and that accumulations of capital, and tracts of some considerable extent, must be in the possession of individuals ere such a subdivision of the general produce can be made, as will call into existence a separate class of landlords. It is laid down in recent works, that rent is that portion of the earth's produce which is paid for the original and indestructible powers of the soil. Now this proposition is ambiguous; for although the same original and indestructible powers to which rent is attributed must ever be in force, still this payment, under that peculiar denomination, cannot be made unless there are in society persons in circumstances to make a sufficient advance of capital, to insure the continuation of such extended cultivation as is competent to yielding rent in a separate form; and unless there be landlords in possession of tracts of land so extensive, that this peculiar share of the net proceeds of cultivation shall suffice for their comfortable maintenance at the very least; whereas the proposition would seem to imply, that original and indestructible powers existing, rent also must always exist: the powers of the land to yield rent being original and indestructible, it follows, that the soil must, as I have already shewn, be always, while under skilful cultivation, yielding what may be called the elements of rent; although it by no means follows that society should be so constituted, or that possessions of such extent should be in the hands of individuals, as shall determine, under a particular denomination, any specific portions of the net produce into the hands of certain individuals living at their ease: and this consideration is important; for although existing theories of rent may seem to account for the appearances exhibited in such a state of society as exists in Europe and America; still they utterly fail to explain even in appearance, the circumstances of the classes, depending for their incomes on the cultivation of the soil, in other parts of the world, where land is held under different tenures from those with which Europeans are familiar.

To the further elucidation of the subject of rent, I will here bring to notice how very much nature and her ways have been overlooked in the theories of later writers; and how sadly her influence, in her procreative and reproductive character, has been misunderstood.

It has latterly been usual to suppose, that in agriculture, even in the most favorable situations, the net produce can continually be reduced, till an increase of only 10 or 20 per cent. or whatever may be the ordinary rate of profits in trade, is obtained through the influence of the reproductive principle; and consequently, it has been inferred that the last doses of capital applied to land, and the last tracts taken under the plough, give nothing in the shape of increase greater than serves to yield a return only equal to that obtained by other employers of productive capital. I have endeavoured throughout to shew, that this is a false assumption, and that the extension of employment to capital on the land, can only continue to be made, so long as increasing volumes of produce are given off in the shape of net gains for the use of those who are interested in fixing production at some particular point. Let us now take the matter a little more in detail, and see how a cultivator could be brought to commit the egregious folly, of which theorists confidently assume that he must be guilty.

M. Humboldt, for instance, bears witness, that the reproductive powers of the Banana are such, that 50 perches of land yield, when planted with these trees, sufficient for the subsistence of fifty individuals; and this in return for the investment of capital amounting almost to an evanescent quantity; for the fruits grow in this abundance almost spontaneously; the sole labour requisite, being that of removing the old trees, after the fruit they have borne is ripe. With such reproductive power at command, can any circumstances be conceived possibly to exist, under which it could be to the advantage of the cultivator to sink so much capital in this employment, that the net proceeds should so sink, as to yield only 10 or 20 per cent. on the capital employed? Suppose, the labour now required in removing the old trees to be equal to what one man can bestow; estimate this capital at £10 and in return for £10 sunk, there is £500 worth of net return; or a clear gain of 2500 per cent. (4900 per cent.)

Again I have reason to believe, that in ordinary rice grounds in Bengal, which yield only one crop a year, the outlay on ten biggahs of 1,600 square yards each, is in round numbers as follows:—

	£	s.	d.
5 maunds of 80 *lbs.* each, for seed, at 2 shillings per maund,	0	10	0
5 ploughs hired for 12 days, at 5 pence per day,	0	19	0
10 days labour of 10 men, at 2 pence per day,	1	0	0
10 days labour of 5 men for cutting the crop,	0	10	0
10 days labour of 5 men for bringing home the crop,	0	10	0
2 days labour of 5 men for thrashing and winnowing,	0	4	2
*Total outlay,	£3	13	2

The ordinary produce of this land is 100 maunds of grain in the husk, or of clean rice, ready for consumption, about 50 maunds; which sells in the market at 2 shillings and 8 pence per maund.

50 Maunds of rice, at 2 shillings and 8 pence per maund,	6	13	4
15 Kohuns of straw, at 4 shillings per kohun,	3	0	0
*Total produce,	£9	13	4

The difference between outlay and net return is, in this case, £6 0*s.* 2*d.*; and the net gain is at the rate of between 150 and 160 per cent.* Now I ask, by what means it could ever become the interest of the cultivator, or of the proprietor of the land, if he were a separate person, that successively increasing doses of capital should be sunk on this land, till the net proceeds fell to 20 per cent.? We may rest assured, for the country is most densely peopled, that every effort, in the small way, has been made to render the spot as productive as possible; that a greater outlay could not, with advantage, take place in seed; or in ploughing, in weeding, or in cutting; for many successive years have proved the present outlay to leave at the end of the season, the greatest net gain. Capital might possibly, with advantage, be invested on the land, in the introduction of new manures and dressings; and a second crop might perhaps be advantageously obtained from the same land by judicious arrangements for irrigation during the dry season; and that in this way, an increasing aggregate of gain might be realized, which should bear a falling proportion to the whole capital sunk, is very probable: but that it should ever be to the advantage of any parties to thrust capital on the land till the net produce fell to the ordinary rate of profit in trade, I cannot be persuaded.

If now we turn from the study of bananas and rice in tropical climates, to soils and skies, where all is comparative sterility, to the wheat lands of England for instance, we shall still meet with results nearly similar: the average outlay upon 100 acres of wheat land may, I believe, be taken at about £350; which includes team, and wear and tear, manure, taxes, and so forth; and the average return may be taken at 250 quarters of grain, with about 200 loads of straw. If the price of wheat be £3 per quarter, we have £750 for the grain alone; from which if £350 be deducted, there remains a clear surplus of £400, every year, or a net increase at about 115 per cent., without the value of the straw. Under what circumstances could it become the farmers, or the landlord's interest, to increase the seed, the team, the number of labourers, &c. while the same system of cultivation prevailed, till return bore the proportion of 10 or 20 per cent. to outlay?

But all the instances I have given are, it may be said, those in which the reproductive powers of nature are exhibited under peculiar advantages. Be it so; let us turn to the bleak hill sides, or to the moors of Scotland, where 1,000 acres of land may yield only sufficient nourishment for a flock of 100 sheep; and we shall still find that the sheep farmer and landlord can never be interested in permitting the extension of capital on their land, till net return sinks to such rate as is calculated on by political economists.

In good pasture lands, I learn, that a flock of 200 ewes, on 100 acres of land, may be calculated to produce every year 220 lambs, each of which at 3 years old is of equal value with the parent ewe, besides having yielded every year a fleece. Let us therefore suppose the case of worse lands, where two thousand acres yield only as much the 100 good acres, where the sheep have far to travel for what they eat, and where they are exposed to many accidents, and that every second ewe bears a lamb, which is in three years a prime sheep; then after the lapse of the first 3 years, there is realized a periodical increase of about 50 per cent. in stock alone, besides the value of the wool. The capital sunk in sheep must always yield the same rate of increase and profit on the same extent of land, so long as the extent of the stock is properly adapted to the powers of the lands on which it is

* There seems some error in the calculation of the preceding statements, but as the gross amount will not be materially affected, we leave them as they stand in the MSS. ED.

grazed ; and it never can be to the interest of any party so to increase the stock that the sheep should become diseased from want of sufficient nourishment: the greatest capital, therefore, which can be sunk in sheep, must be that which gives off yearly the greatest aggregate of net increase in stock, and this, from the procreative power of the animals, must ever be greatly beyond that rate of net return which may be reckoned, for the time, the average rate of profits of the day. Practically then, I consider it quite impossible, that any applications of capital should be made in direct connexion with agriculture and the production of food, which besides profits, generally known as such, does not yield the elements of rent also ; and this is so simply, because God has in his bounty so constituted vegetable productions, that they shall yearly yield a four-fold, a five-fold, and in some cases a fifty, or a hundred-fold, nay, sometimes 1000-fold increase ; and because among the animals, which God has also placed under man's command, he has ordained, that year by year there shall, in most cases be at least, a two-fold increase of numbers: and finally, because it must inevitably be always to the advantage of man to strive, at so accommodating seed and labour to the soil at his disposal, and live-stock to the tracts where they may find their nourishment, that the greatest possible net production shall be periodically set free for his use; whereas, the greatest net reproduction does not in fact coincide with a net return of 10 or 20 per cent. which is reckoned a fair return in trade.

Now, I infer from all the above considerations, that wherever man directly puts himself in skilful co-operation with the reproductive and procreative principle, the elements of rent are, year by year, in every stage of production: and whatsoever constitution of society may hold ; whether a part of the net produce be set aside under that denomination; or whether it entirely goes to the use of the labourers who actually work on the soil ; to the remuneration of the labour, the reproduction of the capital, and the formation of the income of the employer of the capital, which many previously have been sunk to render particular tracts applicable to certain descriptions of cultivation, for which in their natural state they were not adapted; or whether, under a different system of ownership, it may go to the mere support of the two first classes, and leave an excess in the hands of the persons who own the ground. If, for instance, an infant society was to spread itself over a country, in the manner I have supposed in the first sections, each family increasing, and again breaking into new families ; each taking possession of so much vacant land as merely sufficed to yield food alone for their numbers; it is evident, from what has above been shewn, that although the return each obtained for the capital of seed and implements employed, must be at the rate of some hundreds per cent. (a rate fully capable, in a society differently constituted, of yielding besides wages, a profit to capitalists, and a rent to landlords,) still it is equally evident, that nothing but a sufficiency for the maintenance of the different families could be obtained from the small tracts which each had in occupation; and that nothing but a mere maintenance would ever be evolved for their consumption, even after the whole country had become densely populous, and after some considerable advance had been made in the knowledge of the productive arts; and the reasons for the country continuing in this state, of yielding mere wages for all its inhabitants, are these : namely, that the simple habits and ignorance of the people, keep them contented with food alone—that succeeding in obtaining this with perhaps part only of the labour of the family, as they must do when such a ratio of increase is given off, generation after generation sought nothing more; and in consequence, accumulated no capital for indirect application to agriculture, or to manufactures. Under these circumstances, no estates could exist of a size more than sufficient to feed the men who lived and laboured on them; and no investments could be found for capital, of a greater value than the occupant could obtain, by a mortgage probably of a part of the ensuing crop. If, in such a state of society, a government were to step in, and to seize, before it reached its destination, a tenth, or a fifth, or a half of the produce; it is manifest, that this might be effected, the population falling, or keeping back in a corresponding degree: but it is also equally manifest, that the produce thus appropriated, could never be legitimately entitled to the name of rent; and that the men in power who exercised this authority, however they might be the lords of the soil, and of the luckless inhabitants, could never stand towards them in the true relation of landlords. If all these labourers worked a little, and were idle during the rest of the year, they then would in reality enjoy the basis of landlord's share: if one half laboured continually, and the other remained idle, the idle part would live upon the real, though possibly not the nominal rent. I shall again advert to this part of the subject, when we come to the consideration of such taxes, as form a proportion of the gross produce of the soil. meantime I would point out again, what I endeavoured, some pages back, to fix on the attention, that rent does not inevitably proceed from the causes generally assigned to its formation, in recent works on political economy; namely, the limitation of the extent of the land, and the existence of varieties in the soil; together with such intensity of demand for food as exists only in old and fully peopled countries: but that other causes must be in operation, ere rent can be known as a distinct income, for a distinct class; as, for instance, the prevalence of larger possessions, both in land and in capital, than suffice for the mere feeding of the labourers; and the disposition, on the part of the inhabitants, to invest masses of capital in cultivation, in conjunction with the peculiar fecundity of plants and animals, to which all increase after its kind owes its origin. For example, it is obvious, that whether a country were uniformly fertile, or partly fertile and partly sterile, it might still be covered with a population, amongst whom no rent, or profits, were known by distinct denominations; and it is clear, that this population must be in proportion to the fertility of the various tracts; and it is also clear, that whether the districts were fertile or the reverse, the whole population would, whenever population was full, be found living from hand to mouth; although they had amongst them the elements both of profits and of rents. If, in one district, on one acre, a produce of 10 measures be obtained from an expenditure in seed of one measure, and if the balance merely suffice for the support of one man; while, in another less fertile district, an acre, from an equal expenditure, yield only two measures of produce, an extent of surface, equal to nine acres in place of one, will be required for the support of each individual; and both men will be in the same circumstances, both will have what supports him and no more; and in neither case will there exist a landlord and capitalist, known distinctly as such; and the labour either bestows must be the utmost which it is useful to apply. Now here are all the conditions fulfilled, limitation in extent, variety of soils, and a dense population, which are generally stated as being all-sufficient in the evolvement of rent; and nothing but a class of labourers in being. Limitation in the extent of disposable land, and the existence of varieties of soil, together with dense population, by no means therefore insure the existence of landlords; and it appears to me a matter of great importance to know the reasons why rent may not be in existence, with a dense population, offering a full demand for all the food that can be produced, and while infinite varieties exist in the qualities of the soil; and to be assured that its existence depends not on these circumstances alone, but on the state of society, coupled with the power possessed by all primary wealth, of being obtained with less labour than it can support; for without this knowledge, the circumstances of the whole of Agricultural Asia, and of many other parts of the world, would be quite incomprehensible.

I have said, that the elements of rent will always be given off, wherever agriculture, as a science, is known; whether the excess reproduced beyond what sufficed for supporting the producing labour, and for yielding the rate of profits of the day, be swallowed up by a dense population, exclusively employed on minute portions of land for a part of their time; or whether it be set aside yearly, to replace a capital which may have been invested in fitting a soil for certain descriptions of cultivation, for which by nature it was not calculated: and in this latter way I admit, that in an improved country, where manufactures flourish, the last capital sunk in raising food for the use of the manufacturing population, may yield merely a sufficiency for replacing the capital stock employed and the profits on that stock. But although this may be occasionally the case, it will still be found to be true, that to the capital, in immediate co-operation with the reproductive principle, a much greater rate of profits than 10 or 20 per cent. is given off; although this greater rate may just suffice to bring, in the whole course of a lease, the average rate of profits of the day to the greater capital which may indirectly have been sunk in manuring, in paring and burning, and in otherwise altering the nature of a soil; and after the produce, in the course of a term of years, has sufficed to repay the capital originally advanced with its ordinary profits during the interval, I conceive it to be probable that in most cases, the greater net reproduction than serves to form the profits of the day, subsequently following the ordinary expenditure of seed and labour only, will ultimately find its way into the landlord's hands, as rent. Why, I would ask, but with this view, should landlords ever permit the occupation of their lands? persons must offer them a return for the favor bestowed, or the use of the land can never be obtained. Periodical reproduction and increase go on in many more ways than one; and if the expense of keeping land always fit for the growth of wheat, be such as to swallow up all the increase yearly given off beyond the usual profits of trade, it will be manifestly to the landlord's interest to change its destination, and give it to some one who will grow oats, or graze sheep, or even let rabbits breed on it. For under some one of these systems of management, however bad the land, a much greater annual reproduction must be evolved, than suffices for the repayment of the stock so invested, and the ordinary profits on that stock also, and therefore for the formation and payment of rent; and by whatever system the landlord is individually most enriched, that will ultimately be found to be the one pursued in all countries, where extensive tracts of land have become private property. Hence it may be inferred, that whatever the extent of capital may be indirectly employed in agriculture, all lands in old countries, when society is properly constituted, will be found yielding rent.

It has been usual, in the later works on wealth, to treat all labour, and employment of capital, as if really enjoying the reproductive and incremental power—as if in fact they were themselves original sources of profit and wages; and it has become the custom to consider all the powers of nature which tend, in any way, to assist man in his endeavours at effecting the modification of products, as possessing the power of enriching mankind more efficiently than the soil, than the very matrix in which alone reproduction and increase can be effected: and this because the soil alone is limited in its extent; while the aid obtainable from water, from sun-shine, from wind, and from steam, are ever to be had by all who will essay to make use of them: and it has consequently become the common opinion that, in agriculture, nature does no more, nay even less, towards enrichment, than the effects in every other branch of production. But even on these grounds, the attempt to impugn the superior productiveness of agriculture over all other employment of capital is futile; for air and water, wind and sun, are labouring as unremittingly in agriculture, as they can be in dying, in bleaching, or in any other processes wherein the action of the elements is made use of; labouring too in the process in co-operation with a power which is completely lost sight of, that of reproduction and increase, while in all other processes which can be imagined, the elements are labouring solely in the work of modification. Were there no increase effected of similar products to those consumed during production, could we have any increase of products after their kind? and without this how could we count on next year's income, being like in nature to that of the last? How then can it be for a moment supposed, that the power of modification, the power of obtaining one set of products differing in their nature, by the destruction of another set, can be a source of wealth, and periodical increase, except in subordination to that reproductive and incremental influence, by which alone, year by year, a like income is evolved, sufficient for the support of all classes?

As then it appears, that the rate of net proceeds realized, beyond what is expended in production in agriculture, must always be beyond, and in most cases greatly beyond what we are in the habit of considering the average rate of profit of the day; and that the difference between the two goes, where society is properly constituted, to the use of the landlord, under the denomination of rent; and as it also appears, that wherever the reproductive principle has had direct influence on the creation of income, the rate of net return must have been high; it follows that rent, in such a state of society, must always be obtained for the use which is made of the land; it is at the same time true, that, in the earlier stages of society, as there would be but few accumulations of capital, and but few manufacturing establishments, there could hardly be possessed a criterion by which to form a judgment of the difference between the return actually realized by a certain expenditure on the land, and the return actually realized from a similar expenditure in other branches of production; and, as, at the same time, it is probable, that those who then actually tilled the ground, with a view to raising thereby a subsistence, were in possession of what merely served to keep them in being, the existence of rent, as a separate income for the support of a separate class of proprietors, could not be known: still, however, it is clear, that its elements were there, ready to show themselves whenever the land should be so apportioned to individuals, as to form considerable estates: and as soon as the increase of wrought products, and of luxury, put it in the power of the proprietors of these estates, to lavish the produce of hundreds and thousands of acres, on their own personal gratification. When also a manufacturing class has sprung into existence, living on such of the produce of agriculture as is beyond the consumption of those necessarily engaged in its production; and when the accumulation and appropriation of capital in every branch of business has enabled mankind to ascertain what the average rate of gains in these various occupations may be, then the separation of rent from the profits of business proceeds; and then it comes to pass, that the farmer's gains on his yearly expenditure, are forced to accommodate themselves to the rate obtained by all other producers, and that the rents of the landlord are raised with every fall in these rates of profits. Then also it is, that the value of real estate comes to be estimated, by a comparison of what so much capital, as must be paid in their purchase, might realize in trade, or manufactures; and the net surplus obtainable, beyond all cost of production and the profits of the day, is looked on as the interest, or profit of the sum thus sunk in the purchase of tracts of land. It is not probable, that such an investment of capital will be called an actual investing of capital in production, for it cannot but be known, that the real investment of capital in production is not the fee simple of a landed estate; but that the yearly outlay of the farmer is the really productive capital, upon which he obtains, whatever may be the extent of the excess reproduced, only the average profits of the day as an income. Indeed, if many accumulations should happen to be seeking investment, offers, as we have already remarked, may be made to landlords, for the use of their land, which leave an income to the farmer even below the rate of profits in trade; the profits in trade cannot, we have seen, be forced permanently below a certain rate, and a certain aggregate amount; if, for instance, society offers a demand only for 10000 hats, while the price of hats is 10 shillings each, and if the prime cost of the hat should be 9000 shillings, then the profits of hatters will be 1000 shillings, or 10 per cent. and they cannot be brought permanently lower, if the sale of 15000 could only be effected at 5 shillings each, and if the sale of only 8000 could be effected at 11 shillings each; in this case only 9000 shillings could be permanently invested in hat-making. But although profits might be at 10 per cent. in manufactures, they might be at 6 or 4 per cent. in farming, and with their fall in the rate, their aggregate might also be suffering reduction; for the sinking of these to so low a point would be brought about by no new investment of additional capital, which would tend to reduce the aggregate of net produce actually realized from the land; but by the intensity of desire, in persons possessed of accumulations of capital, to be working as farmers on certain lands. The idea which prevail in all recent works on political economy, as a reason why a farmer's profits should not fall below those of other producers, is, that the farmer can withdraw his capital from this mode of production, and vest it in other branches of business where profits are higher, and hence that an average state of profit must prevail in all occupations: the whole tenor of my arguments goes to shew this assumption to be unwarranted; and that this power of shifting from trade to trade at will, upon which men so continually reason in abstract speculations, can only be enjoyed during the time that production is eagerly seeking new investments of capital, and cannot exist where approximations have been made to the full extension of production. My reasonings have, I hope, tended to prove, that an approximation must be continually made to this state of full production, which precludes the possibility of shifting from trade to trade at will; because it has been shewn, that at all times, all classes are greatly interested in the fullest employment being given to capital. Farmers' profits may therefore be greatly under the average profits of trade, and this not because of their having sunk so much capital in their business as tends to the diminution of net reproduction; but because of the competition which must exist for the use of land, in a country where rural pursuits hold out many peculiar charms, such as those who are busied in towns, in trade and manufactures, can never know or enjoy.

IV.—*Barometrical Altitudes. By* H. S. B.

An esteemed correspondent, who has lately made an interesting tour in the North Western hills, in which he has visited Jamnotrí, and the source of the Pábar river, passing thence over the Boranda pass into the valley of the Satlej, has sent us the following table of Barometrical observations, with the resulting heights thence calculated. The observations were compared with those published in the GLEANINGS, as taken at the Surveyor General's office. The Barometer of our correspondent must however, we apprehend, have been subject to a constant error, judging at least by the calculated height given to Barelly, 1090 feet, whereas we cannot believe it to be more than 800 feet. H. S. B. will, we hope, give us some account of the instrument and its means of adjustment, particularly of the zero point.

1830.	*Hour.*	*Bar. at* 32°	*Temp.*	*Locality.*
May.				
27th	8½ P. M.	26.757	81	Banks of the Aglagád'h Nála.
28th	2 P. M.	24.504	88	Dárgadh Village.
"	6 P. M.	22.930	76	Top of Bhagdar Hill.
29th	6 P. M.	25.182	74	Korí Village.
30th	9½ A. M.	22.757	71	Top of Jount Hill.
31st	6 P. M.	24.322	79	Jaudnú Village.
June.				
1st	9 A. M.	24.953	72½	Dhabrí Village.
2nd	10 A. M.	22.850	66	Temple at crest of range between Dhabrí and Matíarí.
3d	6 A. M.	23.741	55	Matíarí Village.
4th	9 A. M.	25.592	70	Banks of Jumna under Barkot, temp. of Jumna water 55°.
5th	9 A. M.	24.560	70	Kutnú, about 300 feet above Jumna.
6th	Noon.	24.136	82	Kunsalú. Temp. of Jumna 54°.
7th	10 A. M.	22.892	67	Banás. Temp. of Jumna 52°. Temp. of hot spring near Banás 159°, of stream on the edge of which the spring rises 49°. There is a highly beautiful cataract here.
8th	7 A. M.	21.936	55	Karsálí.
"	1 P. M.	20.552	62	Jamnotrí hot spring. Temp. of Jumna water 42°, of hot spring 160°.
9th	6 P. M.	19.888	45	Tents, S. E. of Karsálí.
10th	Noon.	18.648	54	Summit of Hill S. E. of Karsálí, on the road to the Sunapra pass.
11th	3 P. M.	23.170	67	Rana.
21st to 25th May 1830.		23.328	66.5	Mean of 8 observations at the "Oaks" at Masúrí.
Do. Do.		29.518	89.26	Ditto, at corresponding times in Calcutta. Altitude deduced, about 6796 feet above Calcutta.
Sept.				
14th	9 A. M.	23.276	64	The "Park" near Masúrí.
15th	6 A. M.	26.077	72	Kusainí.
"	3 P. M.	25.545	81	Lokwarí.
16th	Noon.	24.215	80	Nágthát.

21st	Noon.	21.816	60	Deoban Hill, about 1000 feet below the top.
25th	9 A. M.	24.860	73	Bijowlí.
27th	——	——	—	Temperature of Tonse river at the Jhúla—58°.
28th	6 A. M.	26.068	56°	Banks of the Pábar under Jitar. Temp. of river 58°.
30th	6 A. M.	25.446	54	Do. do. under Nourí. Temp. of river 56°.
Oct.				
1st	6 A. M.	25.242	55	Raeñ Hát.
2nd	6 A. M.	24.905	52	Rurú.
3rd	6 A. M.	24.237	52	Chírgañ.
4th	6 A. M.	22.163	50	Sustwár.
5th	6 A. M.	21.584	45	Jangleg.
6th	8 A. M.	19.693	20	Lítí.
,,	1.45 P. M.	17.349	43	Crest of Buran, or Barendo Pass; no snow on the crest or south face, but large quantities on the north side.
8th	8 A. M.	20.365	33	Tents North of Pass.
9th	Sun rise.	23.040	51	Buran.
10th	7 A. M.	23.968	50	Kilweh.
11th	6 A. M.	23.560	45	Under Yana.
12th	7 A. M.	23.512	49	Paniú.
14th	6½ A. M.	23.310	43	Therandeh.
15th	7 A. M.	23.254	45	Seran.
16th	7 A. M.	24.106	52	Gorakot.
18th	6 A. M.	26.785	67	Rámpúr.
19th	7 A. M.	23.064	53	Nowra.
20th	7 A. M.	23.500	52	Samarkot.
28th	7 A. M.	22.882	41	Koelo.
30th	7 A. M.	23.270	51	Mona.

At Barelly.

Dec. 1830.	Bar. 32°.	T. A.	Dep.
11th ☉ Set.	28.890	63	9.5
10 P. M.	891	57	6.5
12th ☉ Rise.	971	49	5.5
9 A. M.	29.043	54	5.5
2.20 P. M.	28.948	65	8
☉ Set.	838	62½	11
9 P. M.	912	57	7.5
13th ☉ Rise.	944	49	5
10 A. M.	980	57	5.5
Noon.	903	63	6
☉ Set.	842	62	7.5
15th 1 A. M.	900	55	5
9½ A. M.	949	56	4

Dec. 15th, 1830.	Bar. 32°.	T. A.	Dep.
Noon.	28.893	63	6
☉ Set.	806	62	8.5
9 P. M.	852	57	4.5
16th ☉ Rise.	905	49	5
☉ Set.	768	63	5
8 P. M.	814	59	7
17th 9 A. M.	29.003	55	4.5
11 P. M.	28.919	56	5.5
18th ☉ Rise.	967	50	6
19th 9 A. M.	29.002	54	5
3 P. M.	28.809	71	8
20th 9 A. M.	.951	56	6

The thermometer was kept in an open northern verandah, the barometer inside the house.

At Masúrí. Lat. 30° 26′ 35″ N.

1830. Nov.	Bar. 32°.	T. A.	1830. Nov.	Bar. 32°.	T. A.	Dep.
3rd 9. A. M.	23.382	62	9th 9-20 A. M.	567	57	
,, 4-20 P. M.	383	61	4-20 P. M.	544	59	
4th ⊙ Rise.	402	51	10 P. M.	550	43	
5th 9 A. M.	401	55	10th 10 A. M.	558	59	3
Noon.	407	59	Noon.	558	59	3
3 P. M.	417	61	3 P. M.	558	60	4
⊙ Set.	417	60	⊙ Set.	551	59	4
6th 9 A. M.	441	59	10 P. M.	541	43	0
4 P. M.	446	60	11th ⊙ Rise.	499	43	0.5
7th ⊙ Rise.	454	39	9 A. M.	499	54	2.5
3-20 P. M.	491	59	Noon.	484	55	5
⊙ Set.	512	48	1.45 P. M.	465	55	4
8th ⊙ Rise.	490	40	2 P. M.	446	54	3
9 A. M.	485	57	2½ P. M.	446	54	4
3 P. M.	476	60	3½ P. M.	416	53	3

Thermometer and barometer close to an open window.

	Bar.	T. air.	Alt. deduced.
Mean of six observations at Barelly,	28.9156	59.91	1007 feet.
Ditto Ditto at Calcutta,	30.054	73.28	
Mean of another set of 6 ditto. Barelly	28.8873	54.66	1090 feet.
Do. Do. Calcutta	30.033	70.366	

Altitude 1090 feet.

The following are the approximate Altitudes of the foregoing places.

	feet.		feet.
Top of Bhagdár Hill.	7226	Chírgaoň.	5713
,, of Jount Hill.	7586	Sustwar.	8260
Jaudnú.	5697	Jangl´eg.	8918
Dhabrí.	4992	Lítí.	11232
Temple on range.	7453	Crest of Buran Pass.	15036
Matiárí.	6366	Tents N. of ditto.	10538
Tents under Barkot.	4256	Buran.	7206
Kutnúr.	5355	Kilweh.	6123
Kunsalú.	605	Tents under Yana.	6623
Banás.	7501	Paniú.	6731
Karsálí.	8511	Therandeh.	6971
Jamnotrí.	10503	Seran.	7003
Tents S.E. of Karsálí.	11842	Gorakot.	6023
Top of Hill, S.E. of do.	13256	Rampúr.	3064
Rana.	6994	Nowra.	7243
Tents at Deoban.	8900	Samakot.	6683
Rae Haňt.	4539	Koelo.	7361
Rurú.	4935	Mona.	6895

V.—*Contributions in Natural History.* By B. A. Hodgson, Esq.

1. *The Musk Deer.*

As I believe nothing whatever is known of the Musk Deer's period of gestation, or of the appearance of the young at birth, I note down some particulars upon these points, which I recently had the good luck to possess myself of.

General Bhim Sén, prime Minister of the Raja of Népál, keeps a number of wild animals and birds, at large, within the lofty enclosure of a walled garden. Amongst the former are several Musk Deer, males and females.

In January last, a male and female, the former of which had been taken about a year, and the latter, more than four years, previously, had sexual commerce together; which resulted in the birth of a single little one, of the male sex, in June. The intercourse of the sexes was frequent[1], and conducted without any shyness, in the presence of the keepers. The female's period of gestation was about 170 days.

The young when born was marked with oblong spots, of a rusty colour, disposed, linearly and lengthwise, down either side of the body, pretty much as we see in the young of the wild hog and of several species of deer, which are altogether immaculate when grown up. The little Musk had, also, several rounder spots, scattered without arrangement, upon the hams. The legs, shoulders, neck, and head, were unspotted; and in this respect, as in most others, the aspect of the young was similar to that of the parents. At two months and a half old the spots began to grow indistinct, and, no great while afterwards disappeared by confusion with that sprinkling of rusty hue, which is profusely interspersed with the dusky brown ground colour of the animal, when mature; and which admixture began generally to display itself in the young one about the age mentioned above. Soon after the subject of this paper was begotten, the father made his escape by leaping a wall fully seven feet high. He was pursued and recovered; but broke his heart in the chase. The mother is still in confinement, and in high health apparently, notwithstanding the very unusual heat of this climate and season to an animal whose natural habitat is among the glaciers of the Himalaya. She has, however, (as have her companions,) the advantage of never being pent up in a cage; and in the garden where she resides she can easily choose a moist cool lair, under very umbrageous trees. Here she reposes all day, with her cub beside her. She still suckles it, though it has cut its teeth, and already crops the herbage occasionally. There is yet no sign of the tusks in the young one, male though he be.

No peculiar caution is observed in respect to the diet of the Musks. They get daily a small portion of grain, and this, with garden greens, and what the animals pick up for themselves, constitutes their food. The young Musk is now approaching the completion of his third month, and answers to the following description in form and colours. Like those of the mature animal, his quiescent attitudes indicate the most extraordinary elasticity of frame. He stands upon his toes rather than upon his entire hoofs, with all the four feet placed in close opposition: the fore legs being, at the same time, nearly straight, but the hind ones extremely bent. Notwithstanding, however, this stoop in the hind quarters, the croupe is still greatly higher than the withers, and

[1] Coëunt more ordinario.

Cervus Jarâï

J.B. Tassin Lith.

Young of the Tibetan Musk.

from the former to the latter the back makes a slightly curved large fall. The junction of the shoulders and neck is very low, with the neck bowed considerably, but the head carried rather high, and the ears erect. The buttocks are large and full; and appear more so than they really are, from the outward set of the thick erect coat in that part, whereby the tiny tail is completely concealed. The young animal's coat is nearly as long, and quite as full, as the mother's, but it has no woolly fleece beneath it: the hair is one and half inch long, closely and erectly set on, wavy, straight, thick, but weak, having a quill-like appearance and feel, but no stiffness. Dissection and the microscope show no peculiarity in the structure of the hair.

The body and neck are short and compact; and *seemingly* (from the nature of the coat) heavy, but not so in reality.

The coarseness of the hair makes the limbs, too, appear coarse, though really fine as well as long, especially the hind ones, which have even an extreme elongation. The head is small, and rounded; its vertical dimensions very inconsiderable; the tapering, moderate; the muzzle, finely formed; the eye, large, and of matchless soft lustre; the ear, long, narrow, rounded at top, and, in a word, hare-like; the whole expression of the head, gentle and engaging as possible. The hoofs are narrow and sharp: the false hoofs, long and extremely acute: the muzzle, very moist: no suborbital fissures: pupils of the eyes, transverse and broad-linear.

The colour is dark earthy brown, unmixed upon the head, neck, shoulders, and limbs; mixed with rusty upon the rest of the body above: insides of limbs, paler, or, gray brown: belly, dark, as above: pectoral surface of neck, with a dark centre and pale gray sides, the colours being disposed lengthwise in all their extent from the head to the chest: inferior surface of the head, dirty white: inside of the ears, and a patch proceeding from their base over the front, and ending in a narrow eye-brow, the same: on the lateral surface of the neck, near to the junction of the head and neck, two or three large white spots: ears, tipped with black: hoofs, dusky: muzzle, jet black; irides, very dark brown. In conclusion, I may observe, that this description of the proportions and form, and colours of the young musk, will serve almost equally well for the mature animal, from which the young is only distinguished by the peculiar spots described in the beginning of this paper; and which, as already observed, are now nearly obliterated in the young.

The accompanying sketches, [Plate XXI.] exhibiting the young in a variety of attitudes, are done from the life, and are very accurate*.

2.—*Cervus Jarâi.* (Mihi.)

The *Jarâi* Deer. Habitat, the sub-Himâlayan ranges, and Saul forest.

Specific character.—Large, wiry-haired, dusky and tan, Deer, with trifurcate, massive, granulated, round, recurved, and divergent horns.

This large species stands 4 feet 4 inches high at the shoulder, and measures from the setting on of the horns to the root of the tail, nearly 6 feet.

In his general form and carriage he bears considerable resemblance to the stag; but, his hind legs being rather longer in proportion to his fore, and his hocks shorter than in that species, his attitude at rest is less elegant, with the back too much inclined to arch, and the shoulders too low. Nor has he the majestic horns of the stag.

In his ordinary quiescent attitude, his neck is retracted as far as may be, to relieve the weight of the massive horns: it has then a considerable drop from the top

* We have been forced to omit the third figure of the young musk in a sitting posture, for want of space.—Ed.

of the shoulders, and the outward bow is large. The back, too, in this attitude, is considerably arched, and the withers very decidedly lower than the croupe. But, such is the elasticity of entire frame possessed by this large and weighty animal, that he has only to change his position in order to raise the fore-quarters to a level with the hind, to straighten the back and even to give it a concave bend.

At rest the neck appears to be short; but it is, in fact, long and slender—so long that, high as the Jarâï stands, he can graze without the least bending of the forelegs. The body is full, but not clumsily heavy; and there is considerable lateral compression of the barrel. The legs are long and slender, though not elegantly so, owing to the coarseness of the hide and hair. The hoofs are longish and narrow: the neck thin and long: the head small, light, and elegant; of small vertical dimensions, but still having a considerable tapering to the well formed muzzle. The eye has only a moderate lustre and size, the muzzle is very moist, and the suborbital sinuses, S-shaped, as usual with this genus, of medial size, and clearly, but not strikingly, defined. The tail is moderate and void of character; the hair wiry, spare, applied to the skin, straight, and having no peculiar elongation on any part of the body: the horns, very massive at the base, and gradually tapered to their sharp points; the surface, very rough and granulated, as in the stag; the recurvation, very slight; the divergency, great. They have but two branches from the main stem; one situated at the base, and the other, about a foot from the tip of either horn; both, thick and conical, and the former in old animals approximating to the size of the stem. The ears are large, wide-opened, and broadly rounded at top, with little hair inside them, and almost none outside. Large as they are, they give no unpleasing expression to the face, but rather the contrary, as the animal quietly waves them to and fro, fanning his head. The Jarâï only wants a finer coat, and somewhat lighter and more gracefully curved horns, to make him be considered beautiful. As it is, one cannot but admire the combination of so much elasticity of frame and so great evidence of speed, with such size and strength as he exhibits.

He inhabits the whole extent of these mountains west and east from the Satléj to the Tista: but only that half of their breadth, between the snows and plains of India, which lies next to the latter. He never moves higher from the plains than the position of the great valley of Népál, and is most common in the tracts adjacent to the lowlands. He is frequently met with in the great Saul forest at the foot of the mountains; but never, I believe, in the open plains. So far as I know, the species is not very gregarious; not so, certainly, in the hills. The Jarâï loves the forests, and will not ever quit them for the open country: but, to judge by his make, and by the comparative numbers found at the foot of the mountains and in their interior, I fancy he is no otherwise partial to mountains such as our's, than as he is compelled to seek the seclusion they afford, or is seduced by the noble garniture of woods in which they are every where arrayed. The general colour of the Jarâï is dusky brown, sprinkled with hoary surface before, and with rusty, behind; except the head, which has the red sprinkling of the fore parts: pectoral surface of the neck, and belly, and outside of limbs, as far down as the hocks and knees, dusky brown, like the superior surface. Buttocks behind, and insides of limbs, as far down as before noted, bright rusty: residue of the limbs to the hoofs, paler, or albescent rusty, with a dusky stripe down the front of each leg: round the eyes, bases of the ears, and under lip and chin, rufescent white: upper lip blackish, and a patch of the same hue on the lower lip below the gape: tail, unmixed dusky brown, blended with the bright rusty of the buttocks only where it connects itself with them: muzzle and hoofs black: irides dusky.

The dimensions and size are as follows :—

	Feet.	In.
Length of animal, from setting on of horns to root of tail,	5	8
Height of animal, at the fore-quarter,	4	2
Ditto ditto, at the hind-quarter,	4	6
Length of head,	1	3
Ditto of tail,	1	0
Ditto ditto, to end of hair,	1	2
Ditto of the ears,	0	8½
Utmost vertical measure of the head,	0	7½
Length of the neck,	2	0
Ditto of the body, from the fore angle of the shoulder to hind angle of the ham,	3	8
Depth of the body, at the chest,	1	7
Height of fore-leg, in a straight line,	2	7
Ditto of hind ditto, ditto ditto,	3	0½
Length of the horns, in a straight line,	2	5
Basal girth of ditto, just above the ring,	0	8¾
Basal interval of ditto,	0	2½
Divergency of tips,	2	1
Weight of horns, 8½ lbs.		

The accompanying sketch Pl. XXI. of the Jarâi is admirably faithful, easy and natural.

P. S.—The materials of the above description are principally derived from a careful inspection of a living Jarâï, which has been for the last 18 months, in the zoological garden (the term is apt and therefore may as well be used) of the Rája of Népál. The individual in question is a male; and was upwards of a year old, when taken. He is very gentle and tractable, except during the rutting season. It is necessary, however, to govern him by means of a noose passed through the cartilege of the nose. A friend has suggested to me, that though this animal has attained his full dimensions of extent, he has not reached the bulk which belongs to maturity; and that, as he is extremely inclined to obesity in the wild state, the species can hardly escape from the charge of awkward grossness and heaviness of make.

The same friend also observes that, like the stag, the Jarâï is much addicted to wallowing in the mire, that his special habitat is the lower hills and *Saul forest*, and that in the old animal, the horns are weightier and larger than my statement makes them. With reference to this last point, I have ransacked my godown for Jarâï's horns: and out of six pair found in it, have selected one of certainly somewhat greater size than that set down in the description.

The following are the size and dimensions of this pair of horns :—

	Feet.	In.
Length, in a straight line,	2	5½
Ditto, along the curve,	2	11
Basal circuit, above the rings,	0	8¾
Weight, including that of an attached fragment of skull, 14lbs.		
Basal interval of horns,	0	3½
Divergency of tips,	2	0

In the horns, now spoken of, the development of the frontal branches is very extraordinarily great, so great that these branches are scarcely at all inferior in thickness, and not remarkably so in length, to the main stems of the horns. They are directed upwards, in 2 fine bows, the convexity of which is lateral; and these branches have consequently, when seen from the front, the lunated form so often observed in the horns of the ox.

These lower branches diverge from the *out*side of the main stems: the upper branches, on the contrary, are put off *in*wardly from the main stems, that is, in this particular pair of horns they are—for, in all the others I possess, both upper and lower branches are put off outwardly from the trunks of the horns.

Note regarding the Bubaline Antelope described in No. 28. The term "*Bubaline*" is pre-occupied, having been applied to the *Hartebeest Antelope* of South Africa: we must therefore provide another name for the *Thâr* of these hills, or rather we will follow the modern usage and make both the vulgar and learned name one, by designating it the *Thàr* Antelope, *Antelope Thàr*.

Valley of Népál, August 20*th*, 1831.

VI.—*Notice regarding the Anatomical Structure of the Tongue of the Lemur Tardigradus, or Sloth of Bengal. By* J. Taylor, *Esq.*

In addition to the singular distribution of the axillary and iliac arteries into parallel branches, discovered by Sir A. Carlisle, in this and other slow-moving animals, the *Lemur tardigradus* presents, on dissection, a remarkable structure connected with its tongue, which, as far as I know, has not yet been described by comparative anatomists.

The tongue of the animal is slender, narrow, and elongated, as in most of the *quadrumana*, and possesses upon its superior surface, at its base, three petiolated or incupped papillæ, (similar to those of the *Simia Maimon* and *Simia Cynocephalus*,) arranged in the form of a triangle, the apex of which is directed towards the pharynx. But what renders it peculiar and worthy of notice, is the existence of a body not unlike the tongue itself in shape, occupying the same situation, and apparently performing the same office, as the *lytta* (commonly called the worm of the tongue) in the dog. This supernumerary lingual organ measures about one inch in length, and half an inch in breadth, and can be protruded from the mouth to a considerable distance, as may be observed while the animal is drinking. It is of a white colour and of a firm and dense texture, being composed of a broad cartilaginous plate, covered with an elastic tendinous membrane; by a duplicature of which it is attached to the under surface of the tongue on one side, and to the *genio-glossi* muscles on the other. Its anterior extremity or apex is free, and is divided into several sharp pointed processes, somewhat resembling the teeth of a comb, while at its sides it presents a fimbriated appearance like that described by Cuvier* in the tongue of the opossum. It differs both in its figure and structure, therefore, from the vermiform fasciculus of tendinous fibres, found in the same situation in the dog, but appears, nevertheless, to execute the same function as it, viz. *to assist the tongue in taking up liquids by lapping*. Casserius, and afterwards, Blumenbach ascribed this use to the *lytta* in the dog—the latter anatomist, from observing a corresponding structure and similar mode of drinking, in the opossum; and as the Lemur takes up liquids in the same manner as these animals do, we may infer that the organ here described is also subservient to that purpose.

Dacca, 12*th October*, 1831.

* Leçons D'Anatomie Comparée, Tome 11. p. 688.

VII.—*Flat-bottomed River Boats.*

In your Analysis of Mr. Prinsep's work on Steam Navigation, in the 29th number of THE GLEANINGS, there is a note, page 157, stating that, "the plan of Captain Forbes' steam tug does not accord with the specification in Appendix A. 3, which refers to a boat with a *double* truss; but the principle is the same in both."

If in the term "*both*" you allude to the plan submitted by me to the Marine Board, (a drawing of which on a reduced scale, is in the next page to that of Captain Forbes';) I must beg leave to submit a few remarks, with a view of shewing there is not such similarity between the two plans as many people suppose, and as your note above alluded to implies, nor do I think it can be fairly said that the same *principle* has been followed, (although that term will probably admit of great latitude;) they are both shallow flat-bottomed boats, but the one is secured by a system of trussing, and tying, connected from one extreme of the vessel to the other, and imbedded, as it were, in the frame work of the vessel; while in the other, the connection of the trussing and tying is broken in the centre, by a simple frame work in the shape of a parallelogram, in which the principle of both truss and tie is lost sight of, with regard to the relative position of the weight it is intended to support; for although the same, or nearly the same arrangement of materials is adopted in a flat-topped roof, where the upper horizontal beam is the truss beam, and the lower the tie, yet the weights to be supported are so very differently situated that a comparison between them will not hold; for viewed as a roof, the whole weight will be found to rest upon the *tie beam!* and it is only through the medium of the queen posts, that it is brought to bear upon the rafters, (the diagonal timbers at each extreme of the frame work, fig. 1,) and again, the *queen posts* are not acted on by any *direct* strain, the principal weight being placed at a distance from either, so as to exert its pressure in a transverse direction on the floors and sleepers, and *through these* to the *queen posts* and *trusses*. Figs. 1 and 2 are the plan and elevation of the boat designed by Captain Forbes; Fig. 3 is an elevation of that designed by me: the latter shews one side of the boat, in which the trusses and ties are imbedded as before mentioned, the trusses running inside the timbers, and the ties made of flat iron, and shewn by the dotted lines, outside, both being firmly bolted together; and the spaces between the timbers, being filled up with diagonal cheeks, following the course of the ties. Fig. 1 shews the framing in the *middle* of the boat, being unconnected with the side. It is laid down as a principle in constructing frame work, intended to resist great pressure, that all "openings between the timbers should be *triangles*, and that all quadrilaterals should be avoided if possible;" a principle I have strictly attended to in the design, which exhibits six rectangled triangles firmly connected. In Captain Forbes' design there are two rectangled triangles, with two quadrilaterals interposed; which interposition certainly appears to me a subversion of the principle of *trussing*. If the floor timbers, and sleepers are of sufficient scantling to support the weight, and resist the stress of the engine, then it follows that this frame work which stands at the height of 13 *feet* from the surface of the water (at 2 feet draught), might well be dispensed with; since (to quote Captain Forbes' words) they are but "so many air or wind opposing parts;" if these be not strong enough, then I should say, that a piece of timber the size of the truss beam from B to D, laid in the *bottom* of the boat and bolted to the sleepers, would be more effective than placed as it now is; for supposing the timber in question to be 10 inches square and the sleeper the same, combined thus, they would be equal to *one* piece of 20 inches deep by 10 broad, and I feel sure it needs no argument to shew which of the two is calculated to bear the greatest strain. It may be said that this beam is supported further by the cross beams, shewn in the sections through C and D, and so it is; but the strain on both is in a transverse direction, and they also, for the reason above stated, would be more effective in the bottom of the boat.

In the old system of roofing, I believe one of the greatest faults was a want of harmony (if I may be allowed the expression), in its several parts, for while some were so placed as to allow of that "settling down," as workmen term it, which takes place more or less in all roofs, others resisted it, and thereby deranged the whole. Now I may be mistaken, but something of this sort appears to me conspicuous in Captain Forbes' plan; for allowing the centre of gravity of the engines and boiler to be at the section C, any "sagging" down of the bottom of the boat of that point, would pull upon the bolt which passes through C, and cause a deflection on the truss beam B D, in which state it would act as a double lever upon the points B and D; e being one fulcrum and f the other: that this would take place I am not prepared to say, but it seems clear that there is nothing but the tranverse resistance of the timber to prevent it.

Should you consider these remarks of sufficient interest to obtain a place in your work, they may serve to correct an erroneous opinion, which has gone abroad, that the boat which has been built is after *my plan;* and this opinion would seem to rest upon no better grounds than simply because the Government at one time so ordered it. Should you be desirous of any further information on this subject, I shall willingly furnish you with a copy of the several opinions of the members of the Committee who sat in judgment on the two plans.

Diamond Harbour, Sept. 16*th*, 1831. C. COWLES.

NOTE *by the Editor.*—The remark alluded to by Captain Cowles, did not in any way refer to the plan and elevation of his model of a steam tug, but to the *drawing* of Captain Forbes' tug, which appeared to us on reading the work, to differ from the specification of the same boat in App. A 3, in having only *one* longitudinal truss beam instead of *a pair* of parallel beams made on the same principle. We have pleasure however in giving insertion to the exposition of our correspondent's plan of construction, which pleased us much in the model, and presented no error of *principle*, except in the slight unavoidable curvature inwards of the trusses towards the bow and stern, and in the transverse timbers which, if we mistake not, formed parts of quadrilateral figures.

VIII.—*To draw a Tangent to two circles.* Plate XIX. fig. 6.

A good deal having appeared in the public prints lately, respecting the Hindoo College, it may not be uninteresting to publish the accompanying solution of a Geometrical Problem by one of the pupils there, Radha Nath Sikdar. The solution is altogether his own discovery, and I have not altered a word in his composition.

T.

Let DMG and HNC be two circles, it is required to draw a tangent to them.

Let A be the centre of the circle GMD, and B of CNH: join AB. Divide it in the point L in such a way that AL may be to LB as AM to NB.

From L draw LD, touching GMD in the point D; join AD; through B, draw BC parallel to AD, and let it meet DL produced in C. Then DC is the tangent required.

Because the triangles ALD and BLC are similar, AL : LB : : AD : BC

and also by construction AL : LB : : AM : BN.

Whence BC=nd C is in the circumference of the circle NCH.

Because CB is parallel to AD, the angle BCL is a right angle.

Hence DC is the tangent to both the circles.

IX.—*Mót for raising Water at Mirzapúr.*

To the Editor of the Gleanings in Science.

Sir,

I send you the rough sketch of a mode which I lately saw at Mirzapúr of drawing water for Horticultural and Agricultural purposes; should it be of any service to you as a leaf in your valuable nosegay, or useful to the few who turn their thoughts to the value of cheap and expeditious irrigation, I shall be happy in having communicated it: not that I flatter myself it possesses any novelty; for my experience in the world and in books has been too limited to consider that an invention, which I have not myself seen or heard of before.

Plate XIX. fig. 7, will fully explain the particular parts of the machine, which has the advantage of requiring only one bullock and one driver, to be relieved at 12 o'clock, to draw up for six hours a constant supply of water by two *móts*, which alternately ascend and descend as their respective wheels may or may not be hooked to the clog *d*. Supposing the upper wheel *c*, as in the sketch, to have drawn up the *mót*, and the water to be discharged by the mouth, the chain of that wheel is unhooked and applied to the lower wheel, which then draws up its attached bucket; while the first, the wheel being free, falls down by its own weight and fills, and thus each alternately performs the evolution. Both buckets might discharge their contents on the same side of the well, and the pulleys would of course be also on that side, only one above the other, each horizontal to its wheel and separated about two feet in their perpendicular; and this perhaps would be the simplest way, as a view of the sketch with regard to the mouth string will shew; but as it would be less clear on paper, I have made it differently, for the sake of explaining the plan more readily to the eye.

I remain, Sir,

Your's obediently,

X. Y. Z.

X.—*Iron Works at Fírozpúr.*

Having lately had an opportunity of visiting the iron works of Fírozpúr, and of examining the whole process by which the metal is manufactured, I have drawn up a hasty account of it for insertion in the Gleanings, should you think it worth a place in your pages. I have also procured specimens of the wrought iron, which however, does not appear to be particularly good of its kind; but a portion of it shall be forwarded, if required. Not having visited the mines, I am unable to state the manner in which the ironstone is quarried; but from the appearance of the ore itself, I should imagine, that it is got at with very little difficulty.

The Narnoul ore is of two kinds; the one sort being nodular, or produced in small lumps, the exterior of which is of a rusty colour, while the interior has a bright metallic fracture; and the other kind is produced in large masses, apparently of a slightly laminar structure, readily fracturing into very small pieces. I am not, however, aware, that there is any difference in the component parts of these two ores.

The Fírozpúr ore, called *Búrí*, is found in concretions of various sizes like *kankar*, and presents the same appearance both internally and externally, leaving a dull earthy fracture, coloured throughout with iron rust, and yielding a much smaller return of metal than the Narnoul stone. I endeavoured to ascertain the quantity of pure iron obtained from each kind of ore, but the smelters gave very loose data for this purpose, and stated that the returns were only from 15 to 25 per cent.

The following is the process employed, as far as I had an opportunity of examining it.

The ore of both kinds is first broken up with hammers into very small pieces, about the size of a child's marbles, which are mixed with an equal quantity of charcoal (the fuel being bought in this neighbourhood at 25 rupees per hundred maunds), and the furnace is then loaded with this mixture, for the Narnoul and Fírozpúr ores are smelted together.

The smelting furnace, called *Mándarí*, is merely a square receptacle (*a*), leaving an opening both above and below; the upper vent serving for the admission of fresh materials, while the dross runs out from the lower orifice into a hollow sunk in the ground as shewn in Pl. XIX. fig. 4. A wall with two doorways is built at the back of the furnace, and supports a lean-to under which the bellowsmen sit and ply their task day and night: two sets of men being employed for this purpose. Two bellows only are used at each furnace, the nozzles being inserted very low down, nearly opposite to the lower external opening: the bellows are of great size, and are made of a single skin from an unusually large goat.

The iron, which is but imperfectly melted by this process, conglomerates or cakes into a large mass toward the bottom of the receivers, and the dross runs off by small holes punched with an iron crow-bar from time to time through the lower opening, which becomes stopped up by the half-fused mineral.

When a sufficient mass of metal has been smelted, the lower opening is cleared out: the unburnt charcoal and metallic scoria are carefully separated, (being first cooled by dashing water on them as they are raked out of the furnace,) and then the lump of half-melted iron which remains in the receiver is forcibly dragged out by means of large iron pincers (A) called *sangási*, while it is also pushed with crow-bars through the bellow's-hole from behind. This is but a clumsy operation, and consumes much time, though the mass which I saw extracted seemed to be barely a cubic foot in size. Heavy wedge-headed hammers (B) are now used to trim away all superfluous knots and lumps of impure metal from this mass, which is next carried to the refining furnace or forge called *áran*, where after being thoroughly heated it is again broken up into smaller pieces by means of the same hammer, and is then forged in the usual manner into bars about a cubit in length and two fingers thick in the middle, tapering at both ends.

During the operation of forging, one man holds the heated iron upon the anvil and turns it from side to side, while three others beat it with sledge hammers.

The iron is sold upon the spot by retail, at 10 seers for one rupee, or 4 rupees per maund.

Your's very obediently,

A. E.

Kampáspúr,
Feb. 12*th*, 1831.

fig 1

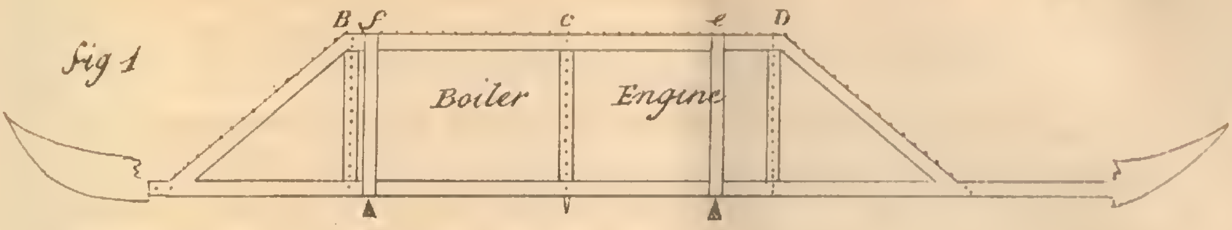


fig. 2

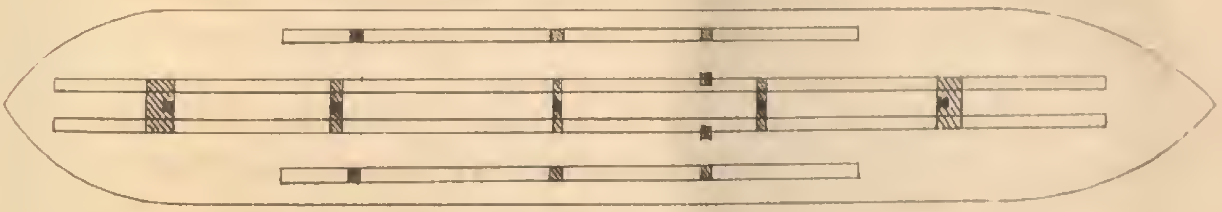
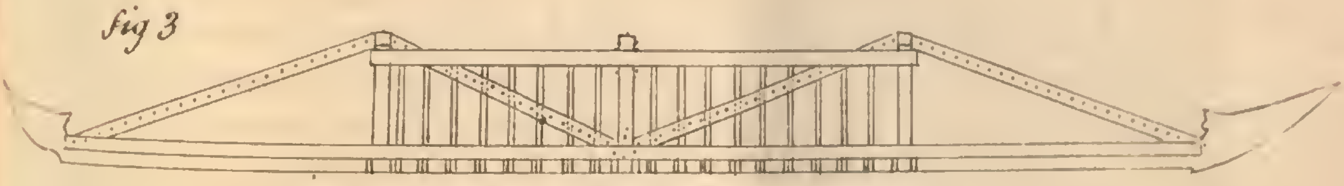


fig 3



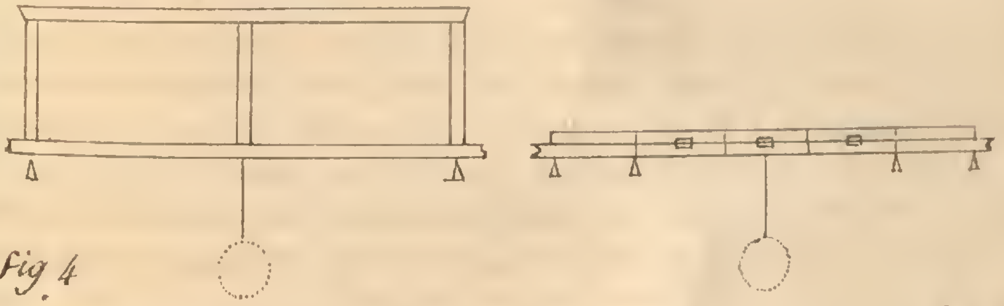
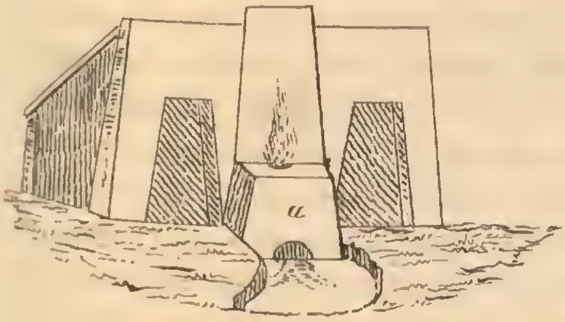


Fig. 4



Smelting furnace. Ferozpoor.

fig. 5

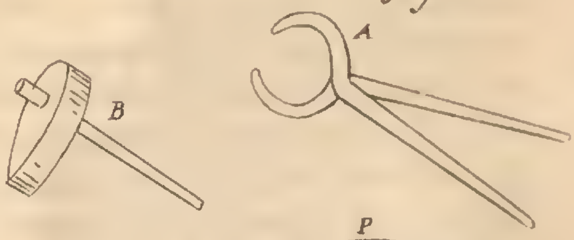
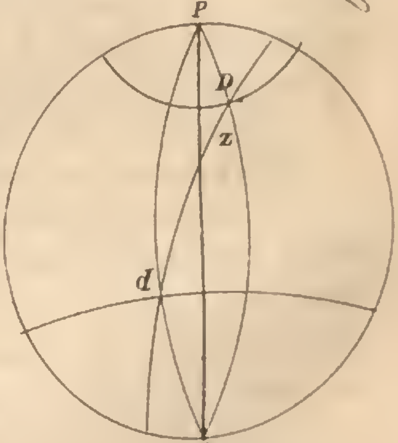


fig. 8.



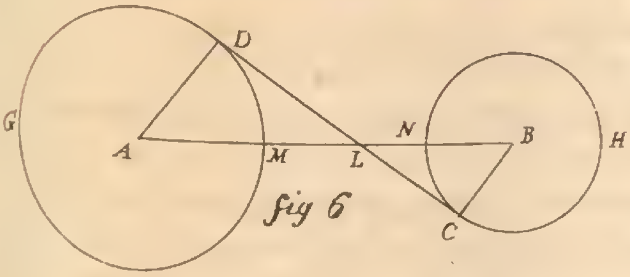
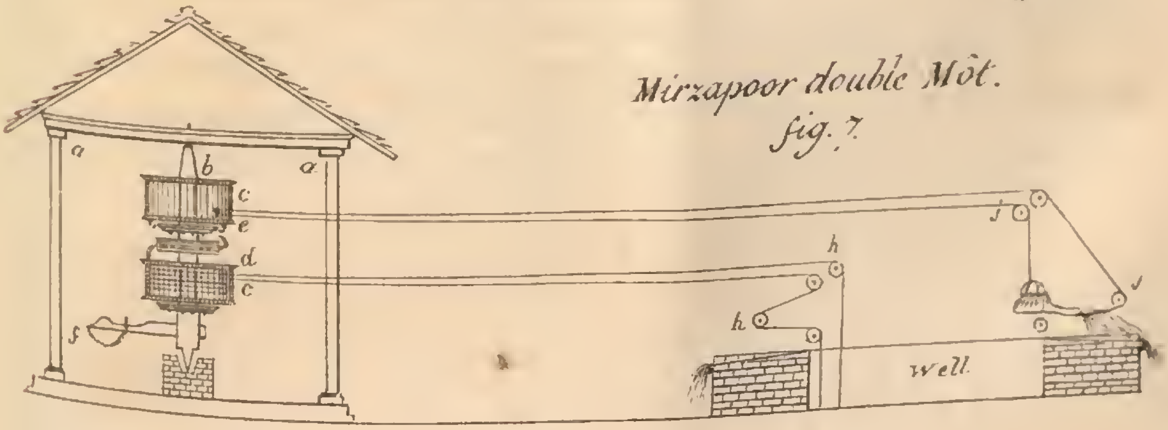


fig 6

Mirzapoor double Môt.
fig. 7.



J. B. Tassin Lith.

XI.—*Method of finding the Meridian. By* R. S.

The following method of finding the meridian is not, so far as I know, commonly to be found in books, though it be very simple, and sufficiently correct for ordinary purposes.

Direct the central wire of the transit instrument to the pole star, and note the time and altitude. We thus have the approximate meridian without any trouble; in this position of the instrument, observe the transit of some star near the zenith: we thus have the approximate time of the stars' transit, and if the star be within 10° of the zenith, the time so found will be within about one minute of the truth, in Indian latitudes; and the error will never amount to so much, if the pole star be not at its greatest elongation. It diminishes also as the star is near the zenith. But for the present purpose the time so found is sufficiently accurate; assuming then the time so found to be correct, find how far the pole star was distant from the meridian at the time of observation, or its horary angle = H A; then with the hour angle, and zenith and polar distances of Polaris, the deviation of the transit from the true meridian is thus found; sin deviation $= \frac{\sin\ P\ D\ \sin\ H\ A}{\sin\ Z\ D}$; this will be generally within two or three seconds of the truth. The right ascension of Polaris is within a few seconds of 1h.; and its polar distance is very nearly 1° 36′; these may be used in ordinary cases. If the zenith distance of the star by which the approximate time is found, do not exceed 5°, the error of the meridian so found will scarcely in this country ever exceed 5″, so that this method, besides being simple, is sufficiently correct for almost any purpose. By taking 1° 36′ as the polar distance, and one hour as the AR of Polaris, the result will never err beyond one minute.

There is another very simple and strictly correct mode of finding the deviation of the transit instrument in azimuth, from the observed error in AR of the transit of two stars. Let P Z *p* (Pl. XIX. fig. 8) be the meridian, Z the zenith, and D Z *d* the position of the transit instrument out of the meridian. D and *d* the observed positions of the stars, and Z D and Z *d* their zenith distances: D P *d* the observed error in A R. It is required to find P Z D, the error in azimuth, or the angle which the instrument makes with the meridian. By the principles of spherics, we have sin D*d* : sin D P *d* :: sin P *d* : sin D $= \frac{\sin\ D\ P\ d\ \sin\ Pd}{\sin\ Dd} = \frac{\sin\ err\ AR\ \sin\ Pd}{\sin\ D\ d}$;

also sin P Z : sin D :: sin P D : sin P Z D $= \frac{\sin\ D\ \sin\ PD}{\sin\ P\ Z} = \frac{\sin\ err\ AR\ \sin\ P\ D\ \sin\ P\ d}{\sin\ P\ Z\ \sin\ D\ d}$

or in words, add together the log. sine of error in AR, and the log. sines of the respective polar distances, and from the sum substract the log. sine of the co-latitude and log. sine of the observed difference in the polar distances of the two stars; the remainder is the log. sine of the error in azimuth. The same formula holds good, whether the stars be on the same or opposite sides of the zenith.

In all ordinary cases D *d* will be obtained correctly enough, by taking the tabular instead of the observed difference in polar distance.

The error in azimuth is NE, when the observed difference in AR is too great; and N W, when the difference is too small—both stars being above the pole.

XII.—*Account of the Process of making Iron at Amdeah, near Sambhalpúr. By* Robert Rose, Esq.

[Read at a meeting of the Physical Class.]

I observe they make iron at this village, procuring the ore from a range of hills about 2 miles to the north. They pound the ore to powder, and having made an oven of clay, round, and open at the bottom, and narrowed on the top, with the tube of clay in the centre, above the oven or fire place ; they fill the tube with charcoal, and having fire underneath, they throw the powdered ore in small quantities on the charcoal in the tube, and the melted contents fall into the oven, the mouth of which is closed up with clay, to prevent any air getting in, except what proceeds from a couple of bellows. The bellows consists simply of a round piece of wood about a foot or a foot and a half in diameter, which is scooped or made hollow about half a foot, and this is covered with a piece of deer skin, and tied down tight to the back with a string; in the centre of the skin is a hole, within which is a bit of stick longer of course than the diameter of the hole; to this stick a piece of string is fastened with a loop at the other end. There is then a piece of pliant stick about three feet long fixed on the ground, almost upright; the loop is fastened to the top of this stick, so as to keep the string pretty tight. The bellowsman stands, with one foot on each of the bellows, and covers the holes with the back part of his feet, except when the wind is to be admitted into the bellows, and this is done by moving up and down with each foot alternately. The mouth of the bellows is a hollow piece of stick about 2 ft. long, and being fixed in the block tight conducts the wind to the furnace through a small opening left for that purpose. The quantity of wind afforded by this simple kind of bellows is astonishing—[see Pl. XIII. fig. 5.] The iron produced is in rude shapeless lumps, but I understand, when more refined, it is of a good quality.

XIII.—*Note on the Mountains and Volcanos of the Interior of Asia. By* Baron Alexander de Humboldt.

[From the Annales de Chinie, Oct. 1830.]

Volcanic phenomena belong no longer to the geological branch of knowledge alone : the generality of their bearing upon the system of the world, entitles them to the first consideration in natural philosophy. Volcanos in a state of ignition, appear to be the effect of a communication between the interior of the globe in fusion, and the atmosphere which envelopes the hardened and oxidated crust of our planet.

The successive beds of lava gush out like intermittent springs of liquefied earths. The coats of them formed in succession seem to repeat before our eyes, on a small scale, the formation of the crystalline rocks of different ages. On the crest of the Cordilleras, as in the south of Europe and in the west of Asia, a marked connection is traceable in the chemical action of *actual* volcanos, or those which give birth to rocks ; inasmuch as their form and position, that is, the smallest elevation of their summit or crater, and the weakest part of their sides, where not strengthened by table land, permit the discharge of the earthy matters in fusion, along with *salses*, or mud volcanos, [such as are met with in South America, Italy, the *Tauride*, and the Caspian Sea,] ejecting first, large blocks of rock, flames and acid vapours ; then, in the next stage of comparative calm, vomiting forth muddy clays, naphtha, and mephitic gases.

The action of volcanos, properly so called, thus manifests a close connection with the formation, sometimes sudden, sometimes slow, of beds of gypsum and of rock salt, including petroleum, condensed hydrogen, sulphuretted iron, and occasionally (as at Rio Huallaga, to the east of the Peruvian Andes), large masses of galena;—also, with the origin of mineral springs; with the deposit of metallic groups at different epochs from the bottom upwards, either in veins, in masses, or in intimate combination with the rock in the neighbourhood of metalliferous veins; with earthquakes of which the effects must not be regarded as purely mechanical, for they are often accompanied by chemical phenomena, such as the emission of irrespirable gas, smoke, and luminous matter; and lastly, with the upheavings, either instantaneous or gradual, of large portions of the earth's surface.

The intimate connection between the above described phenomena, derived from regarding volcanic energy as the action of the interior of the globe upon its outward coat, has served to explain in the present day, a number of geological and physical facts which before appeared inexplicable. The analogy of facts well recorded, and the close observation of recent phenomena in various places, lead us by degrees to guess what must have happened in the remote ages of the world. *Volcanicity*, or the influence exercised by the interior of a planet upon its exterior, in the different stages of its cooling, through the inequalities of aggregation, of fluidity and solidity, in which its component parts are found, is very much weakened in the present day;—this action from within outwards is now restrained to a few points, intermittent in time, less frequently changed in locality, much simplified in its chemical effects, producing only rocks on a small scale around small openings or crevices; and exhibiting its power at great distances only in feeble quakings of the crust of the globe in particular directions, which have remained the same for ages past.

In the time immediately prior to the existence of the human race, the action of the interior of the globe upon the crust, which was then increasing in bulk, must have modified the temperature of the atmosphere, so as to render the whole of the globe habitable to those productions which are now regarded as *tropical;* since when the effects of radiation, of cooling on the surface, and of the relative position of the earth to the sun, have tended to limit the diversity of climates to corresponding geographical position.

It was also in these primitive ages, that the elastic fluids, perhaps, the most powerful agents of volcanic force, bursting through the oxidated and congealed crust, opened crevices therein, and introduced not only in the shape of dykes, but in all sorts of irregular masses, other matter of great density, such as ferruginous basalt, *melaphyres*, and metals. It is the difference of local constitution that causes the discrepancies between the observed acceleration of the pendulum and the trigonometrical measures taken on the earth's surface. The epoch of the greatest geological revolutions was precisely that, when the communications between the liquid interior of the planet and its atmosphere were most frequent, and acting upon the greatest number of points: hence it may be said, the tendency to establish these communications has caused the elevation, in different ages and in different directions, (apparently determined by the diversity of the epochs,) upon long crevices, of, first the great mountain chains, such as the Himmalaya and the Andes; then the mountainous ranges of a less elevation, and lastly the gentle undulations which embellish the landscape of our plains. As a proof of these upheavings, and a record (according to the ingenious views of M. Elie de Beaumont) of the relative age of those mountains, I have seen in the Andes at Cundinamarca, extensive formations of sandstone spreading across the plains of Magdalena and Meta, almost without interruption over table land 1400 to 1600 toises high; and lately again in the north of Asia, in the Ural chain, the same Antidiluvian fossil bones, so celebrated in the low regions of Kama and Yrtiche: they occur upon the ridge of the chain, as on the plateau between Beresowsk and Jekatherinbourg, embedded in appropriate soil, [*terrain de rapport*] rich in gold and platina. Again, there is further evidence of the subterraneous action of elastic fluids, in raising up continents, *dômes*, and chains of mountains; in displacing rocks along with the organic remains contained in them; in forming eminences and depressions by the falling in of the vault, as is observable in the west of Asia; thus the waters of the Caspian sea and lake Aral, which may be regarded as the focus of this depression, have their level 50 and 32 toises [300 and 200 feet] *below* the level of the ocean. The observations of Messrs. Hoffman, Helmerson, G. Rose, and myself, prove, that this debasement extends even as far as Saratow and Orenburg, on the Jaik river; and apparently it continues to the south-west also, as far as the lower branch of the Sihoun (Jaxartes) and of the *Amou*, Jihoon (Oxus). The depression of so considerable a portion of Asia more than 300 feet below the mean level of the ocean, could not, until now, be viewed in its proper light, because our observations had hitherto been made in countries more or less surrounded by the sea, where similar phenomena occur only in a very minor degree. The formation of this concavity in the surface of the north-west of Asia, appears to me to have intimate connection with the uplifting of the mountains of the Caucasus, the Hindú Koh, and the table land of Persia, which are immediately south of the Caspian and the *Maveralneher*: perhaps also it may be allied to the upheaving of the vaster mass, which is so vaguely and incorrectly designated as the table land of central Asia. This concavity of the ancient world is doubtless of the same nature as the craters of Hipparchus, Archimedes, and Ptolemy, on the moon's surface, some of which are 90 miles in diameter, and which may be compared to Bohemia, with more truth than to the little cones and craters of our present volcanos.

XIV.—*On the supposed Adulteration of Banca Tin. By* J. Prinsep, *Esq. Deputy Assay Master, Calcutta Mint.*

The tin trade of Singapúr with China has suffered materially of late, from a supposition that the metal has been brought to market mixed with lead and other inferior metals. A great deal of it was sacrificed thus, at a depreciation of 25 per cent. in Canton, and the evil continuing unabated, the merchants of Singapúr, in July last, transmitted a number of specimens of the rejected tin to the Mint Master in Calcutta, to be submitted to chemical examination. I have been requested to give publicity to the report drawn up on the occasion at this office, with a view to satisfy the public on the subject. I should premise, however, that it must be regarded only as a report upon the specimens themselves, which were apparently cut from the corners of the blocks of tin; for a similar depreciation in the Calcutta market of a quantity of tin from the Straits having been brought to my notice, [where also the musters proved to be of good quality,] I found on breaking the ingots in half, that the interior was a compound of scoria and refuse dust, concealed from view by an outward case of good metal. The same may probably prove to be the case with the tin rejected by the Chinese.

Report on Singapúr Tin.

The eight specimens of tin handed to me, with a letter from Messrs. Thomas and Co. of Singapúr, were submitted to chemical examination, to ascertain whether any and what other metals were mixed with them, which might render them unfit for the purposes to which tin is applied in commerce and the arts, and thus depreciate the value of the Banca Tin in the markets of China or of Europe.

Knowing that the subject was of considerable importance to the mercantile world, I did not confine myself to such a rough mode of testing as is usual with the assayers of this metal in Cornwall, who pronounce at once upon its quality from its colour, weight, and malleability; but went through a chemical analysis of each specimen, wherein it was nearly impossible to be deceived as to the presence of any other metal in any influential proportion.

The following table presents the results; the second column shews the specific gravities of the several samples taken after they had been melted, cleaned, and laminated, and also the appearance of the edge of the strap, though it is difficult to say whether the slight roughnesses or cracks were owing to inferior malleability: I should rather say that all of the samples were perfectly soft and equally ductile. Slight variations in the specific gravity from 7. 30 @ 7. 35 may perhaps be unavoidably due to different degrees of condensation of the same quality of tin under the hammer or the roller. But as the admixture of even five per cent. of lead brings the specific gravity up to 7.4, and every addition becomes more and more perceptible in the increase of weight, this mode of testing the metal would of itself probably answer every purpose of commerce; while the operation, from its simplicity, is within the reach of those unacquainted with chemical processes. The readiest manner of ascertaining the specific gravity, and satisfying purchasers as to the absence of lead, is to have a large sized bullet mould with a small orifice, from which a clean bullet can be cut off when cast in it. The buyer or seller may then melt a standard muster of pure tin, and cast it in the mould first, to serve as a comparison for the rest: if the tin of commerce give a bullet of the same weight, it may be esteemed pure, (provided always that it is perfectly malleable;) if it is heavier, it may be suspected to be adulterated with lead, and the proportion may be readily calculated from the table of specific gravities here subjoined:

Specific gravity of alloys of Tin and Lead.

Pure Tin.		*Pure Lead.*		*Specific gravity at* 80°.	*Diff.*
100	mixed with	0	by experiment,	7.30	.09
95	ditto	5	ditto,	7.39	.09
90	ditto	10	ditto,	7.48	.14
85	ditto	15	ditto,	7.62	.32
75	ditto	25	(by Bishop Watson),	7.94	
66.6	ditto	33.3	ditto,	8.16	
50	ditto	50	ditto,	8.82	
0	ditto	100		11.40	

It may be assumed, that each addition of one per cent. of lead, up to 15 per cent. of the latter, increases the specific gravity of tin 0.02, or $\frac{1}{350}$th part.

To the bullet-trial should also be added a trial of the homogeneousness of the ingots: this is simply ascertained by striking them with a mallet: if they ring clearly, they may be judged to be solid and good; but if they emit a dull unelastic sound, there is room for suspicion of fraudulent admixture within, and such ingots should be either cut in half, or remelted for the satisfaction of the purchaser.

Besides lead, there is no metal that it can be worth while to adulterate with tin, unless it be zinc (spelter), and the presence of the latter would be ascertained by the circumstance of its impairing considerably the malleability of the tin.

With regard to the present samples, I should pronounce them perfectly good in a mercantile sense; and by no means liable to the deduction of 25 per cent. on their value, stated to have been exacted in the China market: each per centage of lead in the compound should give an abatement of full three per cent. in the price, setting aside all considerations of the utility of the tin being diminished by the adulteration. A small addition, however, of one or two per cent. of lead, would be hardly discoverable in practice.

For the satisfaction of those who would repeat the analysis of any of the specimens, I beg to state briefly the process pursued.

100 grs. were digested in boiling nitric acid until converted entirely into a white sub-nitrate. The solution was then evaporated to dryness, and the precipitate redigested in boiling distilled water, and filtered: the subnitrate converted into a peroxide at a red heat furnished the proportion of tin, while the filtered liquor and washings concentrated and treated with sulphate of ammonia yielded the lead in the shape of sulphate: the remaining solution was tested with prussiate of potash for iron and copper, and lastly with carbonate of potash for zinc.

The peroxide of tin was separately examined for antimony, arsenic, tungsten, &c. but without finding traces thereof, unless the yellow colour of the oxide might be attributable to a slight contamination with antimony, a point requiring further experiment to determine satisfactorily, but from its minuteness, not of much consequence on the present occasion. I have since tried M. Gay Lussac's method of separating antimony from a nitromuriatic solution of tin by the immersion of a plate of tin, but without discovering any traces of the suspected metal.

Mark on the Samples of Tin.	Specific gravity.	Malleability.	Composition.		Other Metals.
			Tin.	Lead.	
A.	7.33	slightly rough on edges of laminated strap,..	99.8	0	trace of iron.
B.	7.31	edges quite smooth, ..	99.5	0	ditto iron and zinc
C.	7.31	ditto not quite so good,	100.	0	trace of iron.
D.	7.32	ditto,.............	99.8	0	do. more copious.
E.	7.32	slightly rough,..	98.8	1.2	fainter ditto.
F.	7.33	very smooth edge,....	97.6	0.8	trace of copper & iron.
G.	7.34	slightly rough, ...	100.0	0	slight ditto.
H.	7.37	smooth edge,........	98.6	1.4	ditto of iron and copper.

Calcutta Assay Office,
25th August, 1831.

XV.—*Pernambuco Cotton in Ava.*

[Extract from a letter from Major Burney, Resident, dated 10th October, 1831.]

'Since I sent you some of the Theenban-wa cotton, I have found two or three plants of the regular Pernambuco cotton. The Burmese call this also Theenban-wa (ship or foreign) cotton, and describe it to be a perennial, growing to a large tree in this country. Its leaves also are very large.'

A few pods of this were sent by Mr. Swinton, Chief Secretary to Government, to Fort Gloster, and were there immediately pronounced it to be Pernambuco. Some of the seeds were presented to the Agricultural Society, and another portion also to the Botanical gardens.

Previously to Major Burney's discovery of the Pernambuco cotton tree in Ava, he had found another species, which is also a perennial; the trunk being as thick as a man's thigh, and admitting of a man climbing up it.

'The leaf and seed are much larger than those of the cotton plant common in this country : and not only are the seeds much more easily removed from the cotton, but the staple of the cotton is unusually long ; so much so indeed, that the Burmese find fault with it for this quality, and do not use it for any other purpose than that of making wicks for their lamps. The plant yields the cotton in the latter end of February and March and part of April. The seeds are not placed like those in the Pernambuco cotton.'

XVI.—*Proceedings of Societies.*

Medical and Physical Society.

At the Meeting of the Medical and Physical Society, held on the 1st October, Dr. Macqueen, Surgeon, H. M. 3d Buffs, Dr. Arch. Campbell, Surgeon, and James Lawder, Esq. Assistant Surgeon, Madras Service, and W. B. Taylor, Esq. Assistant Surgeon, Bombay Service, were elected Members of the Society ; J. E. Porteous, Esq. Surgeon, of Edinburgh, was elected a Corresponding Member. The Society proceeded to the consideration of a question proposed at the last Meeting, respecting those who may withdraw their names from the list of Members, adverting particularly to the Resolution passed on the 4th April, 1829 ; and it was now resolved, that any Members who may withdraw from the Society, subsequently to this date, shall not be re-admitted without being balloted for, in the same manner as other Members on first joining the Society.

The following communications were then presented to the Meeting:

1. A letter from Dr. Fleming, Secretary to the Medical Board of Madras, with copies of Medical Reports recently published at that Presidency.

2. A letter from Mr. Preston, of Cuddalore, stating that the case of inveterate epilepsy, on which he performed the operation of tying the common carotid artery, remained quite well, not having had any return of the epilepsy since the operation ; a period of seven months. He also mentions having tied the common carotid artery in two other cases since his former report, one of which was in a patient suffering from disease of the brain after fever, the other a case of hemiplegia ; both these were recovering. A statement of these cases at a later period is promised, as well as the ulterior results of the two former operations on the carotid.

3. A letter from B. White, Esq. at Poona, with a Register of the Rain-guage at that Station, for the months of June and July, 1831, by which it appears, that the quantity of rain which fell in June was inches 1-21. and in July 5-75. A similar Register will be sent for the rest of the monsoon.

4. Anatomical description of extraordinary formation in a human fœtus, presented by Dr. J. N. Casanova.

Mr. Boswell's Medical Report and Dr. Casanova's description of the fœtus were then read and discussed by the Meeting. Mr. Boswell's letter accompanying his report, adverts to the confirmation of his former statement relative to the benefits derivable from the application of blisters of Argent. Nitrat. in various disorders ; similar good effects are recorded in the present report, which contains details of several cases. In Mr. Boswell's letter mention is also made of the numerous cases of leprosy which exist in the island of Penang, and he states an opinion there entertained, that some kinds of leprosy are unquestionably contagious, but does not describe the diagnostic characters of such species of the disease. He states, that orders exist to prevent all convicts affected with that disease from going at large, or mixing with others ; and he promises some further communication on the subject. Mr. Boswell's employment of repeated blisters of Argent. Nitrat. in pulmonary diseases, with tendency to Phthisis Pulmonalis, appears to have been remarkably successful in many of the cases detailed to the Society.

Dr. Casanova's anatomical description of the Lusus Naturæ, which came under his observation at Laguna, near Manilla, in the Philippine Islands ; details minutely the structure of the subject, as delineated in three well finished drawings, which accompanied his essay. The Secretary announced to the Society that the 5th volume of Transactions, now in the press, is nearly completed, and will be ready for publication and distribution among the Members of the Society in the course of the month.

Meteorological Register kept at the Surveyor General's Office, Calcutta, for the Month of October, 1831.

Day of the Month.	Minimum Temperature observed at Sun-rise.					Maximum Pressure observed at 9h. 50m.					Observations made at apparent Noon.					Max. Temp. and Dryness observed at 2h. 40m.					Minimum Pressure observed at 4h. 0m.					Observations made at Sunset.					Rain-gauge, No. 1.	Rain-gauge, No. 2.
	Barometer reduced to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.		
1						,799	85,5	6,0	n. e.	cu.	,764	88,	10,0	n. e.	cu.	,674	89,5	12,9	n. e.	cl.	,661	88,5	9,6	n. e.	cu.							
2	29,736	79,5	2,6	n. e.	cus.	,766	82,3	2,4	do.	cus.	,746	83,5	4,6	do.	cus.	,659	82,3	2,4	do.	cus.	,643	82,7	3,4	do.	do.	,643	81,7	1,0	cm.	cns.		
3	,693	79,7	1,6	s.	do.	,745	87,	6,4	s.	cu.	,688	85,5	6,8	cm.	n.	,642	88,3	9,4	s.	cu.	,615	88,7	11,0	s.	do.	,648	84,	3,8	do.	cu.	0,17	0,15
4	,695	80,	3,1	do.	ci.	,752	87,7	9,1	do	do.	,708	88,5	10,2	s.	cu.	,637	90,3	13,7	do.	do.	,636	89,5	9,6	do.	do.	,653	84,5	4,5	s.	do.		
5	,754	81,7	3,9	s. w.	cl.	,784	86,7	6,3	s. w.	do.	,745	88,5	7,7	s. w.	do.	,667	91,	13,2	s. w.	do.	,659	90,	11,3	s. w.	do.	,681	86,5	6,9	cm.	cl.		
6	,761	80,8	3,0	s. e.	cu.	,788	86,5	5,1	s. e.	do.	,746	90,8	10,5	s. e.	do.	,663	90,8	9,5	do.	do.	,643	91,5	11,1	do.	do.	,664	88,3	10,0	s. w.	do.		
7	,704	81,5	3,5	do.	cl.	,740	88,8	9,6	do.	cl.	,708	89,5	9,2	do.	cus.	,628	90,3	8,9	do.	do.	,631	87,5	6,4	do.	do.							
8						,753	88,8	8,2	cm.	cu.	,718	88,3	9,3	cm.	do.	,637	93,3	9,3	do.	do.	,603	92,5	14,9	do.	do.	,665	86,	4,5	cm.	ci.		
9	,753	83,5	1,9	do.	do.	,829	90,	10,6	s. e.	ci.	,787	90,7	11,8	s.w.	cl.	,714	94,5	17,3	do.	cl.	,673	93,	14,9	do.	cl.	,681	87,	5,4	s. e.	do.		
10	,718	81,8	1,7	do.	do.	,757	87,8	8,3	do.	cu.	,712	90,5	12,5	s. e.	cu.	,680	76,9	1,9	s. e.	rn.	,688	79,	1,7	s. e.	n.	,692	80,	5,6	do.	cis.		
11	,698	79,6	2,8	do.	cu.	,744	83,5	3,4	do.	cus.	,717	82,5	2,9	do.	rn.	,645	84,3	5,9	do.	cus.	,645	83,5	5,9	do.	cus.	,678	79,	2,0	do.	do.	2,35	2,00
12	,733	78,5	1,2	n. e.	rn.	,736	75,9	2,0	n, e.	rn.	,692	77,8	1,3	n. e.	cy.	,675	79,	2,0	do.	rn.	,659	79,7	3,4	n. e.	cis.	,665	79,	2,0	n. e.	do.	0,23	0,20
13	,756	79,5	1,3	do.	cus.	,803	83,	3,2	do.	cy.	,782	85,	5,2	do.	cu.	,688	84,5	5,2	n. e.	cis.	,687	84,5	4,5	do.	do.	,713	81,5	2,0	do.	do.	0,35	0,32
14	,767	78,5	1,3	do.	do.	,832	86,5	6,4	do.	cu.	,793	88,	8,5	s. e.	do.	,693	89,5	10,6	s. e.	cu.	,681	89,	10,4	s. e.	cu.	,704	86,	5,1	s. e.	cu.		
15	,772	78,9	1,9	s. e.	cis.	,834	85,5	8,0	s. e.	cus.	,781	89,	9,9	do.	ci.	,725	90,	11,3	do.	do.	,703	88,7	9,4	do.	do.	,691	84,5	4,5	cm.	do.		
16	,766	79,5	1,3	cm.	do.	,798	84,5	3,2	do.	cu.	,758	88,	5,8	do.	cu.											,738	82,7	2,8	s. e.	cus.		
17	,783	79,8	2,4	s. w.	cu.	,833	86,7	7,0	s. w.	do.	,790	87,3	8,0	s. w.	do.	,732	80,	2,0	s. w.	rn.	,706	79,7	1,6	s. w.	cus.	,723	81,	1,3	cm.	cis.	1,28	1,15
18						,881	86,5	6,9	do.	do.	,837	86,7	8,2	do.	do.	,771	87,2	9,1	do.	cu.	,781	82,5	3,2	do.	n.	,783	80,3	2,0	s. w.	do.		
19						,923	85,3	6,3	s. e.	do.	,873	88,8	9,9	s. e.	do.	,800	90,3	12,2	s. e.	do.	,800	83,3	4,0	s. e.	cus.	,734	81,	2,0	cm.	cu.		
20	,861	82,7	2,8	cm.	ci.	,876	84,7	7,8	do.	do.	,826	85,5	6,0	do.	do.	,736	89,5	11,6	do.	do.	,717	86,7	9,2	s.	cu.	,707	83,	3,2	s.	cl.		
21	,758	79,3	2,0	s. w.	cl.	,803	86,3	8,1	s. w.	do.	,757	88,9	11,7	s. w.	do.	,692	89,3	11,9	s. w.	do.	,684	87,3	7,7	do.	do.	,704	84,7	5,2	do.	do.		
22	,787	76,7	1,2	cm.	cy.	,839	77,8	1,3	cm.	cis.	,826	82,5	4,8	cm.	cis.	,775	83,7	7,0	cm.	cis.	,774	82,7	5,5	cm.	cis.	,775	78,	2,0	cm.	cis.	0,57	0,54
23	,857	76,	1,3	s. e.	ci.	,898	82,5	5,2	s. e.	cu.	,862	84,5	8,0	s. e.	cu.	,817	84,	10,3	s. e.	cus.	,809	84,	9,0	s. e.	cu.	,801	80,3	3,3	s. e.	n.	0,13	0,10
24	,849	76,3	1,8	s.	cu.	,890	81,8	8,2	s.	do.	,844	86,5	14,1	s.	do.	,793	85,6	12,3	s.	do.	,786	84,5	11,0	s.	do.	,800	82,	7,4	s.	cl.		
25	,841	75,5	2,7	do.	cl.	,874	84,8	13,9	do.	do.	,828	85,	14,3	do.	do.	,776	86,5	16,2	do.	cu.	,774	84,8	14,2	do.	do.	,772	81,	9,1	cm.	do.		
26	,832	72,5	1,7	cm.	do.	,876	82,	7,0	s. e.	do.	,833	85,6	12,6	n. e.	do.	,782	86,	14,1	n. e.	do.	,774	84,8	12,2	n. e.	cl.	,769	81,	5,3	n. e.	do.		
27	,843	73,	2,1	do.	do.	,887	81,5	8,2	n. e.	do.	,841	84,5	11,6	do.	do.	,772	86,8	13,6	do.	do.	,772	85,6	15,4	do.	do.	,761	82,5	6,5	cm.	do.		
28	,880	74,5	1,4	n. e.	do.	,863	82,5	9,0	do.	cl.	,803	86,3	12,9	do.	cl.	,726	87,2	15,6	do.	do.	,724	85,5	13,8	do.	do.	,729	81,7	5,2	do.	do.		
29	,837	74,5	1,2	cm.	do.	,876	84,7	9,8	do.	cu.	,823	87,5	12,3	do.	cu.	,759	88,3	15,5	do.	do.	,753	87,	14,8	do.	cu.	,765	81,5	6,8	n. e	cu.		
30	,748	77,5	2,0	n. e.	do.	,818	84,	10,3	do.	do.	,718	84,3	10,0	do.	do.	,729	84,7	11,2	do.	do.	,729	84,	10,3	do.	cis.	,733	83,	8,2	do..	cis.		
31	,721	75,	2,1	n.	n.	,752	75,5	3,0	n.	cy.	,681	75,8	2,9	do.	n.	,599	75,3	2,5	do.	rn.	,542	75,7	2,0	do.	n.	,553			do.	rn.		
Mean	29,772	78,4	2,0			,818	84,4	6,8			,774	86,3	8,9			,710	86,6	10,3			,702	85,5	8,7			,715	82,6	4,6			5,08	4,36

Abbreviations. In the column "wind," small letters have been used instead of capitals; *cm.* means *calm.* In the column "aspect of the sky," *cy.* is *cloudy*; *cl.* clear; *rn.* rain; *ci.* cirrus; *cu.* cumulus; *cs.* cirro-stratus; *cus.* cumulo-stratus; *cc.* cirro-cumulus; *n.* nimbus. The Rain-gauge, No. 1, is on the ground. No. 2, is on the roof of the house, 45 feet above it.

GLEANINGS

IN

SCIENCE.

No. 35.—*November*, 1831.

I.—*On the Measurement of the Indian Meridional Arc.*

The East India Company has frequently received the praises of the scientific world for the attention it has uniformly bestowed upon two popular and useful branches of knowledge, Botany and Geography: of the former, it is out of our province at present to speak; of the latter, we have but to adduce as evidence the splendid maps and charts published under its patronage, not only of the countries directly included in its extensive possessions, but, we may assert, of most of the eastern hemisphere, from the Cape of Good Hope to China. It has always maintained a mârine survey establishment for the examination of the coasts and seas on both sides of India; while, on the continent itself, surveys have been conducted on the most extensive scale: true it is that many districts remain hitherto almost unexplored, but this is rather attributable to the magnitude of surface than to the deficiency of means or exertion. Wherever collision with neighbouring states has opened a road to regions hitherto untrod, the opportunity has never been lost of collecting geographical materials; and, if time permitted, of completing an authentic survey.

No Government would, however, lay a claim to merit for works of so obviously useful a nature, and one so indispensable to its own interests: at any rate, it is not of such that the philosopher would expatiate as 'a liberal boon to science, whereby the Honorable Company have thrown the regal Governments of Europe into the shade.' The trigonometrical survey of an arc of the meridian is altogether of a different description; it is purely of a scientific character, and although, like all other scientific labours, it reflects its utility upon the practical business of life in a hundred different ways, still it is neither essential to the ruling power in the assessment of its territorial revènues, nor, as a member of a late Finance Committee discovered, to the dâk travelling civilian in shaping his course to some lucrative mofussil appointment!

For their steady patronage and support of this vast and expensive undertaking—for their renewal of vigor in its pursuit after twenty-five years of unremitted support, the Company's Government deserves the palm of unqualified praise.

We allude here to the supply of new instruments lately brought out by the surveyor-general for the prosecution of the remainder of the meridional measurements on a scale of grandeur and accuracy hitherto unequalled.

It is our wish to lay before our readers a description of these instruments, and of the improvements introduced in them by the advanced skill of British artists, aided by the personal experience of Captain Everest, acquired during his connection with the grand survey in central India under Colonel Lambton.

But, as many who take in our journal may have but slight acquaintance with the purpose or with the detail of trigonometrical measurements, we propose to make the subject more familiar by prefacing it, with a brief sketch, first of the historical course of this branch of knowledge, and then of the practical operations necessary in measuring a meridional arc.

As soon as the astronomers of the ancient world had arrived at the conclusion of the globular form of the earth, it would seem an easy step for them to have formed a rough estimate of its magnitude; nothing further being requisite for this purpose than to know the travelling distance between two places situated north and south of one another, together with the difference of latitude as marked by the shadow of the gnomon of a sundial at each place. A long interval however, elapsed before any such speculations ensued. Nothing of the sort is to be met with in the astronomical works of the Hindús, and although Aristotle (350 B. C.) vaguely mentions, that the mathematicians of his day estimated the circumference of the earth at 400,000 stadia, the first who appears to have aimed at the solution of the problem on satisfactory data was Eratosthenes. From the distance between Syene and Alexandria, he determined the degree to be equal to 700 stadia, and the circumference of the globe, therefore, to be 252,000 stadia, but his estimate is now of little avail, as there exists no means of discovering the value of the *stadium* or unit of his scale. The next operation on record, and perhaps the first actual measurement of an arc of the meridian, was that undertaken by the Arabian sages under Caliph Almámún, on the plains of Sinjar, in the year A. D. 827. They divided into two parties, one proceeding to the south, and the other to the north, measuring their way until they found by their *astrolabes* that they had compassed an amplitude of two degrees; but the accuracy thus attained by experiment fell short of that acquired before by the Grecian philosophers, for it gave only 56⅔ miles to the degree; unless, as has been suspected, an error has crept into the Arabic manuscripts consulted by the European astronomers.

Seven hundred years intervened before the subject was taken up again, in the beginning of the 16th century. Fernel, in 1526, measured the distance from Paris to Amiens, by counting the revolutions of his carriage wheel; the difference of latitude was already known, and fortunately Amiens lay almost due north of Paris, so that although this line has been, from its favorable situation, remeasured and verified no less than three times, very little change, as it happens, has been necessary in Fernel's original determination.

Snellius in 1617, had the merit of introducing the method of triangulation into geodetic measurements, which we shall have to describe more fully by and bye. A few years afterwards, Norwood measured the arc comprised between London and York; but his work shewed all the rudeness of a first attempt, and was in error to the extent of 400 toises on the degree. Meantime greater progress was making in France: Picard in 1665, had introduced the important improvement of telescopic sights and micrometers to instruments for measuring angles, and had remeasured the Amiens' line with an error of only 15 toises. Richer too had discovered, in 1672, the diminution of gravity towards the equator, by the alteration of the rate of his astronomical clock at Cayenne, which made it necessary to reduce the length of its pendulum 1-10th of an inch.

By the beginning of the 18th century, the magnitude and figure of the earth engrossed more and more the attention of mathematicians. Huygens and Newton soon engaged in the consideration of the question, and the latter demonstrated from the laws of gravitation, that the rotatory motion of the earth must cause an enlargement of its equatorial diameter, and a consequent flattening at the poles. The most simple and effectual means of verifying this hypothesis was by measuring arcs of the meridian in different latitudes, and the French academy boasts the honour of having set the example, and put in execution the most difficult and decisive parts of this undertaking.

In less than half a century were accomplished no less than eight new measurements.

In 1718, the Dunkirk arc, by Cassini and Lahire.
In 1738, the Lapland arc, by Maupertius, &c. (re-examined carefully by Svanberg.)
In 1745, the Peruvian arc, by Bouguer and de la Condamine.
In 1750, the Cape of Good Hope arc, by La Caille.
In 1755, the Roman arc, by Boscovich.
In 1760, the Piedmontese arc, by Beccaria.
" the Austrian, by Liesganig.
" the Philadelphian, by Mason and Dixon.

These operations, combined with experiments on the length of the pendulam, left no doubt that the earth was in fact flattened at the poles, but the results were not sufficiently accurate for determining with precision the degree of compression, or even the absolute dimensions of the globe. It was at the memorable epoch of general innovation in France, when a new system of weights and measures was proposed by Cassini, depending on the length of the terrestrial quadrant as an unit, that a simultaneous impulse once more actuated the learned world to complete the investigation of the earth's figure, aided by new instruments, new methods, and new formulæ of calculation.

In 1790, Mechain and Delambre were entrusted with the extension of the French arc southward to Barcelona and the Baleares Isles, (which was completed by Biot and Arago in 1806,) while on the north it was united to the English triangulation, then in progress under General Roy, who had brought himself into notice by his careful measurement of a base on Hounslow Heath, in 1784. Upon his death, in 1790[1], his important portion of the task devolved upon Colonel Mudge, who by 1802 had carried a meridian line from Dunnose to Clifton, and has since extended it to the northern extremity of the Orkney Isles, whither M. Biot, who had distinguished himself at the southern extremity, was deputed by the French Academy in 1820, to aid Captain Kater, of the Royal Society, in conducting the final experiments with the pendulum, and fixing as it were, the key-stone to this splendid monument of labour and science.

We have thus in a few words pursued the historical course of geodetical operations in the west; having purposely reserved for separate notice the Indian trigonometrical survey, which from our nearer connection with it, as well as from its vast scale and intrinsic merit (bearing in fact a competition with all that has been effected in Europe), is, on our part at least, entitled to a more lengthened review.

In a former part of this work, (vol. 2. page 76,) we have described the origin of the Indian survey; we shall therefore, make as short a recapitulation as is consistent with the thread of our history.

[1] Since this period, the English triangulation has been carried into Ireland, under Colonel Colby's charge. The French and Italian arcs have also been united by a perpendicular arc on the route of Mont Cenis, and no doubt many trigonometrical operations have proceeded in other European countries with the details of which we are as yet unacquainted.

After the successful termination of the war with Tipú Sahéb, Brigade Major Lambton brought forward his plan of a geographical survey of that part of the peninsula. His first idea was confined to throwing a series of triangles across from Madras to the opposite coast, but in the prosecution of this object his enlightened mind soon resolved to combine with it the measurement of as many degrees of latitude as the limits of his survey might enable him to subtend: his design was fortuitously seconded by the arrival in India of the duplicates of the instruments employed by General Roy, and it met with the cordial support of Lord Clive and his council.

Major Lambton had in 1801-2 established a first series of triangles on a meridional arc of one and a half degree, 35 miles to the west of Madras. He subsequently abandoned this line, and selected the Dodagontah meridian depending upon a twice-measured base line at Bangalore. The object of this substitution was to obtain a clear run to the southernmost point of the peninsula, which was effected by February 1809, making a line of 4° 50′; a suspicion having however arisen on the calculation of the resulting length of a degree in the latitude of Dodagontah, that the plummet had been subject to some deviating influence, a new arc was carried northward from Págar to Gútí in 1811, and the series was extended 3 degrees further north to Dámargidda, by the winter of 1815; making in all an arc of nearly 10 degrees in length.

During the three following years, owing to the Pindarí war, the establishment was employed upon the subordinate arcs of Lavendrúg and Kylasgerh. Active operations were only recommenced in 1819; at which period Captain Everest was associated in the grand work. For three years in succession the disasters encountered by the whole party were of the most discouraging description. The Nagpúr country was one impenetrable jungle, hitherto entirely unexplored; the climate was uncongenial both to Europeans and natives, who were overcome by privations and sickness. Colonel Lambton came to Calcutta; and Captain Everest was soon after driven to the Cape of Good Hope, to recover his health.

In 1822, the veteran Colonel was again in the field, measuring a base in the valley of Berar, near a place called Takal Khéra, where he was joined by Captain Everest. He had dispatched his medical attendant, Dr. Voysey, viâ Calcutta, to Agra, for the purpose of reconnoitring the country along which the survey was to proceed.

Although the Colonel had not for some years taken an active part in the measurement of the angles, he seems to have had some reluctance in yielding the honour of his undertaking to a coadjutor; he deputed his assistant, therefore, to spread the net of triangles westward towards Bombay while he himself should continue the main line;—but he had already done as much as could be expected in the short space of human life, his energy was gone, he was among strangers, and in a pestilential climate. He sunk under an attack of fever in January 1823, and was buried on the field of his labours.

It had been Colonel Lambton's rule to confine his operations to the rainy season, when alone, he had by experience learnt, the atmosphere was clear enough to enable him to see his distant signals, and avoid the effect of lateral refraction. This system however was fraught with the most ruinous consequences to the party, and it became one of Captain Everest's first studies to introduce a radical change in the season of out-of-door exposure. By the adoption of night signals he was not only able to overcome the haziness of the winter months, but also to continue his operations throughout the hot winds. He met Dr. Voysey at Hyderabad in June 1823, and took the field in his company on the 3d September following. The roots of their former sufferings however were but imperfectly eradicated, and a fresh exposure to the same influences brought on a return of the symptoms: it was under the disadvantage of continual attacks of fever that Captain Everest pushed on the triangulation to Kulianpúr, and determined the latitude of that place by an ample series of celestial observations. Dr. Voysey fell a victim to the climate in December 1823, and his companion was finally compelled to quit the field a second time at Bhaorása, lat. 24° 10′, and take his departure to Europe; having previously completed the prolongation of the measurement to a total length of 16 degrees.

We need not advert more particularly to the operations of this period, since an interesting account of the whole was given to the public during Captain Everest's sojourn in England.

During his absence, the subordinate officers of the establishment were employed in extending a series of triangles westward, along the Vindáchal mountains, to Benares, Patna, and Calcutta, which has been completed within the last few months; and the final operation of measuring a base of verification has, as our Calcutta readers are aware, already made considerable progress along the Barrackpúr road, a line admirably suited for such a purpose.

Having now terminated our brief historical outline of geodetical operations, we may proceed to describe the *process* of executing a trigonometrical survey, with a very cursory mention of the instruments usually employed thereon, which will enable us better to appreciate the merits and excellencies of the chefs d'œuvres destined to supersede them in the continuance of the Indian arc.

The principles of the whole operation may be stated in a very few words; *first*, a line of sufficient length (five or six miles) is measured with the utmost attainable accuracy, upon the surface of the earth; *secondly*, this measurement is expanded north and south, in the direction of some meridian line by means of triangles, the sides of which can be readily calculated from the given base, and the three measured angles. *Thirdly*. The arc of latitude, comprehended between the extremities of the expanded line is determined by the inclination of the vertical or plumb line, with regard to the fixed stars.

I. As the measured BASE LINE is the foundation of the whole work, its measurement demands every possible accuracy of execution: the line should be as long as the surface of the ground will allow; and not less than half the length of the average sides of the large triangles. The two ends must be permanently established by sinking a mass of stone or metal into the earth to carry the adjusted points at the extremities of the line: their position must also command a view of the first triangle stations, with two of which the base should form a right angle as nearly as possible. (Pl. XXIII. fig. 1.)

There should be bases of verification at certain distances (about 100 miles apart) to check any errors in the first, which would otherwise go on diverging as the triangulation proceeded; being in fact a percentage upon the length of the whole line.

Wooden rods or perches were employed on all the older measurements, without any precaution to shelter them from the action of the weather: in the Peruvian arc, they were even occasionally suffered to float on the water. The irregularities however, produced by humidity and change of temperature, were too great to escape notice long. General Roy found reason to abandon them in the English base, and after an elaborate series of experiments on the dilatation of various bodies, he gave the preference to glass tubes of 20 feet long, which appear to have performed their duty with extraordinary precision; these tubes do not seem to have been used in any other survey, having been superseded by the introduction of the hundred foot steel chain, which had the advantage of greater simplicity. The defects of the chain were, the wearing of the hinges, the difficulty of stretching it always with equal force, the impossibility of knowing its precise temperature, and the danger of shaking the register marks by driving the stretching posts in the ground: these were in some measure compensated by the rapidity of passing over the line in spaces of 100 feet at a time. The line at Misterton Carr of 26,342 feet in length, measured by the chain, is not supposed to err more than two inches from the truth.

The French academicians made use of double rods of platina and brass, 12 feet long, so fitted together that from the unequal expansion of the two metals, a register pointed out at one end the mean temperature of the whole apparatus, and the consequent correction for temperature was easily applied.

But Colonel Colby has lately introduced, in the Irish survey, a compound bar which nullifies all the corrections for heat, and provides in the most perfect way for the several adjustments of horizontality, collimation, and juxtaposition; at the expence, it must be confessed of some little increase of trouble in the field, though on the other hand it saves all calculations of reduction, a principle to which English artists seem particularly attached. This is the form of measuring rod now adopted in the Indian Trigonometrical survey, in fact the apparatus brought out is the exact duplicate of that invented by Colonel Colby.

Two bars, one of steel, the other of brass, are placed side by side in a long wooden box, and united firmly together by their middle; they are also connected at their extremities by levers or cross bars, projecting on the side of the steel bar to about twice the distance between the bars: the levers carry very fine dots imprinted on silver discs, so adjusted, that the difference of expansion of the brass and steel keeps the dots always at the same distance apart. This adjustment is experimentally made by submitting the bars to alternate heat and cold in a proper apparatus: but it can easily be calculated from the known expansions of steel and brass, which are nearly as 2 to 3. The bars are enclosed in a double case of flannel and deal, resting upon rollers to allow of free motion: they are 9½ feet long; and there are six pair, so that when placed on tripods, six inches in advance of one another, they occupy a length of 60 feet. The avoiding of contact between the ends of the bars is essential to their steadiness: the six intermediate inches are read off by means of double microscopes, connected firmly together, which are also provided with compound bars for compensation of temperature. In the microscope at the two extremities of the series of bars, a third microscope is placed between the other two, having a longer focus for the purpose of reading off a minute dot on a platina disc fixed on a steady brass tripod, which is called the register, maintaining its post while the bars are moved on. We need not here advert to the minor ingenious contrivances for levelling, moving, and protecting the apparatus, as we hope on some future occasion to be permitted to give our readers a drawing of the whole apparatus.

The base measured by Colonel Colby, with these bars, near Loch Foyle, in Ireland, was submitted to the most rigorous examination by comparing the different parts together, and the extent of variation was found to be only 3 inches in as many miles. The Indian bars were also tried by order of the Court of Directors, in Lords' cricket ground, and the discrepancy between two measurements of a line of 567 feet was only 3-40ths of an inch. Any one who has witnessed the *modus operandi* with them on the Barrackpúr road, will easily believe the attainment of an equal or even greater precision here, from the firmness and evenness of the ground, the steadiness of the climate, and the host of experienced surveyors engaged in carrying it forward.

II. Next to the base in importance comes the system of TRIANGULATION, which is however so far independent, that it contains a principle of verification within itself, well known to every geometrician. Where accuracy is so indispensable, it is of course necessary that not only the measure of all three angles of each triangle shall be taken, but that the triangles shall be knit together by numerous cross sights as checks : wherever a hexagon or pentagon is formed by the meeting of five or six triangles, an additional check upon the whole is gained : the average angles should be as near to 60 degrees as the nature of the country will admit. (fig. 1.)

The English and French methods of taking angles are distinguished from each other by the same peculiarity as was pointed out in their manner of measuring a base-line : the one may in fact be called the practical, and the other the theoretical method: the circle of Troughton, always employed in English surveys, by construction maintains a perfect horizontality, and depends upon the beauty of its division alone for the true measurement of the angle. The repeating circle of Borda, used by the French academicians, on the contrary, seeks to overcome errors of division by bringing the whole circumference of the instrument in succession within the measured angle. It also necessitates a theoretical reduction of each measured angle to the plane of the horizon. Again the English surveyors generally place their circle over the centres of their stations ; the French almost invariably had a correction, both for the eccentricity of the signals, and for that of the observer, to say nothing of the smaller one, for that of the under and upper telescope of their repeating circles. Delambre, where it was possible, obviated the correction for the observer's place, by placing himself in the direction of the tangent to a circle supposed to be described about the triangle under measurement, on the principle of angles at the circumference, having the same base, being equal : A being the true centre of a station, the observer placed himself at D in a tangent to the circle ABC ; the direction of the line AD being found by the equality of the angles CBA and CAD the former of which had been previously determined. (fig. 2.)

The French generally took twenty repetitions of each horizontal angle, together with ten measurements of the zenith distances, or dip, to reduce the former to the plane of the horizon ; whereas Colonel Mudge, from the nature of his circle, could rest well satisfied with four or five readings of each azimuthal angle only.

With all the accuracy of both methods however, differences of 1 or 2 seconds, and sometimes even 8 or 10, are observable in the best registers of terrestrial angles, and lateral refraction will always tend to oppose a limit to their accuracy hardly short of the former amount.

The superiority of the new circle made by Troughton for the Indian Survey, consists in its having 5 microscopes, which allows of the angle being read on 10 different parts of the divided circumference, with one reversion of the telescope; in the beautiful contrivance for lifting and turning the instrument to change the position of the zero ; and in the substitution of a microscope in lieu of a plumb line, to adjust the instrument centrally over the station dot. These improvements will be acknowledged by the practical surveyor to be most valuable, in the saving of time and trouble to himself, as well as the removal of many causes of danger to his instrument.

The points determined for the positions of the series of triangles are distinguished from the theodolite station by means of *signals*, and these are found to require many precautions in practice : first, as to the direction of light thrown upon them, as it is sometimes only the illuminated portion which is visible—sometimes the darkened : Mechain's angles have differences of 30 seconds due to this cause. Secondly, as to shape and size : In France, pyramids of plank or cones of straw work were used where natural objects, such as towers and spires, were not at hand ; night signals could not be employed, because of the revolution, amidst the horrors of which the labours of the academicians demanded caution as much as intrepidity.

It is generally assumed, that for day observations a signal mark should subtend an angle of three seconds in space: if projected upon the sky, it should be painted black; if upon green foliage, white:

In the English survey, under Col. Mudge, Bengal lights were introduced as signals, and they seem to have added greatly to the precision of the angles, as well as to the facility of observation in dull weather. Reverberating lamps, or Argand lamps fitted in the focus of parabolic mirrors, soon supplanted the troublesome fire-work, and Lieutenant Drummond, in the Irish trigonometrical survey, has further improved this kind of signal by the substitution, in lieu of the oil burner, of a fragment of lime ignited by a stream of mixed oxygen and hydrogen gases, which presents an intense light, visible at an immense distance.

The signals brought out by Captain Everest are of three kinds: one, the reverberating lamp for night-work, already described; the second, a *heliotrope*, or circular plane glass mirror to be adjusted over the centre of the station and to reflect towards the observer at the theodolite a portion of the solar rays: the light produced by this simple contrivance is so powerful as to penetrate the morning mists of India with great ease. The principal difficulty in the use of the heliotrope consists in giving a right direction to the reflected ray: this is effected by means of a cross wire placed in front of the heliotrope, in the ascertained direction of the distant station, upon which the light is centrally directed: near the theodolite is placed another heliotrope throwing its image in an opposite direction towards the signal station. The third is the *lime* or Drummond light already mentioned, for a description of which we must at present refer the reader to the last volume of the Philosophical Transactions.

The triangles thus being found with the utmost accuracy, and corrected for spherical excess, or the rotundity of the earth's surface, the lengths of their sides are deduced from the original base, and converted into a meridional line by bearings taken at every station, that is, by measuring the angle formed by a side of the triangle and the north-pole. Azimuths of the polar star, at its greatest elongation, east and west, supply this point, and where the celestial and terrestrial sights cannot be coincident, a small lamp fixed at a convenient distance is introduced as a referring point or meridian mark: the lens of this lamp is adjusted so that the light may issue towards the theodolite in parallel rays.

The field operations, being now supposed to have been carried over a sufficient space, are terminated by the measurement of a base of verification with all the precautions described at the commencement of the work.

III. It now remains for the geodest to determine the celestial arc corresponding to his terrestrial measurement: in other words, to find the latitude of his extreme (and if requisite, intermediate) stations.

The latitude derived from the sun or circum-polar stars of moderate elevation, involves the uncertainties of polar tables, of deflection of the instrument by heat, of refraction, &c.; in all great surveys, therefore a zenith sector has hitherto been employed: this is nothing but a long telescope fitted with a portion of a circle of very large radius (8 or even 12 feet) for observing the altitude of stars within a very few degrees of the zenith where the refraction is nearly insensible. The zero of the instrument is marked by a very delicate plumb-line, but it is too well known to require further description.

The stars observed with the zenith sector have to undergo correction for nutation, precession, and aberration, unless they can be compared with the simultaneous observations of some established observatory in the neighbourhood; in this country such could never be the case, aud even in England the catalogues of Mudge's latitudes exhibit discrepancies of 5″, while the variation of his theodolite angles seldom exceeds a sixth of that quantity. Part of these errors may be due to the instrument, for it is doubtful whether the great dimensions of such telescopes, with their wooden frame work, gives them any real advantage over metal ones of more portability and compactness. Captain Everest, however, determining to free the Indian arc, as far as possible, from the errors of catalogues, calculations, and instruments, has commissioned from the first of English artists, Troughton, two three-feet circles of exactly similar construction: one will be placed at each extremity of his measured meridional arc; and the same stars, and any number of them, will be observed with the two instruments simultaneously for a sufficient period: nothing can promise greater perfection of result than this simple plan, and the liberality of the Court of Directors in disregarding the small addition of expence, deserves the highest praise.

Part of the errors of the vertical angles are attributable to the attraction of mountainous masses upon the plumb-line of the instruments: this cause of irregularity has been experimentally investigated by Maskelyne, Hutton, and by Playfair in his survey of Schehallien in 1774. The correction in most cases was thought trivial enough to be omitted in Mudge's survey, but Don Rodriguez in a very able manner reconciled an anomaly which came out on the publication of the Colonel's measurement, whereby the length of a degree seemed to decrease, instead of increasing, towards the pole, by proving that the local attraction of Arbury hill must have influenced the latitude taken at that place to the large extent of five seconds. Captain Everest in his account of the Indian survey gives a similar instance of the necessity of attending to this circumstance, which Colonel Lambton was inclined to disregard. The plumb-line of their zenith sector on approaching the edge of the lofty table-land, north of the Taptí valley, was drawn perceptibly to the north, and vitiated the latitudes taken in the valley to the amount of a few seconds.

Connected with the trigonometrical determination of the earth's figure, are the experiments made in various parts of the world upon the length of the second's pendulum, so much encouraged within the last few years by the introduction of Captain Kater's convertible pendulum. At Madras, and on a small island, near the equator (*Gaunsau lout*), Mr. Goldingham has already provided us with a most elaborate series of experiments on this subject, which agree more closely than those made in the Atlantic, with the other deductions of geodesy. To complete the equipment of the Indian survey, a Kater's pendulum with clock and a tripod stand, similar to that used in the polar expeditions, has been supplied: and a duplicate instrument has, we understand, been also sent to the Company's astronomer at Bombay. A first series of observations with this instrument has already been made at the Surveyor General's office, with the results of which we hope in due time to be made acquainted.

Before concluding our brief and imperfect sketch of trigonometrical operations, it might be expected that we should enter briefly into a statement of the results of all these vast undertakings, and their influence upon the sum of our knowledge regarding the exact shape of the world. But here we must be still more brief, for, even were we competent to the task, this elementary essay were not a fit place to discuss the many subtle points upon which the first geometricians of the day are at variance. It has been found, that none of the three series of experiments directed towards the solution of the problem, namely, those of the pendulum, the meridional arc, and the perpendicular to the meridian, yield a perfect accordance with one another: and many have hence supposed the earth to be an irregular solid beyond the reach of mathematical analysis. Mr. Ivory has however taken up the question in the mode best calculated to expose the limits of uncertainty: after patiently examining how far many of the points at variance might be traced to the formulæ of calculation used in the survey, and in this way expunging so large an anomaly as 200 fathoms in the perpendicular degree of Dunnose, he applies an assumed excentricity of the ellipsoid, $\frac{1}{300}$, to all the arcs, perpendiculars, and pendulum lengths, hitherto accounted of any authority, and shews that the theoretical assumption does not differ from the practical results more than can well be attributed to unavoidable errors. He thinks it therefore established that the earth is a regular solid of revolution, having its meridians truly elliptical, with an excentricity not much differing from $\frac{1}{300}$. As far as India is concerned, it is satisfactory to see that Colonel Lambton's and Mr. Goldingham's labours are among those which have received the most implicit confidence in Europe; and their results tally very nearly with Mr. Ivory's assumed ellipticity. We may feel assured, that the remainder of the task will inspire an increase of confidence proportionate to the superiority of the instruments now introduced; and we may look forward with eager interest to the recommencement of the campaign of science under the auspices of one so well qualified to lead in the field as its present conductor.

II.—*Overland Journey to India.* *By* Lieut. Arthur Conolly, *6th Regt. Bengal Light Cavalry.*

Quitting London 8th August, 1829, I travelled through France and Germany to St. Petersburgh. There two English friends joined me, and we proceeded together viâ Moscow, and the capital of the Don Cossacks, through and over the Caucasus mountains to the capital of Georgia. At Tiflis we sold our carriages, and buying horses, rode across the Arras to Tabríz, where we spent the winter, in the very pleasant society of the English then at that place with the British mission.

Wishing to follow a new road to India, I engaged a native of that country, many years a resident in Persia, and much in esteem with the English there, to accompany me on an overland route. Syed Kerámut Alí was as unprejudiced as learned, and I had more than one occasion to congratulate myself on having such a companion.

We rode from Tabríz 6th February, 1830. The snow lay deep on the ground, and our road was a narrow foot-path, which, if we missed, we were plunged up to the horses' girths in the drifts on either side. We left Tabríz still in the depth of winter: 15 days after, when we reached Tehrán, such was the difference of climate, that the trees were in blossom.

At Tehrán our object was to obtain bills for the road. The late envoy, Sir J. Macdonald, had most kindly authorized me to draw upon him during my journey, and had referred me to his banker, a Hindú, at Tehrán: at this time however the man was absent at Yezd. Shortly after our arrival, a severe earthquake drove the inhabitants from their homes, and business was at a stand. Though earthquakes are events of common occurrence in Persia, the panic spread by this one was great; several houses were thrown down, and part of the arched brick bazar fell in; we rode through it after the first shocks, and saw the deserted shops open, with the various goods displayed as for sale. In all open places were grouped families with their most valuable portable effects: in some cases the sick had been hurried from their houses, and anxiety was on every face. Unable to get bankers' bills, we thought ourselves fortunate in obtaining from a Parsee merchant cash for a draft, which added to what we before possessed, we calculated would pay our expenses to India. We converted the whole into gold ducats, and secured them in belts round our waists.

To Astrabád, through Mazenderán, our journey was delightful. It is a province of mountains, which are clothed from base to summit with the forest and fruit trees of Europe and Asia. The wild vine twines itself round the large trees, and drops its tendrils from the highest branches. The walnut, the mulberry, the pear, and pomegranate trees were in profusion; and their blossoms were in beautiful relief to the dark foliage of the forest trees: the turf was green and covered with flowers, and the wild rose and the hawthorn perfumed the air. The narrow vallies between the high mountains are cut in steps, like the hanging gardens of Lahore; through each one runs a stream, the water of which raised to the level of the highest step, falls successively upon the others into its bed again. On these descents is grown rice, the staple food of the inhabitants, and an article of considerable export.

Mazenderán is an unhealthy province; the villages are high up in the mountains, and a few only of the men come down into the valley to look after their rice grounds, and profit by travellers, who do not follow this road in summer, on account of a malaria which is said to be produced by the thick forests and saturated vallies.

We passed through Sári the capital of Mazenderán, which though called a fortress, is a place of no strength; and we spent a day among the still magnificent ruins of the palaces of Shah Abbás at Ashraf. Hence we had a view of the Caspian sea, down to the very coast of which runs a thick forest; through this we travelled to Astrabád, and took up our lodgings in the merchant's caravanserai.

Astrabád is a moderately sized town of no strength, situated close under the richly wooded mountains of Elborz. It is chiefly inhabited by Cujjers[1]; and being a frontier town, is governed by a prince of the blood royal. 10 miles north of Astrabád is the river Gúrgán, on the fertile banks of which you first meet the Túrkmáns. Those who are seated near this river affect an allegiance to the Shah of Persia; but it is a very nominal one, and they have so little regard for his Majesty's fellow subjects, that they catch and sell them when they can. An Astrabádí dares not go to Gúrgán without the safeguard of a Túrkmán, nor does a Túrkmán think it prudent to come to Astrabád without the guarantee of a townsman.

We presented letters which the Parsee merchant at Tehrán had given us, to two merchants of the town, who received us kindly, and who answered our inquiries about the possibility of our getting to Khiva, by engaging to send us there safely. We were accordingly introduced to one Orauz Kouli, a Túrkmán, with whom our friends were in the constant habit of dealing for horses; and he said that he would provide a man to conduct us there. To have some pretence for the journey, I assumed the character of an Armenian merchant; the Syed took that of my partner, and we purchased for the Khiva market, red silk scarfs, kerman shawls, furs, and some bags of pepper, ginger, and other spices. For our own use on the road, we were advised to take rice and tea, and our friends kindly baked a large supply of biscuit for us in their *anderúns* (inner, or women's apartments).

April 24th. Rode with Orauz Kouli and our two Persian friends to Gúrgán. Four miles of our road were through a wood, in which was a vast lake, and our path lay chiefly over the heads of many strong dams, raised, that the water might be kept for rice grounds; then we rode for six miles across a very rich meadow, over which,

[1] Those of the tribe from which the present Shah of Persia has origin.

in every direction, herds of oxen, horses, and camels, and large flocks of sheep and goats, were choosing their pasture. The banks of the river were dotted with neat black tents, in camps of from 30 to 80 families. Orauz Kouli led us to his oubeh[2] on the bank of the river, and hospitably entertained us till we quitted it.

The Gúrgán measures 60 yards from bank to bank: its bed is deep, and in spring, when the snows of the Elborz melt, there is much water in it; but in summer it is shallow; the water, though not clear, is sweet, and very drinkable. Three miles' breadth on either side is cultivated with the finest wheat and barley; the ground is just turned up with a wooden share, (to which is yoked a horse, bullock, or camel,) and gives an increase, it was said, of from 70 to 100-fold.

The Túrkmáns now to be noticed, range from this river northward to the parallel of Khiva, and eastward to the banks of the Oxus, divided into large tribes, which have so lost regard for their common origin, that many of them are at variance with each other.

The large tribe of "Yimút" occupy the banks of the Gúrgán 50 miles east from the sea, and extend up the right coast of the Caspian to above Balkán bay, when meeting with the small tribe of "Attah," they turn and range the desart eastward to near Khiva[3].

The "Gôklans" are a smaller tribe. A few miles of neutral ground are left on Gúrgán between them and their enemies the "Yimúts," and they then possess the banks of that river for about 90 miles till they meet another enemy in the "Kúrds," who were removed from the Turkish frontier by Shah Abbás, that they might be between the Túrkmáns and his people. The "Gôklans" do not at most range more than 40 miles north; at enmity both with the "Tekkahs" and the "Yimúts," they are obliged to keep back upon Persian Khorassán, and may be considered as subservient to the Shah: living a more settled life than other tribes, and having fine lands, they raise much grain, and have great herds and flocks.

The "Tekkahs" range from north of the "Gôklans" up to Khiva, and beyond the parallel of Merve, are found upon the banks of the Oxus. They render feudal allegiance to the Khan of Khiva, and are the most powerful tribe we know[4]. It is chiefly the "Tekkah" Túrkmáns, who make inroads into Persia; they either make a descent upon a village, or lay wait for a kafila; kill the old and useless, and carry off captive those who are strong or handsome. Slaves are sold in the markets of Khiva and Bokhara twice a week.

The Túrkmáns rove the desart in parties proportioned to its fertility in different parts. They prefer a wandering life, and though they may settle themselves on any fertile spot, they keep up connection with the rovers in the desart, and generally return to it. The rovers possess many camels, and also flocks of sheep and goats, which manage to thrive upon the scanty vegetation of the

[2] Turkish word for camp.

[3] A small tribe of Yimúts called Ogarjeli, are settled on the east coast of the sea; they have boats and catch fish, which they salt and sell in Persia. They also reap much profit from Naphtha, which rises in wells, dug for the purpose. Profiting from their intercourse with the Russians, they are said to be more friendly to them than their inland brethren are.

[4] South of Merve till they meet the Usbegs, are found small tribes, chiefly branching off from the tribe called "*Salour.*" These are generally known by the appellation of Serruxes, on account of their being thickly seated about Serrux: they form a confederacy, and occasionally take part in the quarrels of the Khorassán chieftains.

desart. Those on the contrary who settle near fine grass lands, keep but few camels, and have large herds of cattle, besides their flocks. They both rear a fine race of horse, which when crossed with the Arab is very superior. The extraordinary marches that these animals make, when their masters are on a foray, prove their mettle.—The food of the Túrkmáns is wheaten or barley bread, baked in embers[5], curds, frequently rice (or Yarma[6]) and sour-milk, and occasionally mutton, or camel's flesh ; their drink is butter-milk. The Túrkmáns who rove towards Balkán are dependent upon Persia for supplies ; those beyond, get theirs from Khiva, as they can raise no grain in the desart. All have a share in the cultivated lands, parties of the rovers coming in at sowing and reaping times. Their luxuries are articles of gayer clothing than they can manufacture themselves, a few spices, coarse sugar and tobacco : these things they get chiefly from petty merchants, who come among them with a "sauf conduit" from Persia.

Every great tribe is divided and subdivided into smaller clans which, retaining the common name, have each a distinguishing one ; that probably of a patriarch who went out from a large society to form a new one : as for instance,

Yimút, ... [head of the tribe.]
Chúni, Sherruff, Bairam Challi, Cowjuk Tatar, .. [4 main branches.]
Jaffer Bi, Yelgoi, Auk, Otaboi, Dévechí, &c. [to 20 divisions of these.]

The divisions of tribes have their understood ranges : within them are many stations ; places where forage is most plentiful, and water best : and they rove from one to another as the herbage becomes exhausted, not staying more (with the exception of winter time, when snow is on the ground) than from six to ten days at each.

Our host introduced us to an elderly man named Pírwalí, owner of four camels, who engaged to take us and our merchandize safely to Khiva. One camel carried a pair of cajávas[7], for the Syed and myself; two others were laden with our merchandize, (the 4th was to be got at the *Attruk*,) and a Persian servant, Meshedí Nouroz, a Tabrézí who spoke Turkish, and who took the alias of Abdúllah, as better sounding in Súni ears, stationed himself upon the spice bags. Pírwalí, our guide, led the march on foot ; and a young Khivian, who had brought a Kalmuck Tartar girl for sale to our hostess, being about to return home, accompanied us on his own horse.

We quitted Orauz Kouli's tent on the morning of the 26th April, 1830. At parting we presented our hostess with a red silk scarf, (not to affront her with the offer of money,) and receiving in return "Khosh geldin, Allah Yarin"—you are welcome, God be with you,—we commenced our journey.

We crossed the Gúrgán, where the water was up to the horses' girths, and took a northerly direction. After six miles we lost the meadow land, and entered upon a light, dry soil, where, save here and there patches of good grass, grew only small thorns and weedy bushes. We halted at evening from half past 5 till 8, to graze the camels ; then continuing our march two and a half hours more, halted till four in the morning.

27th.—At half past 5, forded the Attruk river, distant about 27½ miles from Gúrgán : it is 40 yards broad, and when we crossed, the water was up to the middle of a man's thigh. It was so muddy, that we could not wash with, much less drink it : the Túrkmáns however seemed to think it very good, and it

[5] Wood is burnt to a red heat, and the dough is covered up in its ashes till baked.

[6] Bruised wheat.

[7] Wooden cribs slung like panniers on a camel's side, 4 feet by 2, open to all weathers, on which we sat or lay on our bedding.

may be so when its mud has settled. In early spring this river overflows its banks, and the Túrkmáns sow Jawarí [8], and melon seed in the alluvial ground. We saw no tents here, and soon lost the good soil. With the exception of one hour's halt, we travelled on all day till 5 in the evening, when we halted at a long pool of rain water, and collecting a heap of weeds, made a sort of fire, at which we boiled some rice and tea. At 8, we resumed our march, and kept on a northerly course over a bare country all night till 4 in the morning of the

28*th*.—Halted one hour, and marched on. Passed in the morning over the remains of a town, once apparently of good extent, and as it seemed, systematically laid in ruin; not a stone was upon another to mark the form of a building, but square well-burnt bricks lay in detached low mounds over a considerable space. At one, we came to 22 Yelgoi Yimút tents, and got some camel's cháal, (butter-milk,) the acid of which was most refreshing in the heat. Six miles to the west of us were the ruins of a city called Mcshid-í-Misreán ; two minarets and a mosque were seen hanging in air above a cloud of vapour. Here we altered our course to N. N. E. and travelled at a less quick rate that day, the 29th and the 30th, over the same sort of country, which I will here describe.

The desart generally is of a light soil, white, and inclined to be sandy, yet so firm, that in dry weather camels barely leave the print of their feet upon it. This soil produces thorns and weedy bushes, much camel thorn, a root like the stem of a vine, called Tákh, and stunted Guz bushes. Much of the ground is quite hard and bare, and in parts spring patches of coarse grass, doubtless when water is near the surface. A third feature is the sand: this is either spread loosely over the plain, or is gathered in broad ridges, which assume some consistency. In such spots the Túrkmáns love to encamp: the young cattle thrive, good water is found at no great depth, and the camp is more private and sheltered from the wind [9].

On the 30th April, in the afternoon, we came to the bank of a nullah, into the dry bed of which we descended. This after a while led us into deep ravines, and from thence we passed into what appeared to be the dried-up bed of a once very large river. We journeyed for two hours N. E. up this bed, and then halted to cook a lamb, which was roasted *à la Tartare*, on ramrods, over the trunk of a withered tree. My companion and I parting from the centre, walked each to a bank, and measured about 500 ordinary paces each; the soil differed from that above, having more stones and pebbles, and against the left bank to which I walked, and which was *very* high, many large stones were collected, and the earth near it was coned up as if by the strong force of water. For some distance the banks would run at a breadth about equal to that we measured, then they would be entirely broken into a succession of parallel deep ravines, each the size of a nullah. It must have been a great convulsion of nature which tore the sides of this river open. Moravief talks of an earthquake, which happened 500 years ago; we heard of a great flood at that time, but the Túrkmáns have no books, neither have they very positive notions about time or events. We set off again at 8^{h}. of a dark rainy night, in which not a star shone to guide us. After an hour and a half, we quitted the bed, and got into a narrow path between rocks: we lost our way more than

[8] They give this grain to their horses (though they chiefly feed them upon barley), and think the young Jawarí stalks, which are very sweet and fattening, good food for their cattle.

[9] Wild leeks, and a sweet root called Koussuk, are found in such spots; a fine grass also grows in the sand, but every blade is far from its neighbour.

once, and finally halted from 2 to 5 in the morning, at a spring of delicious water, rising from a plateau of fine grass. The hills were apparently of volcanic origin; being formed of differently composed rocky strata, irregular and of various colours. On some of the narrow flats between the hills grew excellent grass, and here and there a small tree. We marched away from the spring N. E. In an hour we got upon the plain again, and halted near some Guz bushes, with which we made a fire to dry our clothes and bedding by [10]. We travelled the whole day across a barren white plain, on which there was not a blade of grass,—not a weed: in parts the surface was encrusted with salt, and the bones of a camel which lay bleaching in the sun, were the only sign we had of any other one's having passed over so waste a place. Before us was apparently a forest, but when we neared it at evening, we found only large bushes growing in deep sand, with here and there a stunted tree, so much had the mirage deceived us, although we had become accustomed to its illusion. A cuckoo was singing on the decayed branch of a small tree: we saw some beautifully colored paroquets, the body green, head and wings of a rich brown color; and desolate as the scene was, there was a beauty about it in the stillness of broad twilight. Occasionally, during our journey, we had started a hare from a bush; many antelopes bounded across the plain, and the desart rat (an animal rather slighter than a common rat, with a tuft on the tip of its tail, and which springs with four feet like a kangaroo), was every where common. At sunset we left the hard plain, and by a heavy sandy road between weedy bushes, kept on our course till half past seven, when we came to a large pond of water called Chín Mohamed, where we halted all night.

May 2d.—As we were about to resume our route, a party of Túrkmán horsemen came upon us at a gallop, one of whom we recognized as the brother of our Gúrgán host; another as the brother of our guide Pírwalí; the other two were ill looking villains, whom we had not seen before. They had ridden, they said, to our assistance, one Súltan Mohamed having set out with a party to rob and murder us, and we must turn aside with them to a place of safety. Though we saw the lie on their countenances, we felt our helplessness in the desart; so told them that as we were their guests, we would of course go where they thought fit to conduct us.

They led us back for four days and nights, nearly the road we had come; at one time affecting kindness, at another displaying their ill-feeling towards us; convincing us that their story was false, and that we had them only to fear. They avoided all camps, and were joined by 2 others on the road. Early on the morning of the 6th, we came to a large burying ground, where were many large stuccoed gúmbaz (domes) in good repair; round one of them (not to be out of fashion,) we performed Zeárut[11], because a black slab (supposed to have fallen from heaven with the holy one now in the Cábaa), was fixed in the wall outside. Cúfi characters were cut on a stone within, of which the Syud could only read *Bismillah*, probably the opening verse of the Koran.

Hence we marched five miles west, and passed close by the south wall of the ruined city Meshid-í-Misrean. It was four-square, each face of somewhat

[10] These hills are called Aujíri. About 30 miles distant on our left was a range of higher hills called Balkán. We learnt that there were several springs and much verdure in them, and that many Túrkmáns lived in them during the summer.

[11] The ceremony of walking round a sanctified place, which is supposed to balance many sins. My friend feared that they were compounding for that of killing us, and that they had come there to make the deed "hallal," as the Wahabee pirates thought they did by exclaiming "Allah ho Acber," when they cut their victim's throats.

more than ¾ of a mile. We counted 25 bastions in the south-wall, chiefly of burnt brick, and some of them double, like two nuts of one shell. Being on a camel, we could see over the broken wall, before which was a nearly filled-up ditch: there were many ruined houses, and in the centre two very high minars and a mosque in good repair. On two sides were remains of high-arched gates, such as now front royal residences in Persia. In advance of the south wall was a watch tower, and fronting the eastern one, was a large stuccoed mosque, in excellent repair. Outside the city had evidently been mixed gardens and houses, and at some miles distance we passed a mosque, round which we thought we could distinguish where the beds and walks of a garden had been, from the rain resting in the former[12].

We kept on towards the sea, a little to the south of west, meeting no one; but during the whole of this day, we viewed marks of buildings and canauts, which proved that the plain had once been populously tenanted. The remains were evidently Persian, shewing that the latter people had yielded to the encroachment of the Túrkmáns, until they had been brought up by the hilly country, which it would not suit the Tartars to occupy. An hour after sunset we halted at a patch of coarse grass, and our conductors busied themselves in keeping alive in the rain, a fire by which to cook a young deer, which they had ridden down. We had gradually become less cordial, and I believe kept a wary eye on each other, as we retained our arms, so that we were considerably alarmed when our servant, who alone understood Turkish, told us that the Túrkmáns intended to murder us, and proposed being before-hand with them when they lay down to sleep, seizing their horses, and riding to the coast, or to Astrabád. We rejected this murderous and wild proposal, but passed a most comfortless night, exposed to rain, and in fear of being attacked.

The next morning our guides thought proper to come to the point. They said that I was reported to be a Russian spy in Abbas Mirza's service, travelling with loads of ducats on my master's business, and that they must examine our baggage, to judge how far the story was correct. They were much disappointed on the examination of our effects, to find pepper instead of ducats; but begged us to produce our purses, and on various pretences, deprived us of half our money, and some of our clothes. They then said, that the danger being now past, they would escort us back to Khiva; but suggested that as our money and provision had both decreased, we had better recruit them from Astrabád. They volunteered to carry the letter to our friends, but forgot not to promise to cut our heads off if we wrote aught against them. They then helped to load our camels, and rode away with the letter, leaving us with our rascal guide Pírwalí, who led us about the desart in all directions for two days, having for object to keep us out of sight till his friends returned, and flattering himself that we did not know in which direction we were going. On the evening of the second day, seeing some tents in the distance, we threatened to shoot Pírwalí if he did not go to them, and much against his will he reached them about 9, by moonlight.

The encampment belonged to another tribe. Pírwalí found one of his own branch who had married into it, and he made us guests in his tent. We were with this

12 Of Meschid-i-Misreán we could obtain no satisfactory accounts: the Túrkmáns esteem the place holy, and carry their dead to be buried there. Those who had been within the walls said that there were many Cúfí inscriptions, and that coins impressed with the same character had been found there. There are several large ruined towns besides Meshid-i-Misrean in advance of the present Persian frontier, which, perhaps only fell to ruin when the founder of the Karasmián dynasty invaded Khorassán at the death of Shah Ismael Sufi.

Lieutenant Conolly's Route from Tiflis to Meshid

Túrkmán Tents.

Frame-work of Sticks

Felt covering

tribe nine days, marched with them, and saw much of their mode of life. They marched with great regularity: the women had the chief share of the labour, in striking and packing the tents, &c. and during the march they led the camels on foot. The sheep were driven ahead by themselves, and the men on horses, patrolled on all sides, at a great distance. In the course of the march, we made a few acquaintances in the new "Oubeh," and should have been inclined to think them very pleasant people, had we not feared that they would assist to sell us. The Syed professed himself a rigid Súni, fresh from Mecca Sheriff; and such was his tact, that he began to establish an influence over these superstitious Tartars. He talked much of the dignity of the Prophet, as violated in the person of his descendant, and of the sure vengeance that would follow; and on the other hand, he uttered hard Arabic sentences, and used an entire deer's skin, in writing charms for the prosperous increase of man and beast. Abdúlla and I practised a little physic; but though they began to look kindly upon us, they were shy of taking our part, as Túrkmáns are bound not to interfere in each other's affairs. A quarrel which they had with Pírwalí's tribe, and their having no share in us, led them gradually to think us ill-used persons; but we owed our escape to the providential arrival in camp of two merchants from Astrabád with goods for sale. These men knew us, and told us that we were reported to have been murdered, (a trick of our captors, to try the effect of announcing our death, that they might, if our friends appeared resigned to our loss, sell us.) The Persians who possessed a considerable influence in the oubeh, at once embraced our cause (thanks to their being Sheahs), and at the suggestion of the Syed, declared that they had started from Astrabád some days sooner than had been their intention at the solicitation of our friends, who were anxious for our return; and we, to give force to this fib, which was pretty well understood by all parties, courted the leading men with presents from what remained of our property. They seeing that it was more to their profit to assist than injure us, suffered themselves at last to be convinced that we were by right free agents, and turned round upon Pírwalí, whom they disliked for the grudge they bore his tribe. He not being able singly to make head against the whole camp, was forced to admit, that he had no better reason to prevent our choosing our road, than the fear that it might be thought he had not kept his agreement with us. The Syed in answer, begged him to dismiss such an erroneous idea from his mind, and declared publicly that for no man had he a higher esteem; he then on the spot engaged, from one of the assembled company, horses to carry us back to the frontier. We started that night under escort of a dozen Túrkmán mercenaries, and our two Persian friends, and rode 160 miles, to Astrabád; in which town we found ourselves again on the 19th of May, safe, but without money.

The Caspian desart has been described. We satisfied ourselves that it would not be difficult for a power stronger than the Túrkmáns to reclaim a considerable portion of it inland from the coast. Much of the soil, (that especially between the rivers Gurgan and Attrák,) is good, and water is found at very little depth below the surface.

Of the Túrkmán character I believe that we were able to form a just estimate, from the opinions of many who lived near them, and from our own experience. The Túrkmáns are like other wandering tribes, fond of the name of some virtues, but little inclined to forego their own interests by following the spirit of them. They profess the Súni Mohamedan religion, but if they ever had a real regard for any feeling other than superstition, avarice has superseded it. They are in many cases guided more by old custom than by the ordinances of the Mohamedan law, though they are glad of a text that they can turn to their own purposes; and they give great latitude to the one which authorises them to make war upon Kafirs.

The hospitality of a Túrkmán is of that sort which will induce him to give you bread in his tent, and to fall upon you when you are beyond its precincts; and though he will keep good faith with one of his own race, I doubt whether he would not find a law to evade a pledge given to a stranger if it was much his interest to do so. They are great thieves, greedy, and cruel; and it is I imagine chiefly to the cowardice of the Persians, that they owe any reputation for bravery: they make a dash upon a mass of frightened people, cut down a few of the least valuable persons, and do not find it difficult to drive off the greater part of the rest; but when they exchange blows with the Kúrds, who are good soldiers, they are generally worsted.

The men, who have an overweening idea of the consequence of their sex, and of their part of it especially[13], lounge about idly when at home; but they are capable of great exertion when any thing is to be gained by it, and considering the immense fatigue that both they and their horses can undergo upon the scantiest fare, it must be admitted that few irregular troops are equal to them. We expected to find them the very Parthians of old, and to witness prodigies done with the bow and arrow; but we hardly saw this weapon: the sword and light lance, were in general use, and all who could afford it had a gun of some sort or other.

The dress of the men is very similar to that of the Usbegs: a cameze[14], and zerjamas[15], alkhalik[16], and a camel hair abba[17] belted round the waist over all: hessian boots with pointed iron tipped heels, and a sheep skin cap; but the two first named articles frequently suffice them, and they are not particular about wearing any nice article of clothing that they happen to light upon in a stranger's wardrobe.

The women are dressed in a long chemise, open in front, which reaches down to the naked heels, and covers I believe a pair of zerjamas. They wear the hair in two long plaited tails, with a bunch and ornament at the end: young girls part theirs "a la Madonna," but it is the privilege of a married woman to put upon her head a heavy and ugly cap, something like a hussar's: from the back of this drops a red silk scarf, and in front are strung as many gold coins as the husband can afford.

The Túrkmáns marry at a very early age. Women are esteemed among them according to their knowledge of the "ménage;" consequently, a widow is more in request than an unmarried girl. They have very arbitrary laws in regard to their progeny: children born of other than Túrkmán fathers and mothers, are called *kouls* (literally, slaves), and neither they nor their descendants ever lose the appellation, though they live among, and on terms of general equality with the *Eegs* or freemen. In speaking of them, a man will say, Koul-e Otaboi, Koul-e Yelgoi, &c. The term is not one of reproach, but the Túrkmáns of unmixed descent do not from custom intermarry with them, and retain certain peculiar privileges, the greatest of which extends even to the life of a Koul, which an Eeg may take without entailing upon himself the blood feud, which would be the consequence of his killing a freeman. This privilege has its limits, for the freemen of a tribe esteeming themselves protectors of the Kouls who live with them, would resent an abuse of it; and wedded

[13] The Syed once saying to Pírwalí, that he had some thoughts of settling in the desart, and asking for his daughter to wife, was answered by this dirty and ragged old villain—Nay, nay, Syed Aga, a joke's a joke, but nothing of *that* if you please.

[14] Trowsers. [15] Shirt. [16] Vest. [17] Cloak.

as the Túrkmáns are to old customs, this one will probably become yearly less influential, as the Konls form already a large majority among the tribes.

The Túrkmáns capture many beautiful women in Persia, but prefer making money, by selling them in the markets of Bokhara, and Khiva, to taking them to wife. The women of pure Tartar blood are proud of it, and ill disposed to share their lords with a stranger; so that a man will for the sake of peace content himself with a wife or two of his own race. Of the passion of love, as civilized beings imagine it, they have but a faint idea, and indeed if they valued personal above other attractions they would soon be disappointed in their wives; for the hard labour that the latter perform soon causes them to lose the little beauty that can be found in a Tartar girl's face, and to appear aged: a really old Túrkmán woman looks as if she was made of leather. The women are very seldom idle, and talk little; when men are conversing near them, they draw up a small piece of cloth from their bosoms over their mouths, to signify that they take concern only in their own occupation. They are assisted in their labours by slaves, who live very much like dogs.

The tents in which the Túrkmáns live the year round, are made of stick frame-work, covered with thick felts. They are light and roomy, and are a defence against all weathers. The accompanying sketch designed from recollection, may help the description. Four pieces of frame work are set up in a circle, place being left in it for the lintels of a wooden door. To the top of this frame are fastened the ends of long pliant sticks, which bend up in the shape of a dome, and are fixed in a circular hoop of wood, which forms the top and the chimney of the tent.

They are a dirty set the Túrkmáns, and subject to much disease. Water is but sparingly used, and they wear the same clothes for a shockingly long time. In the Oubeh of 45 tents, we saw few whose eyes were not partially affected: there were some bad cases of ophthalmia, a stone-blind old woman, and a raving madman. Cutaneous disorders and rheumatism seemed to be common, and we saw cases of leprosy, and elephantiasis[18]. Taking into consideration all things connected with the Túrkmáns' mode of life, their exposure to the extremes of climate, their bad food and their total ignorance of medicine, &c. a conjecture may be hazarded, that the population of these nomade tribes is not on the increase, and that as many now inhabit the desart as could be supported in it.

We were on the road towards Khiva, (not I imagine the usual one,) 127½ hours, of which we marched 84½, and halted 43½. I think we were justified in laying down as a rule, that caravans march nearly two hours for one that they halt, and loaded camels do not advance at the rate of more than 2¼ miles an hour; so that, if the number of days march to any place can be ascertained, the distance may be nearly guessed.

From the 26th of April to 19th May, the thermometer in the shade at noon ranged from 76 to 80 Farn. there was usually a light wind stirring, and the nights were cool.

At Astrabád, we were so fortunate as to get 50 tomauns cash, for a bill on Tehrán, which bought us horses, &c. and paid our expenses to Meshíd. We wrote to our friend, requesting that money might be sent to us at that city, and after

[18] One child was brought to us who was a most extraordinary object; on his legs and arms, large excrescences of bone had formed: they were covered like the other bones with flesh, and the veins were carried over them; the child's health and spirits did not seem to be affected.

nearly a month's detention by the Prince[19], who pretended that he would recover our property, we took a second leave of the town, and travelled across the Elborz mountains to Shahrud Bostan, where the pilgrims for Meshíd assemble.

We joined a party of 600 pilgrims, (Persians, from all parts of Iran, and Arabs,) and by the route of Subzawar and Neshapore travelled in great fear of the Túrkmáns who infest the road, to the holy city. The whole distance is about 279 miles, 160 of which to the large town of Subzawar are through a barren country, and the three first marches are 40, 45, and 22 miles, with no water between them. The country gradually improves to Neshapore, which is a very flourishing city in an extensive closely cultivated valley. Hence, for 28 miles the road goes through a plain well-cultivated country, to the foot of the Elborz mountains, which you cross by a tremendous côtul, and travel 25 miles to the city of the sacred Imam Reza[20], chiefly through fine gardens, which supply the city with every kind of fruit, amid which are built small villages, and the country seats of the rich.

The holy city of Meshíd is large, irregular, and dirty, yet it is a city worth seeing, for in the centre of it are some splendid edifices raised in honor of the saint Imám Reza, and pilgrims from every part of the eastern world assemble there, 100,000 souls yearly. The fixed population may amount to that number, and the greater part of these are rogues, who only take thought how to make the most of the pilgrims who visit the shrine; from the high priest to the seller of bread, all have the same end, and not content with the stranger's money, those in office about the saint appropriate to themselves the very dues for keeping his temple in good repair. Thus a fine stone canal which ran through the city and the great square, was dry, because the motwalí had turned the water off upon his own melon grounds. Meshíd, from the time of Nadir Shah, has seen strange vicissitudes. The descendants of that monarch are still there, though unnoticed and in poverty. Two years before we visited it, Mohamed Khan Karáí of Turbat, had expelled Hossein Khan, the Shah's sirdar, by stratagem; and nominating himself Lord of Meshíd, laid a heavy contribution upon the inhabitants. Shortly before our arrival the chief of Kelát, in concert with the Túrkmáns, had the city in close blockade till he was killed; and though a son of the Shah is nominally governor there, he finds it necessary to be allied with some of the chiefs against the others. These chiefs are a turbulent set, and preserve pretty equally the balance of power; one who shews a wish to make himself much stronger than his neighbours, is sure to be assailed by them in concert. We were at Meshíd from 28th June to 13th September. During that period the average heat of the thermometer in the shade at the hottest time of the day, was 89°; once the thermometer rose to 98°, and was never below 76°. In September, the nights began to be very cold. Every necessary of life is cheap and plentiful here; the bazars are filled with the choicest fruits of every description, which are within the means of the poorest. During the whole time of our stay, we received no letter from our friends, nor could we get money for bills. An army sent from Herát by King Kamrán[21] to co-operate with the troops of the Kúrd chief against the Túrkmáns, was on its return from Meshíd; and we being desirous of travelling so dangerous a road in safe company, the Syed redoubled his exer-

19 We learned that this youth was concerned in the outrage practised upon us, and had ordered all our books, instruments, &c. to be brought to him.

20 Fraser has written minute, and very accurate accounts of the city of Meshíd.

21 Son of Shah Mahmúd, and heir to the Affghán monarchy, though rebels keep him from his throne.

tions to get money. Some few promised to try a fall[22] in our favor, but invariably pitched upon an unlucky verse; and when we applied to the Vazír, to whom and the Prince I had brought introductory letters, requesting him to vouch to some merchant for our respectability, he wrote in answer a most elegant epistle, in which he swore by the fortunate head of the point of the world's adoration (the Shah) that there was no money in Meshíd. At last we were relieved through the assistance of a Múllah of Herát, an excellent man, who had come on a pilgrimage. Though he had no money himself, he persuaded a young Yezd merchant, desirous of visiting his relations at Herát, to advance us 200 tomauns, to be paid to his partner at Tehrán: this worthy merchant assisted us at a profit of 200 per cent. and took some other advantages of our situation. We dispatched a cásíd to Tehrán with pressing request for money, and he engaged to go there in 12 days, and to follow us to Herát. On going to take leave of the Vazír, he commended me to the protection of two or three chiefs of Kamrán's army, and we paid our debts, and dismissed our servant, who would accompany us no further, giving as his reason for parting from such excellent masters, Sheik Sadi's fable of the two cats, a story inimitably well told in the "Sketches of Persia."

III.—*Answer to E. R.*

To the Editor of the Gleanings in Science.

Sir,

As the investigation of truth is my object; and this too in a science of vast practical importance, which, to my apprehension, is at the present day greatly misunderstood; the notice of my crude lucubrations, which appeared in No. 32 of the Gleanings, has given me pleasure; inasmuch as it has assured me that some, at least, of my heavy papers had been read through.

This notice, it is true, contained nothing but censure; much of it, no doubt, well merited; and much which, whether deserved or not, I was sorry to see; not so much because my self-love was thereby hurt, as because the far greater part of the observations were not directed to points of real importance to the science of political economy. What occasion was there, for instance, to waste more time on the question, of whether we are justified or not, in using, in ordinary conversation and composition, the term value, metaphorically? Or of what moment is it, whether the employment of the term value, (with reference to that quality thereof, which is indefinite, and not susceptible of appreciation,) is a metaphorical employment of the term or not? My opinion is, that this is by no means a metaphorical use of the term; for I feel assured, that in the infancy of society, when terms are first employed, a perception of value must universally have been made, which must have been indefinite in its nature; from the absence of any conventional standard whatsoever, whereby specifically to arrange various products. The employment of the term in an indefinite sense must therefore have been usual in every language on the face of the earth, long before the perception of specific value could have been made. Nay further, in the most refined societies of the present day, where the application of a standard of value to every useful product has been long familiar, still the perception of indefinite value must precede the perception of that which is definite; because man must ever apprehend that quality which is generic in its nature, before he perceives that which is specific. But after all what, I repeat, is the importance of the discussion; particularly in a criticism of my lucu-

[22] In the manner of the Sortes Virgilianæ.

brations on political economy, in which it is distinctly laid down, that the value, peculiarly existing in wealth, is that which is definite, and which is susceptible of specific appreciation; and that, as such, it is precisely the positive or real (if this term is preferred) value of recent writers on political economy, when they are consistent in the employment of their terms.

What I had written on this subject does not appear, to me at least, calculated to favor the employment of "terms in a double sense;" upon which alone "my occupation" as an arguer (for I cannot here use the term reasoner) appears to my critic to depend. Let all this pass, however, for it is mere waste of words. I cannot however help expressing my surprize at finding a writer, whom we may presume to be familiar with abstract speculations, confounding hypothetical reasonings with details of facts. Thus when I purposely exclude from my reasonings the influence of all restraints on population, save want, in order that we may form just conclusions regarding the principle of increase in man, under these circumstances, I am taxed with ignorance of the influence of moral restraint and vice in certain societies; and when I hypothetically treat of man, as depending solely on one primary description of wealth, I am gravely told, that man would die of cold, in some parts of the world, unless he were clothed and housed; and again, when I reason of a country, without any reference to the existence of other countries, whether unoccupied, or full of inhabitants, in order that the effects of the principles already in operation may be traced, uninfluenced by disturbing causes; colonization, I am informed, has been on foot, ever since the world began: and, when I state, that in actual practice the naked hypothesis does not hold, and that certain counteracting influences must always be in operation, I am told that one-half of my writings are occupied with the contradiction of the other half.

But let us come to what is of moment; the determination of the truth of the theory of wealth now in vogue; upon which a majority of the British legislature profess themselves determined to act; the theory I mean of Mr. Ricardo. With this view I beg leave again to propound the following queries: 1*st.* Are the relations subsisting between wealth and man the same as the relations subsisting between the different articles of which wealth is composed?

2*nd.* Is it through the means of the relations subsisting between wealth and man, or is it through the means of the relations among the commodities composing wealth, that we may learn how man is enriched or impoverished?

3*rd.* If it be through the former; then, I ask, how can arguments regarding the latter lead to true conclusions about wealth?

4*th.* Does Mr. Ricardo, in his celebrated theory of profits, conduct his reasonings on the supposition that the relations subsisting between wealth and man are to be studied; or that the relations subsisting amongst the items composing wealth are to be looked to; or does he reason inconsistently upon both of these assumptions?

5*th.* If he does, how can his reasonings be correct? If he does not, let me intreat any one to explain how he does arrive at his conclusions?

6*th.* Is not Mr. Ricardo's doctrine of value and profits allowed to be the masterpiece of the existing science of political economy? Is it not adopted by Messrs. Mills, McCulloch senior, &c.; and are not all the reasonings of the liberal press, regarding corn laws, free trade, taxation, and wealth, generally conducted on the assumption that Mr. Ricardo's chain of arguments is irrefragable?

These are some of the points discussed in my papers in the GLEANINGS; and to these I apprehend a critic, really master of the subject, would have directed his attention.

But it may be answered, the attention of the present writer has been devoted to these subjects ; and that he has set the matter at rest by referring me to McCulloch's note on value in that author's second edition of the " Wealth of Nations ;" and to Mr. Mill's work on the elements of political economy ; in which works it is clearly explained, that the relative and real value of products are identical, and that nothing but ignorance of the existence of these explanations, or " a determination to quibble, could lead one to doubt the truth of the proposition."

I regret to say that I have neither of these works by me, nor can I conveniently get them ; but I have read them, and neither perceived myself, nor heard from others, that either of these writers did more than attempt to illustrate Mr. Ricardo's principles on this very point ; I will not therefore go to the commentators and illustrators, but to the original work which these writers endeavour to make more generally intelligible.

The distinguishing point of Mr. Ricardo's theory of profit is, that any causes which affect all commodities equally, cannot produce an alteration in their price or value ; and that the only causes which can affect the prices of products are such as affect them unequally.

Let us take no man's word for Mr. Ricardo being right in this conclusion ; but let us trace the steps by which he arrives at it. When the necessity exists for resorting to worse lands for the supply of food, an enhancement of the value of food takes place *relatively to the men* who obtain it ; because food can only be raised upon worse soils by a superior expenditure of labour : while at the same time all other products requiring only the same labour as before for their production, and all of these being equally affected by the enhanced difficulty of obtaining food, they must continue to stand, *relatively to one another*, precisely as they did before.

Here then we have it laid down, that the relations of man and food having been altered, (by more labour being necessary to obtain food than formerly,) *therefore* the value of food is raised *relatively to him ;* and we have it further laid down, that all other products of industry being equally affected by this rise in the value of food, and the *relations of these products amongst themselves* being unaltered, *therefore* their values *relatively to one another* are unchanged. We find from this part of his theory, that Mr. Ricardo is attempting to go two ways at once, when he reasons regarding the value of products : in the first place, that he is moving towards the relations of men and products, when he says the price of food must rise ; and in the second place, that he is moving towards the relations of products amongst themselves, when he says that the value of all these will remain unchanged ; in the one case, that he is looking to the real, and in the other case to the relative value of the products in question.

Now, I beg any person to answer me these questions. Is the value existing in food, the same thing exactly in its nature, as the value existing in any other commodity ? If the same, then why reason regarding it on two different principles ? E. R. tells me that Mr. Ricardo uses real value (cost of production), and exchangeable, or relative value, as convertible terms ; and that he had a right, on his own premises, so to do. This is telling me then, that the value existing in food, in the case above given, is the same, according to Mr. Ricardo, in its nature, as the value existing in other products ; and in this I am ready fully to agree with him. If this be so, then I answer that Mr. Ricardo had no right to reason on very different principles indeed, regarding the values existing in these two. But he does continually reason as if they were different ; and out of this very assumption of their difference, springs his belauded theory of profits. If, says he, there should be a class of capitalists, between the productive labourers and the consumers ; then, when food rose in price, as all capitalists would be equally affected, by the enhanced cost of feeding their workmen; and as the relations of all subsequent products of industry would remain unchanged, (or in other words their relative values would remain unaltered,) the consequence would be, not that the value of commodities would rise with the enhanced cost of feeding the labourer; but that the gains of the capitalists would be reduced. I appeal to all who have studied the subject, to say whether this is not Mr. Ricardo's theory of profits; and I appeal to all who enjoy the reasoning faculty to say, whether this theory does not inevitably spring out of the contradictory assumptions, that value, in one description of wealth, proceeds from the relations of man and wealth; while in other descriptions of wealth it proceeds from the relations amongst themselves of the commodities constituting wealth: in other words, the theory rests on the admission, that the value of food is purely real, or positive in its nature; and that the value of other products is purely relative; and I further appeal to the same persons to know, whether it can be justly said that Mr. Ricardo had a right, on his own premises, to treat cost of production (real value) and relative or exchangeable value (the relations of products amongst themselves) as being convertible terms; they being actually treated by him as things so very different?

If, says Mr. Ricardo, there be a class of capitalists to take upon themselves the charge of feeding labourers at a greater cost than before, then "a rise of wages cannot raise the price of commodities as maintained by Adam Smith, &c." But suppose there was no class of capitalists, what would happen? In this case, population is supposed to increase, and a resort to be rendered necessary to worse soils than those formerly yielding food; the labouring population, now supported on more valuable food, works as before, and produces other items of wealth; all of which, being equally affected, cannot vary in their relations one to another; therefore according to Mr. Ricardo, they cannot be altered in price—their value or price cannot rise; and hence an enhanced difficulty in obtaining the food of all labourers is to produce no effect whatever on consumers. Consumers, in this case, as in the case where capitalists were in existence, cannot be touched, because all products have been alike affected by the change; the fisherman, the weaver, the hatter, the hosier, and the worker in the gold mine, can none of them urge a plea for a higher payment in their neighbour's commodities, which is not as just a plea in the others' mouths. If this be so, prices in commodities must remain unchanged, and gold being only a commodity, prices in money also;—in other words, consumers cannot be affected by a rise of wages, and capitalists there are none upon whom to share the charge; I submit that agreeably to Mr. Ricardo's theory, higher prices would be obtained for food than formerly, and, no other effect whatever would be produced. Is this possible? But we are justified in asking whence is to come the means of paying the increased price for food.—It must be paid for in commodities, agreeably to Mr. Ricardo; but in whose commodities? Mr. Ricardo shall answer us this question. When the price of food rises it is because the increase of wealth and capital have occasioned a new demand for food, which will be infallibly attended with an increased production. To circulate this increased quantity of food, even at the same price as before, more money is required. Whenever a commodity is required in greater abundance than before, its relative value rises comparatively with those commodities with which its purchase is made.—If more hats were wanted, their price would rise, and more gold would be given for them.—If more gold were required, gold would rise, and hats would fall in price, as a greater quantity of hats and all other things would then be necessary to purchase the same quantity of gold.

But to say that the price of food will rise when it is more in demand than formerly, is to affirm a positive contradiction; for we first say gold will rise in relative value, in consequence of demand to circulate increased quantities of wealth; and secondly, that it will fall in relative value, because the price of food will rise; two effects which are totally incompatible with each other. To say that food is raised in price, is the same thing as to say that money is lowered in relative value, for it is by corn and other commodities that the relative value of gold is estimated[1]. How then is the price of food to rise, when recourse is had to worse soils? How is money lowered in relative value, by the circumstance of men requiring more food than their former extent of cultivation can supply? More money, on the contrary, is required to circulate the greater quantity of food for which there is now a demand, by which cultivation is extended: it is therefore more in demand than formerly, and higher priced relatively to food and all other products; at the very time, when, by Mr. Ricardo's supposition, it is to be of less relative value compared to food than it had been before. Now I again appeal to the reasoning public to know what chance we have of arriving at truth, by following Mr. Ricardo in his system; in which we find that the relative value of products is made to be the sole regulating principle; while we at the same time find, in the very first step in the theory, this regulating principle is utterly inapplicable? If there can be no rise in value in any product unless accompanied by a corresponding fall in value in other products generally, (and this the theory of profits and the system of relative values requires,) then there can be no rise in the price of food; money and all other commodities being, at that very time, in increased demand, as well as food. No rise of wages can therefore take place, and no fall of profits; and here appears to me to be the demolition of that fair fabric, the new theory of profits.

Let me beg of some one of Mr. Ricardo's admirers to explain, in what way the relative price of food is to rise and affect consumers, when an increase of population renders demand more brisk for every commodity, and makes a resort necessary to worse lands than those formerly under the plough? A relative rise in food is nothing more than a relative fall in money and all other commodities; all of which as well as food must, by the supposition, have simultaneously experienced increased demand; and with increased demand a rise in value; which rise in value cannot possibly be simultaneous in all things, rises in one set of products being, according to the book, only relative falls in some other set of products.

Is it not clear from the above, that the attempt to go two ways at once, ends in standing still; and that a system so conducted contradicts itself? Yet this is the system we are called on to support and to believe and admire; and upon which English statesmen promise to legislate.

E. R. dislikes my writings; and he has every right to do so, if he pleases. I do not ask him again to read them, although in them he will find all I have now advanced. But he of course likes the writings of Mr. Ricardo.—Will he be so good as to look over that author's main work again, and endeavour to reconcile him with himself. Do not let us be referred to commentators. Let E. R. take Mr. Ricardo's defence into his own hand; I ask this for information's sake, being anxious to know the truth.

[1] For a parallel chain of reasoning to the above, see Ricardo on political economy and taxation—3rd edition, pages 100 and 101; where he endeavours to prove that prices of commodities would not rise on a rise of wages; under the supposition that money came from abroad; for money coming from abroad, I have here supposed it to be produced at home like any other commodity; in both cases the reasonings are equally applicable.

If a rise in value in one set of commodities must be, what Mr. Ricardo assumes, a mere fall of value in all other commodities relatively thereto; then it follows incontestibly, that such a thing as a simultaneous increase, or diminution of value in commodities, is utterly impossible; and it follows also that the aggregate of existing values can never experience any increase or diminution whatever; every increase being necessarily met by a corresponding decrease. The applicability of the theory of relative values to the actual circumstances of mankind may be judged of from this observation alone, without diving into the mysteries of political economy.

But lest it should appear that, in trying to turn attention solely to the errors of existing systems, I am tacitly renouncing whatever may be original in my own views regarding wealth; I must offer a word or two in answer to E. R. where he asserts, that no good can be expected from my telling people simple truths or truisms with which they must already be familiar. First, then, I would have him remark, that knowing a thing to be true when it is suggested to you, and prosecuting a long series of consecutive inductions, with due allowance for the weight of that truth, are very different affairs. I am led by E. R. to infer, that all political economists are well aware, without my telling them, that the co-operation of the vivifying principle in seed, with the industry of man, is essential to ensure periodical return and increase; and I am laughed at for my endeavours to fix attention on such simple matters. Will E. R. be so good as to inform me, upon what principle the arguments in favor of unlimited freedom of trade are conducted? It will, I apprehend, be found, that they are only tenable on the supposition that all commodities are alike the products of human industry and capital; I say however without fear of contradiction, that a proportion of commodities only, is the result of industry and capital; and that a proportion is the result of industry and capital in co-operation with the principle of reproduction and increase. If there had been no occasion to call attention particularly to this circumstance, it could only have been, because political economists actually did take this consideration duly along with them. This however they do not do; otherwise they could not argue, that nations, in importing and exporting every conceivable description of commodities, imported and exported alike the products of industry and capital.

Mr. McCulloch is made to speak on this subject to the following purport: "Labour may be defined to be any sort of action, or operation, whether performed by men, the lower animals, machinery, or *natural agents*, that tends to bring about any desirable result." But when it is said that the value of the commodity or product is determined by the quantity of labour expended in its production, reference is only made to that species of labour which is possessed of value, that is, to the labour of man, or of capital expended upon the commodity or product." Granting with Mr. McCulloch, that the co-operation of the *natural agent*, vegetable life, is labour, and that this description of labour is performed spontaneously, still I maintain, that this species of labour is possessed of value; that is, to use his own expression, that it can communicate that quality to its peculiar products. Thus let us suppose a country in which unlimited abundance of unappropriated land exists, that in this country the society is composed of agriculturists and manufacturers; does or does not the food raised by the agriculturists, on which the manufacturers also are subsisted, enjoy, in those circumstances, a value equal to more than the value of the labour and capital expended in obtaining it? If it does not, it will not be raised. If it does, whence then originates this value? This co-operation of vegetable life is not that of a monopolized *natural agent*; for there is abundance of good land on which to set it gratuitously to work, if it pleased the society so to appropriate the land. Here then we find a "non-monopolized *natural agent*, concurring in production, and giving its labour gratis;" and yet creating value. Yet Mr. McCulloch says, "in so far as non-monopolized natural agents concur in production, they do what is done gratis. Their labours are often of vastly more consequence than those of man, or the capital produced by man; but as they are performed spontaneously, they are neither valuable themselves, nor can they communicate that quality to any thing else." A fall of water which shall propel mill works is a natural agent, which may be valuable in itself to its owner; and may be productive of value also; it may be substituted for more expensive descriptions of labour; and being a thing of rare occurrence, its appropriation may insure compensation for its use. This Mr. McCulloch would call a monopolized natural agent productive of value. The good lands of a country being all appropriated, and vegetable life being a natural agent which only acts advantageously to man upon such land; this also, according to Mr. McCulloch is, in a fully peopled country, a monopolized natural agent, productive of value; and in both these cases the rent, or compensation, for the use of the fall of water, and for the use of the soil, proceed from the same cause, exclusive appropriation, or, as he terms it, monopoly. But are the two cases parallel? in both of these do the natural agents co-operate with man in the same manner? The mill stream, to my apprehension, aids man in the mere work of modifying and changing existing qualities in bodies; while the vivifying principle co-operates with man, by enabling him from one thing destroyed possessing a specific quality to get an increase of perhaps a thousand similar things possessing similar qualities in return. Can it be believed that this is a difference of no importance, and can it be asserted that it is a difference which political economists have so noted and attended to, that no occasion does exist for calling to their minds the axiom which I would enforce, namely that wealth can only be periodically reproduced and increased, "by well directed industry, when co-operating with the vital principle inherent in the reserved stock of seed?"

When a sufficient cause is shown to exist for the evolution of more than will cover outlay in capital and in labour, and more than sufficient for profits besides, a sufficient cause is shown for the evolution of rent; whether the appropriation of the matrix wherein this cause operates, be complete or not; or in Mr. Maculloch's phrase, whether monopoly exists or not. This sufficient cause is, I submit, to be found in the influence of the living principle alone; and this sufficient cause I maintain to have been greatly, if not entirely, overlooked by all recent writers on political economy; most certainly by all those who insist that monopoly is the sole cause of rent, it has been overlooked; and by none more particularly than by him, who maintains, that the exclusive possession of a fall of water is a similar possession, with respect to wealth, as exclusive property in the soil.

But I find I am running over ground already marked by my own footsteps; and that the present and former prints are falling nearly on the same spots; besides, I am dwelling too long on an uninviting theme.

My motive is a desire to have my mind satisfied one way or other; either that existing theories are right; or that they are wrong; and I shall feel greatly obliged either to E. R. or to any other of the contributors to the Gleanings, if they will put me in the way of obtaining the satisfaction which I seek. I am not, I trust, wedded to my own conceits; and if it can be shown that the existing theory is right, I shall gladly throw them off from me for ever.

IV.—*Problem of the Arbelon.*

To the Editor of the Gleanings in Science.

Sir,

Having lately sent you a specimen of Hindú proficiency in mathematics, it may be a little interesting to send one of Mohamedan intellect too. Happening to mention to Hakím Abdúl Mojíd (a well known literary character in Calcutta) Archimedes' problem of the Arbelon, (of which the reader will find an account in the Quarterly Review for February 1810, p. 103,) he took it home, and in a day or two brought me the accompanying solution, which I accompany with a translation.

Your very obedient Servant,

T.

(Plate XXII. fig. 21.)

خط مفروض مثلا ا ب عليه نصف دائرة وهو ا ح ء ک ب
و ايضا على قسمي الخط نصفا دائرتين وهما ا ٥ ت ج
ج ف ر م ب واخرج على ج من ا ب عمود ج ء الى
المحيط فالدائرة التي على ء ج تساوي شكلا متفاضلا بين نصف
دائرة خط ا ب وبين نصفي دائرتي قسميه وهو شكل ا ٥ ت ج ف
ر م ب ک ء ح وذلك لانا اذا وصلنا ا ء ب ء حدث مثلث
ا ء ب وزاوية ا ء ب قائمة ورسمنا على ا ء و ب ء نصفي
دائرتين وهما ا ط ء ب ل ء فقسي ا ٥ ت ج و ج ف م ب
و ج ث ٥ ح ء و ء ص ز ع ج المتشابهة مساوية لقوسي
ا ط ء ب ل ء المتشابهتين يعني مساوية لقوس ا ح ء ک ب
فقوسا ج ح ء ج ر ء اعني دائرة ج ح ء ع مساويتان لشكل
ا ٥ ت ج ف ر م ب ک ء ح وهو المطلوب *

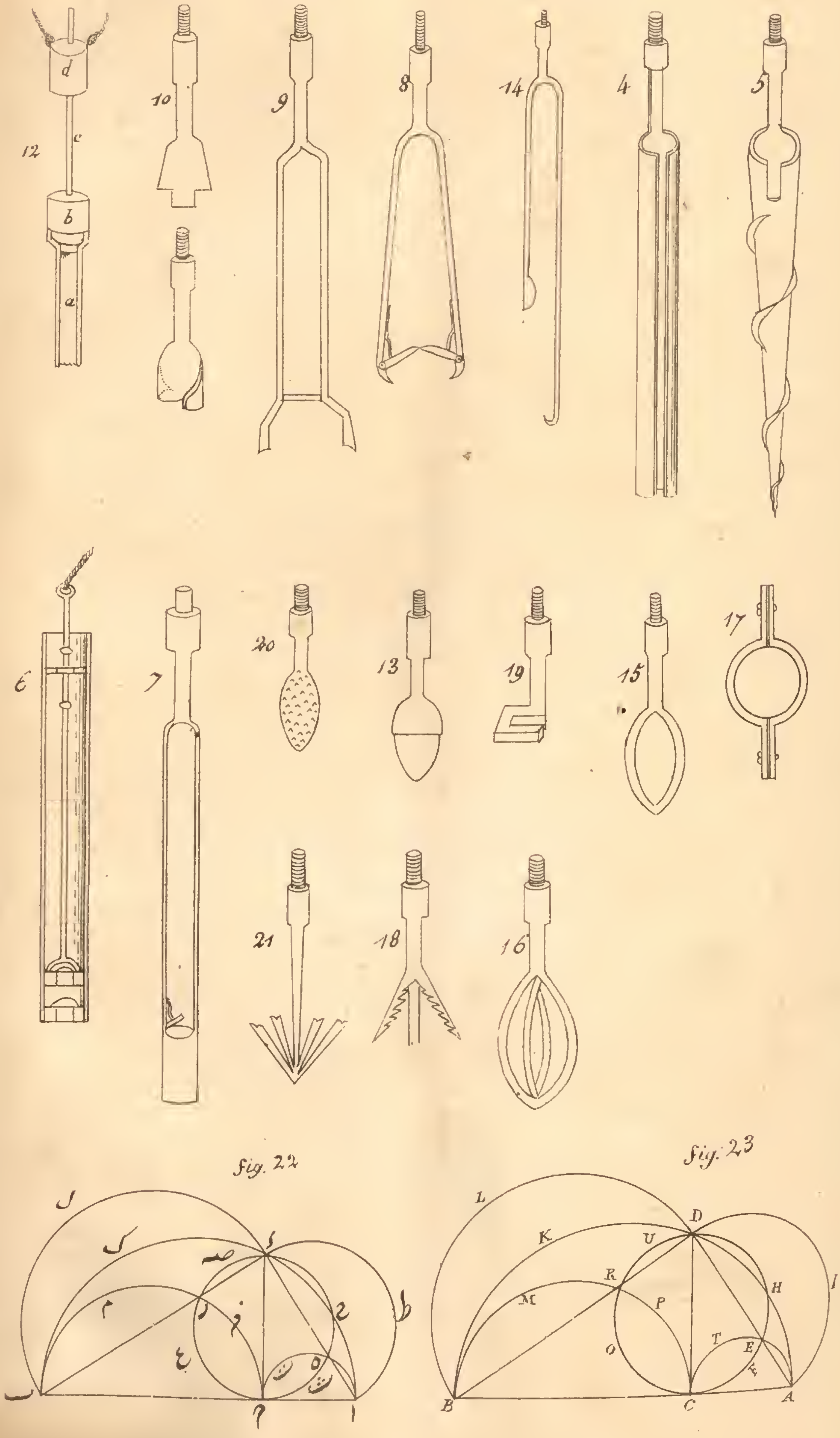
(Plate XXII. fig. 22.)

On a given line, as AB, let there be a semicircle AHDKB, and also let there be semicircles on the segments of the (given) line, viz. AETC and CPRMB. Draw on (the point) C of AB the perpendicular CD to the circumference, and the circle described upon CD is equal to the figure included between the semicircle on the line AB, and the two semicircles on its segments, that is the figure AETCPRMBKDH.

Join AD, BD, so as to produce the triangle ADB, then the angle ABD is right; describe upon AD and BD two semicircles, viz. AID, BLD, and the arcs AETC, and CEMB, and CFEHD, and DUROC, being similar, are equal to the similar arcs AID, BLD, that is equal to the arc AHDKB, and the two arcs CHD, CRD, that is the circle CHDO, are equal to the figure AETCPRMBKDH.

Q. E. D.

Good's Implements for boring the Earth.



J. B. Tassin Lith.

V.—*Good's improved Apparatus for boring the Earth.*

We have been requested by a correspondent, to give insertion to the following extract from the *London Journal of Arts and Sciences,* vol. VIII. p. 247, describing several tools, contrived by Mr. John Good of Tottenham, for assisting the operation of boring the earth : the tool marked 19, was found very useful in extracting the broken rod in the experiment in Fort William a few weeks since.

Plate XXII. exhibits the newly invented implements; fig. 4 is an auger, to be connected by the screw-head to the length of rods by which the boring is carried on. This auger is for boring in soft clay or sand; it is cylindrical, and has a slit or opening from end to end, and a bit or cutting-piece at bottom. When the earth is loose or wet, an auger of the same form is to be employed, but with the slit or opening reduced in width, or even without slit or opening. A similar auger is used for cutting through chalk, but the point or bit at bottom should then project lower, and for that purpose some of these cylindrical augers are made with moveable bits, to be attached by screws, which is extremely desirable in grinding them to cutting edges. Fig. 5 is a hollow conical auger for boring loose sandy soils; it has a spiral cutting edge coiled round it, which, as it turns, causes the loose soil to ascend up the inclined plane and deposit itself in the hollow within. Fig. 6 is a hollow cylinder or tube, shewn in section, with a foot valve, and a bucket to be raised by a rod and cord attached at top ; this is a pumping tool for the purpose of getting up water and sand that would not rise by the auger. When this cylinder is lowered to the bottom of the bore, the bucket is lifted up by the rod and cord, and descends again by its own gravity, having a valve in the bucket opening upwards like other lift-pumps, which at every stroke raises a quantity of water and sand in the cylinder equal to the stroke, the ascent and descent of the bucket being limited by a guide-piece at the top of the cylinder, and two small nobs upon the rod, which stop against the cross-guide. Fig. 7 is a tool for getting up broken rods : it consists of a small cylindrical piece at bottom, which the broken rod slips through when it is lower, and a small catch with a knife-edge, acted upon by a back-spring. In rising, the tool takes hold of the broken rod, and thereby enables the workmen at top to draw it up. Another tool for the same purpose is shewn at fig. 8, which is like a pair of tongues; it is intended to be slidden down the bore, and for the broken rod to pass between the two catches, which pressed by back-springs, will, when drawn up, take fast hold of the broken rod.

Fig. 9 is a tool for widening the hole, to be connected, like all the others, to the end of the length of rods passed down the bore; this tool has two cutting-pieces extending on the sides at bottom, by which, as the tool is turned round in the bore, the earth is peeled away. Fig. 10 is a chisel, or punch, with a projecting piece to be used for penetrating through stone; this chisel is by rising and falling made to peck the stone and pulverize it; the small middle part breaking it away first, and afterwards the broad part coming into action. Fig. 11 is another chisel, or punching tool, twisted on its cutting edge, which breaks away a greater port.on of the stone as it beats against it.

The manner of forcing down lengths of cast iron pipe, after the bore is formed, is shewn at fig. 12 ; *a* is the pipe in the socket, at the end of which a block *b* is inserted, and from this block a rod *c* extends upwards, upon which a weight *d* slides. To the weight *d* cords are attached, reaching to the top of the bore, where the workman alternately raises the weight and lets it fall, which by striking upon the block *b* beats down the pipe by a succession of strokes ; and when one length of pipe has by these means been forced down, another length is introduced into the socket of the former. Another tool for the same purpose is shewn at fig. 13, which is formed like an acorn, the raised part of the acorn strikes against the edge of the pipe, and by that means it is forced down the bore. When it happens that an auger breaks in the hole, a tool similar to that shewn at fig. 14 is introduced; on one side of this tool a curved piece is attached, for the purpose of a guide to conduct it past the cylindrical auger, and at the end of the other side is a hook, which taking hold of the bottom edge of the auger, enables it to be drawn up.

Wrought iron, copper, tin, and lead pipes, are occasionally used for lining the bore; and as these are subject to bends and bruises, it is necessary to introduce tools for the purpose of straightening their sides. One of these tools is shown at fig. 15, which is a bow, and is to be passed down the inside of the pipe, in order to press out any dents. Another tool for the same purpose is shewn at fig. 16, which is a double bow, and may be turned round in the pipe for the purpose of straightening it all the way down. Fig. 17 is a pair of clams, for turning the pipe round in the hole while driving.

When loose stones lay at the bottom of the hole, which are too large to be brought up by the cylindrical auger, and cannot be conveniently broken, then it is proposed to introduce a triangular claw, as fig. 18, the internal notches of which take hold of the stone, and as the tool rises brings it up. For raising broken rods, a tool like fig. 19 is sometimes employed, which has an angular claw that slips under the shoulder of the rod, and holds it fast while drawing up.

In raising pipes, it is necessary to introduce a tool to the inside of the pipe, by which it will be held fast. Fig. 20, is a pine-apple tool for this purpose: its surface is cut like a rasp, which passes easily down into the pipe, but catches as it is drawn up, and by that means brings the pipe with it. Fig. 21 is a spear for the same purpose, which easily enters the pipe by springing: at the ends of its prongs there are forks, which stick into the metal as it is drawn up, and thereby raise it.

These are the new implements for which the patent is granted; in the process of boring, there does not appear to be any thing new proposed, but that these several tools are to be employed for boring, pecking, and otherwise penetrating, raising the earth, and extracting broken or injured tools. There are also suggestions for employing long buckets with valves opening upward in their bottoms, for the puspose of drawing water from these wells when the water will not flow over the surface; also lift pumps, with a succession of buckets for the same purpose; but as these suggestions possess little if any novelty, it cannot be intended to claim them as parts of the patent.

VI.—*An Essay on the Game of Billiards.*

[Continued from p. 181.]

Hitherto, a consideration of the game has been nearly confined to the ball played with, as it regards the different ways of striking it: To examine, and account for the effects of both, after hitting, will be the object of the next endeavour.

Suppose a ball perfectly elastic[1], as A (see fig. 14) and to hit another at rest, of equal weight and size, as P, with their centres exactly in the line of direction; the hitting or active ball will give up to it the whole of its own motion, and stop

[1] Elasticity is that power which many bodies have towards a recovery of their original form, and would be called perfect, if equal to the force that changed it. What immediately follows is as much a test, as a consequence of this perfection, but no body has yet been known to possess that property so amply.

quiescent at *b*, the point of contact: but, should it hit obliquely (see fig. 15) the passive ball P, at whatever distance, will be driven in a right line drawn through its centre from the point of contact, and with a velocity inversely as its deviation from the line of direction, compounded with the loss of motion in A, the active ball, which is carried off by the difference, making an angle with the line of accidence always greater than a right one, and inversely commensurate with the portions opposed.

It is obvious this angle of reflection cannot be so small as a right one; for since, in the former case, where the balls are centrally and completely in opposition, the active one is not driven back beyond the point of contact; therefore (a fortiori) it cannot take place where the opposition is less; and the angle must increase according to that diminution. Besides, otherwise the balls must have an elastic force more than equal to the aggressive; whereas, on the contrary, reflection simply[2], (that is) without these rotary motions which influence it conformably with their characters, as already described, has ever proved it to be inferior. The walking power operates over this angle with a tendency to enlarge it; and, although it may be increased at the same time with the progressive; not only, its increments of motion are always proportionably small, but the quantity performed in any definite distance, regularly less, as the other becomes augmented: so that increasing the violence counteracts the means of enlarging it.

The twisting power influences this angle to an opposite purpose: but, as it may be increased by violence, in a definite distance, without adding to the progressive also, the active ball may be drawn back upon the line of accidence or towards it, and the angle accordingly in a great measure reduced. This power is most efficient when the balls are not further asunder than a free use of the cue make necessary, because, in that case, having less attrition to contend with, it will therefore be less diminished, and consequently return with a greater quantity. Moreover, the angle resulting from such a situation appears to be smaller than if the balls were more removed, though no twisting should have taken place; because the active ball struck at different distances upon the same right line, between the centres of both, will be most reflected from it, when the interval is shortest; though the passive ball be hit in the same part precisely. But this conclusion (admitting the statement) is drawn erroneously; for the line of accidence from which the angle should be measured, also changes with the distance. This may be seen in fig. 16, by putting A, A, to represent the active ball, and P, the passive, at different distances upon the same line *b*, *c*; and the dotted lines *d*, *d*, *e*, *e*, those of accidence and reflection respectively; and though the portions opposed, viz. *f*, *f*, increase with the interval as the figure shews; the reflection from the original line *b*, *c*, will not be equivalent to the angle which attends a diminution of the distance.

Hence it is obvious, that giving back the active ball in the line between both produced, when not within reach of the cue's point (which is sometimes done in careless play), alters the angular relation with a cushion or pocket; and, to leave the position with respect to both unchanged, it should be put back so, that the centre may occupy some place in the parallel *g*, *h*, as *i*.

But the active ball can never make so great an angle as a right one with the motion of the passive ball, except by means of twisting; yet, were it not for

[2] This may be shown by suspending two equal balls from the same or adjacent points, and letting one fall against the other: the angle thus formed between the lines of accidence and reflection will always be obtuse, and consequently a proof of this inferiority.

rotary motion, and their imperfectly elastic nature which will not retribute in adequate proportion as the quantity of aggressive force increases, it would be always of this magnitude: But, although to this extent they cannot separate, these circumstances (granting a choice of situation) render them efficient of any angle less, till they coincide: or to be more explicit; one ball, as A (see Fig. 17) being driven from the point *b*, in a tangent to another as P, the angle which both thus make after hitting, is the nearest to a right one, and greatest that can be made; but, if driven from the several positions *c*, *d*, *e*, *f*, *g*, *h*, *i*, *k*, notwithstanding the opposition, and of consequence the reflection also, be increased with each advance, the vertical angle will be in the same order progressively diminished, till at *k*, whence they hit centrally, it vanishes altogether, the active ball following in a line coincident or corresponding with that wherein the passive ball moves.

This may be further illustrated by supposing A and P, divided into eight or any other number of parts, and only the two divisions immediately adjoining to be excited when the active ball A is driven from the point *b*, whence the opposition must be least; consequently the quantity of direct force turned towards reflection, will be affected by no more of that deficiency from elastic perfection, than resides[3] in those parts which receive the impression; and a situation necessary to increase that opposition, will also add to the quantity of that latent principle which proves a drawback on the reflecting line; for, by altering it from *b* to *c*, &c. to *k*, though the absolute reflective power be enhanced at each promotion, the opposition becoming more direct; the concussion which the balls undergo, penetrating at the same time further from the point of contact, will rouse into action this attenuating quality of matter which lies dormant in the portions behind; and thereby deteriorate reflection, without a suitable or any alteration in the direction of the passive ball—the other constituent line of the angle in the proposition. It must therefore be diminished in the like ratio.

An effort, or tendency towards lateral rotation, arises from this indirect opposition also; and may sometimes be perceived; but that it always exists, will appear, by supposing *c*, *d*, (fig. 15) equal portions cut off from the balls on opposite sides, changing their centres to the line of direction, *e*, *f*, as in fig. 14; then likewise, the portion on one side being opposed by an equal portion on the other, and no predominating influence to turn the scale, the balls may be said to be in equilibrio. It is plain therefore, that, not only a difference in direction must take place, by restoring these crescents, which alter the centre of gravity, and destroy this equilibrium; but also, that the crescent of the active ball, being unopposed, is warped from its rectilineal course, by the violence its complement receives in reaction from the passive ball, and carried by its momentum, horizontally and slowly round, having that part of its surface, which came in contact with the other, as a centre or focus point of its motion. A similar effect is produced in the passive ball, but its crescent having no momentum at the time of contact, it is of much less consideration.

Lateral rotation acting, as it seems, obliquely against progressive motion, may be conceived as somewhat analogous to the power of gravity, making the ball, in subservience to the law of projectiles, describe a parabola, whose principal vertex

[3] Giving to a negative quality a positive place, may be a crust for a critic, but the author's chief aim is to be explicit, and if that abuse administers to this purpose, he will readily admit his acumen; with the same view only, he has sometimes ventured to express his meaning figuratively, Theory having a little claim to this indulgence, beyond the bounds of Practice.

(if thus generated, and the ball walk after hitting) is commonly at or near to the crescent point *e*, though subject to be further removed by the stroke, and the power greatest in its nascent state; whence it declines uniformly, and deviating from the line of direction according to the superiority or inferiority of the impelling and repelling powers respectively, the ball proceeds, gradually unbending its way, as *g*, *h*, *&c.*; but, if the ball moves under an influence of the twisting power, sufficient to overcome this forward and rotary effort of the crescent, its agency will succeed, and hanging on (as it might be) or attracting the line of reflection, change the former termination of the parabola into its origin; and also make the ball describe that curve backwards, increasing or decreasing as similar circumstances may prescribe[4].

Some may suppose, as these crescents are the immediate causes of lateral rotation, that the quantity should be as their magnitudes; but let it be observed, it has the progressive to contend with, and that the same means, viz. obliquity of opposition, by serving the purposes of both, renders the effect nugatory; or from the eccentricity of its curve, undistinguishable from a right line.

The parabolic curve is fully evident to a common observer; but the horizontal or lateral rotation, whence it partly takes its rise, is not very perceptible; because it requires much more quickness of sight to catch the parts of a surface as they come and go, if the body be uniform, and the colour or whiteness the same. The curious, however, by a close attention to the red ball, (should the colouring not be equal,) may frequently perceive it, and the experimentalist may render it still more visible by using contrasted colours for that purpose; but even the most determined sceptic may be convinced (if a digression will be allowed from elastic to non-elastic substances, without changing the principle) by suspending two non-elastic balls, for instance, of clay, or wax, from nearly the same point; so that by drawing one backward to a convenient distance, the other may be hit obliquely, and afterwards adhere to it: the horizontal or lateral rotation in this case, can no longer be a matter of doubt, nor does it appear how the effect can be attributed to any other cause than that already stated.

It has been just shewn, that a ball impelled by a twisting stroke, obliquely against another, will after hitting, describe a parabola backwards; but, if that stroke be combined with the means necessary for horizontal rotation, it will discover a tendency to that figure unassisted by any opposition, and move curvilineally the breadth of an inch or two, within the distance of a few feet, by which the direct interposition of another ball may be entirely eluded; for this purpose, the ball should be struck upon the side, and high up also, with the but-end of the cue raised, after the manner *e*, *f*, (in fig. 3); and thus, it will be made to circulate (as it proceeds) in a plane cutting the horizon at an angle of about forty-five degrees, producing the above effect.

(To be continued.)

VII.—*Proceedings of Societies.*

1.—Asiatic Society.

Wednesday, 9th November.

The Honorable Sir Charles Grey, President, in the chair.

Mr. J. Colvin and Dr. De Noyes were ballotted for and unanimously elected.

The Secretary submitted a correspondence with Mr. Cullen on the subject of Mr. Bruce's legacy.

Referred to the Committee of Papers.

[4] The above are the lines of radiation, to which the second note in page 115 alludes.

For the Museum.—Various Asiatic weapons and a suit of mail, presented by Lieutenant Anderson.

Horns of various kinds of deer, presented by Captain Herbert.

Specimens of Rocks from Penang, by the President.

Resolved that the thanks of the Society be given to the donors of the above.

For the Library.—The following donations were received.

The Philosophical Transactions for 1830, part 2, from the Royal Society.

Transactions of the Medical and Physical Society of Calcutta, vol. 5, from the Society.

Medical Reports, from the Medical Board of Madras.

Four Nos. of the Vienna Review, from J. Von Hammer.

Edinburgh Philosophical Journal, Nos. 19 and 20, for January, and April, 1831, from Profesor Jamieson.

Archæologia, vol. 23, from the Antiquarian Society.

First volume of the Transactions of the Plymouth Institution, with a letter from Mr. Ross.

Journal Asiatique, Nos. 37, 39, and 40, from the Asiatic Society of Paris.

Fragmens Bouddhiques, and description du Tubet, by Klaproth.

Resolved, that the thanks of the Society be given to the donors of the above.

Read a letter from Captain Ruddell, transferring to the Society, a further collection of Tibetan manuscripts.

The Meteorological Register for August and September, presented by the Surveyor General.

The following books received from the London Booksellers, since the last meeting, were laid on the table.

Carne's Letters from the East, 2 vols.

Cabinet Cyclopedia, 4 vols.

——— History of France, 2 do.

——— Ditto of England, 2 do.

——— Ditto of Netherlands, 1 vol.

Literary.—Submitted the abstract catalogue of the 2nd, 3rd, and 4th divisions of the KAHGYUR by Mr. Cosma, with a note by the Secretary.

Read a letter from Sir C. Grey, forwarding a paper on the Geology of Penang, by Mr. Ward, with specimens.

Resolved that the thanks of the Society be given for the preceding communication, and that it be referred to the Physical class.

Submitted a Journal of a Journey from Ava to Kenbal, by Dr. Richardson.

Physical Class.

Wednesday Evening, 16th November.

The Honorable Sir Edward Ryan in the Chair.

The following communications were read:

1.—A letter from N. A. Vigors, Esq. Secretary to the Zoological Society of London, dated 20th January, 1831, expressing that Society's acknowledgments for the handsome collection in natural history, presented by the Physical Class through Captain Franklin. Also, forwarding printed copies of the Society's Proceedings, in which an account of the objects in question is given.

2.—A letter from G. Swinton, Esq. transmitting three balls received from Captain Rawlinson, Political Agent at that Court, supposed to have fallen from the atmosphere during a thunder-storm near Tongho, in Pegu. Their exterior appearance precisely resembled that of rusty iron shot; weight 1 to 2,000 grains; spec. grav. 3.4; texture granular; colour grey; not attracted by the magnet.

The mineral was analyzed by digestion in muriatic acid, which took up the iron; the residue was then boiled in nitric acid, which acidified the sulphur; clear granular sand remained, from which, by the usual process, a portion of the other earths was separated: the composition was in round numbers as follows:

Sulphur,..	20
Iron,..	34
Silex,...	39
Alumine and lime,.........................	7
	100

The absence of nickel, chrome, and manganese was fully ascertained, and consequently, the non-meteoric origin of the balls: they differ in no respect from nodular pyrites, or impure bi-sulphuret of iron.

3.—A letter from G. Swinton, Esq. was read, communicating extracts of letters from Major Burney, Resident at Ava, and forwarding other mineral productions of that country.

4.—A series of Geological specimens from the range of hills at Chéra Punjí was presented by the President.

They comprise varieties of granite—gneiss—mica and clay slate—bituminous shale—coal—sandstone and greenstone. The geology of the Kasya hills has already received elucidation from Lieutenant Fisher's specimens and surveys.

5.—A complete series of the rocks at Penang and the neighbouring Islands was transferred from the General Secretary to the Physical Class; they were presented by the Hon. Sir Charles Grey, on the part of Doctor Ward, accompanied by a paper on the Geology of the same Islands, the reading of which was defered to the next meeting.

6.—Notices and drawings of the *Ratwa* deer, the *Jhâral*, wild goat, and *Nyaur*, or wild sheep of the Himalaya, were received from B. H. Hodgson, Esq. Acting-Resident, Nipal. This zealous naturalist characterises all three animals as of new species, and peculiar to those hills, unless the deer should prove to be the same with the *Cervus Mantjac* of Java, hitherto but imperfectly described.

7.—A paper on the migrations of the *Natatores* and *Grallatores*, as observed at Kathmandoo, by B. H. Hodgson, Esq., was then read.

The author commences by describing the local peculiarities in soil and climate of the valley of Nipál. It is an oval of about sixteen miles longest diameter, elevated four thousand five hundred feet above the sea: temperature generally ten to fifteen degrees lower than that of India. The valley is populous, and industriously cultivated during the spring; the winter being too severe for vegetation. In the rains, plantations of rice cover the greatest part of the land, which is flooded for the purpose.

The wading and swimming birds generally make a mere stage of the valley to and from the vast plains of India and Tibet. Mr. H. classes them under four heads:—1. Those which pass the valley without alighting. 2. Such as alight and remain a few days or weeks. 3. Such as seek the valley for the entire season; and 4. Such as do not appear to migrate at all.

The migration southwards of the snipes, teal, ducks, heron, storks, cranes, and woodcocks, respectively follows in succession from August to November; and their return takes place in the same order, beginning with the commencement of March, and continuing till the middle of May. The wild swan was seen but once in Nipál, in the midwinter of 1828, and was regarded as a *rara avis*. The teal, widgeon, and coot remain for the whole season upon some few tanks. Also cormorants upon the larger rivers within the mountains. The red-legged gull, the pelagic tern, and even the fishing eagle, have been met with at this distance from their natural habitat, the ocean.

Thanks were voted for the several contributions.

2.—Medical and Physical Society.

Meeting of the 5th November.

C. Ducat, Esq. Civil Surgeon at Poona, was elected a Member of the Society, and Monsieur Julien Desjardins was elected a Corresponding Member. Various European Medical Works were laid on the table, and it was decided that the transactions of the Calcutta Medical and Physical Society be transmitted to Cadiz, and a series of their publications requested in return.

The following communications were then presented to the Society.

1st. Remarks on the Climate of Bangalore and on the prevalence of Hepatitis at that station, from Dr. Mouat, Surgeon of H. M. 13th Light Dragoons: forwarded by Dr. Strachan, Deputy Inspector-General of Hospitals, H. M. S. Madras.

2d. A letter from Dr. Robert Jamieson, presenting two numbers of the Edinburgh Philosophical Journal.

3d. A letter from Dr. Grierson, forwarding Travers's work on Constitutional Irritation, Christison on Poisons, and Abercrombie on the Intellectual Powers; and inclosing a proposal from Mr. George Simson, of the Royal College of Surgeons, London, to furnish the Society with Anatomical Casts of Dissections, and of the gravid uterus;—accompanied by a specimen of the engravings in his work, descriptive of the muscles of the human body, for the use of artists.

4th. A communication from Dr. Traill of Liverpool, through Mr. Ross, acknowledging on the part of the Committee of the Royal Institution of Liverpool, the receipt of the 4th volume of this Society's Transactions, and returning thanks for the same. Dr. Traill alludes to the Meeting of the German Naturalists and Physicians at Hamburgh, in September, 1830, where it appears that there was a numerous assemblage of literati from all parts of Europe; those of the medical profession held a meeting every 2d day, for the discussion of medical subjects: among other topics which occupied their attention at these meetings, Dr. Traill mentions that the treatment of Syphilis underwent especial inquiry. That disease is now treated at Hamburgh without Mercury, Nitric Acid, or Sarsaparilla; simply by frequent ablution, antiphlogistics, and rest. A particular account of this mode of treatment was preparing for publication in the West of England Medical Journal.

5th. A letter from Dr. Boswell of Penang, with a short notice of a case of Tubercular Sarcoma, occupying the scrotum and penis, and obstructing the flow of urine; in consequence of which, inflammation and ulceration took place about four inches above the symphysis pubis, and an aperture formed there, at which the urine was voided. It would appear that the fistula communicated with the urethra within the symphysis, and not directly with the bladder; for the patient had the voluntary power of expelling the urine in a jet with some force, which could not have happened unless there existed a power of retaining the urine in the bladder, until a considerable quantity had accumulated.

6th. A letter from Dr. Neil Maxwell, of the 3rd Light Cavalry, at Sultanpore; with a parcel of a dried plant, which is in high estimation among the inhabitants in the vicinity of Benares, and with the troopers of the Regiment, for the cure of persons poisoned by snake-bites. The natives assert that many persons had been cured by this medicine, after suffering the worst symptoms. Dr. Maxwell speaks of having forwarded the flower and leaf preserved in spirits, for the purpose of having the class and order ascertained. It is to be regretted, that the preparation has been lost, as it might have enabled the Society to determine whether the plant be the Ophiorrhiza mongos, or the Ophioxylon serpentinum. As far as can be made out from the dried specimen, it is either one or other of these plants which has been sent to the Society by Dr. Maxwell; and probably it is not the Ophiorrhiza, as Dr. Wallich observes in a note in the Flora Indica, vol. ii. p. 545. "The leaves are unequal in size in each pair, which is more or less the case in all the species of Ophiorrhiza," and this distinction cannot be seen in the specimens which have been received. The natives near Benares name the plant *Dandi* or *Andhá Ouli*, and they assert that it is a certain cure in the worst cases of snake-bites. Dr. Maxwell states, that he has not had occasion to prescribe the remedy himself, but that a short time ago he was called to the Hospital to see a man who was reported by the messenger to be insensible, in consequence of a snake-bite; on Dr. Maxwell's arrival, he found the man sitting up in bed, and complaining of great internal heat, but otherwise quite well: the prompt relief in this case was ascribed by the native Doctor, and the other attendants, to the medicine now under consideration. The entire belief of the natives in the virtues of this plant, is considered by Dr. Maxwell, a sufficient ground to cause a series of experiments to be made, for the purpose of ascertaining the nature of its medical properties.

7th. A letter from Dr. Desnoyes, of the Mauritius, promising to draw up for the Society, an account of the malignant fevers of Madagascar, and of the visceral disorders which often arise in the course of those fevers.

The following papers were then read, and discussed by the Society. Remarks on Dracunculus, by Dr. John Milne, of Bombay. The author is decidedly of opinion that the Dracuncle is not a worm*, but a diseased lymphatic; which he describes, after extraction, to be a slender pellucid tube, varying from the thickness of the bass string of a violin, to the size of a horse hair.

Dr. Tytler's case of eruptive disease of the scalp, occurred in a Hindoo, aged 20 years; it had existed for six months, and had not been cured by the remedies used by nature. The disease consisted in a species of warts on the scalp, which were removed by the knife, after which a caustic application was used for some days, and the disease was cured. A highly finished drawing accompanied this case.

In Mr. Boswell's statement of a singular nervous affection, to which old Malays are subject at Penang, he gives an account of a disease, which in several of its

* A recent examination of several specimens of Dracunculus, sent from Bombay to Dr. Duncan of Edinburgh, prove beyond all doubt the incorrectness of Dr. Milner's opinion. The examination was made by Dr. Grant, professor of Comparative Anatomy in the London University, who has "no hesitation in pronouncing every one of them to belong to the common species of Guinea worm (Tilaria medinensis)." *Vide Edinburgh Medical and Surgical Journal, No.* 106—*page* 116.

symptoms, in a slight degree resembles a combination of hysteria and chorea. The latta, or paroxysm of the affection, is brought on by sudden surprise or by loud noises, and at the moment the patient imitates the motions and gestures of any other person he sees;—first throwing down any thing which at the time may be in the hands.

Dr. Casanova's observation was also read, relative to the dissection of a subject whose habits during life had been the most intemperate for many years, who was for the last two years constantly dyspeptic, and ultimately died suddenly. There was a quart of serum in the cavity of the peritoneum, the omentum much loaded with fat and firmly attached to the sigmoid flexure of the colon—one-third of the stomach towards its pyloric extremity was of a yellow color internally—and at other parts of its mucous membrane, there were red patches, with masses of lymph adherent. The liver was of a peculiarly pale color, the left lobe enlarged, its exterior rough and tuberculated, and these tubercles extended through its whole substance. A foot of the lower portion of ilium was much indurated, and of a livid color; its corresponding portion of mesentery highly inflamed and indurated; the mucous coat of the small intestines was lined with masses of red coagula and frothy mucus.

Mr. Blackwood's case of amputation at the shoulder joint, was in a Hindoo woman, whose arm and shoulder were dreadfully lacerated by a tiger; 16 hours after which accident the operation was performed: the wound readily healed, although there was difficulty in saving sufficient integuments to make a covering to the bone. It is an instance of the facility with which natives of India recover from very severe injuries.

3.—Agricultural and Horticultural Society.

At a Meeting of the Society, held on Thursday, the 3rd November, 1831, Sir Edward Ryan, President, in the Chair: Mr. James Pattle, Mr. John Hastie, and His Highness Nawáb Tuháwer Jang Bahádur, were elected Members.

1. The Secretary informed the Meeting, that owing to the smallness of the supplies of vegetable seeds from the Cape, Sydney, and other places, this season, he had not been able to supply all the members; and, therefore, with the consent of the Garden Committee, he had purchased an investment of Cape garden seeds per *Belle Alliance*, offered by Messrs. Alexander and Co. at one hundred and sixty rupees, from which such individuals as still required seeds, would now be supplied.

2. Read a letter from Mr. J. Thomason, Deputy Secretary to the Government, dated 15th August last, sending, by desire of the Honorable the Vice-President in Council, the copy of a letter from the Bombay Government; and requesting to be furnished with the information respecting the culture of hemp, and the manufacture of gunny bags, in Bengal. These letters were referred to Baboo Ram Komal Sen, who kindly undertook to make the necessary inquiries into this subject, and to report the result to the Society at its next Meeting.

3. Read a letter from Mr. Swinton, Chief Secretary to Government, dated 26th August last, transmitting, by desire of the Hon'ble the Vice-President in Council, an Extract from a despatch from Major Burney, Resident in Ava, and a paper on Cotton therein mentioned, together with two bags of Cotton, and specimens of Nankin Cloth, manufactured by the Burmese and Shaims.

The specimens were submitted to the Meeting, and compared with others of the same kind of Cotton and Cloth given in this country, which showed that the Burmese cotton and manufacture were very inferior.

4. Read a letter from Mr. A. Bushby, Officiating Secretary to Government, dated 30th August last, sending, by desire of the Hon'ble the Vice-President in Council, some Egyptian Sesame Seed for distribution; and requesting the Society to report hereafter, whether the Oil obtained from the produce is superior to that from the seed of the same plant at present grown in India, known by the name of the Teel plant. The Secretary informed the Meeting, that as the season was far advanced before the seed reached the Society, he had immediately sent portions of it, and copies of the letter, to the Allipore Garden and the Akra Farm, and also to such Members of the Society as he thought would give it immediate attention, and furnish reports of the result.

5. Read a letter from Captain Wade, dated Loodeanah, 15th August last, informing the Society, that he had established a garden at that place for the purpose of acclimating plants from the Seikh country; and describing a mode of transmitting cuttings to distant places practised in Cabool.

6. Read a letter from Captain H. B. Henderson, dated 1st September last, forwarding a packet of rare Seeds, not connected with Agricultural and Horticultural, and a letter to the address of the late Mr. Leycester, from Mr. Telfeir, of

the Mauritius. Mr. Telfeir's letter and the Seeds were referred to Dr. Carey, for the purpose of examining them carefully, and reporting how they should be disposed of.

7. Read two letters from Mr. T. Harris, of Khaul Boulya, dated 1st September last, and this day presenting a specimen of Cotton grown by him at that place from the Upland Georgia, furnished to him by the Society, together with three balls of Thread spun from the same at Santipore.

Read a letter from Mr. J. Willis, dated 22nd September last, reporting on the above specimen of Cotton.

8. Read a letter from Mr. H. Piddington, dated Nímtala, 3d September last, forwarding some Mauritius Asparagus Seed, and a communication dated 16th June last, received from Mr. Newman, the Superintendent of the Royal Botanic Garden there; together with a paper by Mr. Newman on the culture of Asparagus. Resolved, that the Secretary be requested to send a copy of Mr. Newman's paper to the Garden Committee, together with a portion of the Seed, and that the rest be retained for distribution to the Members.

9. Read a letter from Lieutenant Brotherton, dated Secundrabad, 14th September last, directing the Society's attention to the culture of Grass, the Olive, and the Manioc.

10. Read a letter from Mr. D. Andrew, dated Mulnauth, 28th September last, presenting a box of Cotton Seed, produced from what had been furnished to him by the Society.

11. Read a letter from Mr. Swinton, dated 29th September last, presenting a letter and specimens of brown Cotton, cultivated at Tinnevelly, which he had received from Mr. Speirs.

12. Read a letter from Messrs. Willis and Earle, dated 6th ultimo, presenting a bag of Safflower seed, and a paper on its culture at Dacca, by Dr. Lamb; also some Bareilly Paddy Seed. The Secretary informed the Meeting, that he had according to the request of Messrs. Willis and Earle, forwarded to the Superintendent of the Akra Farm, these seeds and copies of the above letter and enclosure.

13. Read a letter from Mr. W. Bruce, dated 27th ultimo, presenting for distribution four bags of Bushire Cotton seed. Resolved, that a portion be sent to the Akra Committee.

14. Read a letter from Mr. H. Piddington, dated Nímtala, 31st ultimo, presenting some English Vegetable Seeds, and particularly a Pea called the Scymitar Pea. Resolved, that the seeds be sent to Allipore, and that the thanks of the Society be offered to Mr. Piddington.

15. Read a letter from Mr. John Bell, dated 2nd instant, presenting a copy of his Treatise on the culture of Sugar and Distillation of Rum in the West Indies; also on the culture of Cotton, Indian Corn, and Guinea Grass.

16. Mr. Kyd presented some Van Dieman's Land Seed Potatoes, brought round by Captain Gray, of the *Donna Carmelita.* Resolved, that the Potatoes be sent to the garden at Allipore.

17. Mr. Ballard presented papers on the Cultivation of the Indigo Plant, as followed in Bengal, Oude, and Tirhoot. The Secretary was requested to forward copies of these papers to this Government, for the purpose of being transmitted to the Government of Bombay, as promised by the Society, in the letter of their Secretary of the 26th January last.

Sir Edward Ryan stated to the Meeting, that the plants which the Society had entrusted to his care, all arrived at Chéra Púnjí in excellent condition; and that, under the direction of Mr. Cracroft, they would be planted in such places, and in such soils, as in his judgment might be best suited to their growth—that the seeds had also been distributed by him to the residents at Chéra Púnjí.

It might perhaps not be uninteresting to the Society to know, that the late Mr. Scott had established experimental gardens, at three places, on these Hills—one at Chéra Púnjí, one at Myrung, and one at Nanklao.

At Chéra Púnjí, the ground was certainly not well selected, nor were the plants in this garden flourishing. At *Myrang*, the ground is rather too much exposed to the cold winds so prevalent there, and the soil not the best that could have been chosen; but notwithstanding these disadvantages, European fruits and vegetables thrive there—the fig is particularly luxuriant, and some plants of this description, taken from the Society's Garden, are now placed there. On the 23d September last, he found there excellent peas, lettuce, and new potatoes, small, but well flavoured.

At *Nanklao*, which appears to have been the favorite residence of Mr. Scott, there is an experimental garden on a larger scale, and more attention appears to have been paid to its produce. All the European fruit trees appeared very thriving, particularly the apple and plum ;—of the vegetables, he could particularly speak to the new potatoes, of which he brought a supply to Calcutta, and which he would have presented to the Society, had it been possible to fix an earlier day for this meeting.

Every place on these Hills bears testimony to the liberal and philanthropic spirit of the late Mr. Scott, which led him to leave no experiment untried which might lead to useful and beneficial results. At Nanklao, Mr. Scott had, at great expence, procured two fine English bulls, some English cows, and Native cattle, in the hope of improving the breed ; and there is every reason to believe, that the attempt would have led to a great improvement in the breed of cattle (of this description at least) in this part of India. It was with great regret that he (Sir Edward) heard that this establishment would be immediately broken up, and the cattle driven to the plains on the Gohátí side of the hills, and sold by auction to such natives as might choose to become purchasers.

It might perhaps be not altogether out of place, to say a word or two upon the general character, production, and climate of these hills. After passing the valley of the *Bogapání*, about 14 miles north of Chéra Púnjí, the whole character of the hills is changed. The atmosphere becomes dry and bracing, and instead of tropical plants and trees, those of Europe begin to present themselves—the lowest point of the valley of the *Bogapání*, in the road from Chéra Púnjí to Mofláno, is higher than Chéra. After passing Mofláno, which is nearly 6,000 feet above the level of the sea, the thistle, the fern, the nettle, the wild apple, the pine, and the oak, are to be seen; and there is every reason to conclude, that most European trees and plants would flourish on this side of the valley. Of the variety of flowers which appear in the grass, which is never higher than two feet, and generally about one foot, only a very experienced Botanist can attempt to give any accurate description ; but certainly any common observer must be struck with the variety and beauty of the flowers with which the grass is so richly studded. Native huts and villages are but thinly scattered over the country ; patches of cultivation, as is the case in all mountainous countries, appear on the sides of the hills, and the land seems to be selected with judgment, and is certainly very productive. Of the crops he observed growing, was a root called *Súplaon*, which the natives sow in April and May, and which is ready for use in October. There were several pieces of land sown with a white seed called *Kukurú Dhán*, which is also sown in April and May, and reaped in the beginning of November. The Indian corn is very fine and large, as is a species of cucumber cultivated by the natives.

Mr. Scott appears to have been strongly impressed with the opinion, that these hills might become of great importance as a Sanatarium for the European inhabitants of Bengal. He (Sir Edward) so far as he was able to form any opinion, entirely concurred in Mr. Scott's opinion that Chéra Púnjí is not the best spot that could have been selected for this purpose; but until our political relations with the inhabitants are placed upon some more secure footing, it is only to this place that Europeans could at present resort with any degree of safety.

There are many places of higher elevation which appear very superior, in point of climate, to Chéra Púnjí ; but Nanklao is not one of those places : it, like Chéra Púnjí, is the first table-land in ascending from the plains, though on the opposite side of the chain of hills ; and consequently, like Chéra Púnjí, is much more subject to mist, fogs, and rains, than Myrang and other places in the interior. Spots might easily be selected near *Negandí*, *Morim*, *Mofláon*, *Myrang*, and between the latter place and Nanklao, which are well adapted for the purpose of a Sanatarium , but Chéra Púnjí has facilities for building which none of those places possess : there is an abundant supply of limestone on the spot, whereas none could be found, as far as he could perceive, after passing the valley of the Bogapání. It had other advantages, and a greater facility of access by the plains, which is of no slight importance, when the greater part of the supplies must come from thence. As to temperature, nothing can be more delightful than Chéra Púnjí. The highest point that the thermometer ever reached in the month of May in the shade was 76°. In September of this year, it was occasionally higher. Houses are rising rapidly at this place, and roads are being formed, which nothing but the want of funds will prevent from being very extensive.

Sir Edward further informed the meeting that, on his leaving Chéra Púnjí, Major Watson had furnished him with a number of plants peculiar to the Garrow hills, which have been forwarded on his arrival here to the Society's Garden.

Sir Robert Colquhoun, Acting Secretary to the Garden Committee, reported the arrival from the Cape, on the *Belle Alliance*, of a number of fruit trees, which were now in the Society's Garden. On the motion of the President, it was resolved to send a large proportion of these to the Kasya hills, to be planted at the several stations under instructions from Mr. Cracroft, who had kindly undertaken to see them disposed to the best advantage.

Meteorological Register kept at the Surveyor General's Office, Calcutta, for the Month of November, 1831.

Day of the Month.	Minimum Temperature observed at Sun-rise.					Maximum Pressure observed at 9h. 50m.					Observations made at apparent Noon.					Max. Temp. and Dryness observed at 2h. 40m.					Minimum Pressure observed at 4h. 0m.					Observations made at Sunset.				
	Barometer reduced to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.
1	29,539			s. e.	n.	,624			s. e.	cus.	,630	79,6	9,3	s. e.	ci.	,616	81,	8,6	s. e.	cis.	,640	79,	7,0	s. e.	cis.	,662	79,	5,7	s. e.	cus.
2	,796	71,8	4,3	w.	cus.	,848	74,	5,7	w.	do.	,817	74,8	5,3	w.	n.	,756	75,6	6,4	w.	n.	,753	74,5	3,9	cm.	cus.	,751	76,	2,6	cm.	ci.
3						,817	76,3	6,3	n.w.	cu.	,776	76,5	6,9	n.w.	cu.	,719	79,5	9,8	n.w.	cu.	,705	79,	12,1	n.w.	ci.	,727	76,7	3,3	n.w.	cl.
4	,782	72,5	2,1	cm.	cl.	,854	78,3	6,2	do.	do.	,805	81,5	7,8	do.	do.	,752	83,8	13,0	do.	do.	,753	82,7	14,3	do.	cu.	,773	80,7	10,5	do.	do
5	,868	70,	2,4	do.	do.	,919	78,5	15,7	n.	do.	,904	79,7	18,3	n.	do.	,827	82,	21,1	n.	cl.	,827	80,8	20,2	n.	cl.	,848	79,3	21,0	n.	do.
6	,888	70,7	2,1	do.	do.	,936	74,	18,7	do.	cl.	,898	79,	16,3	do.	do.	,871	79,3	26,4	do.	do.	,772	78,3	24,4	do.	do.	,852	73,	10,1	cm.	do.
7	,916	61,	1,9	do.	do.	,955	72,5	15,9	do.	do.	,927	78,5	24,7	do.	cl.	,881	79,5	26,8	do.	do.	,869	77,3	25,7	do.	do.	,878	73,5	17,3	do.	do.
8	,910	60,	2,6	do.	do.	,985	70,5	12,7	do.	do.	,936	76,5	21,3	do.	do.	,866	79,5	24,0	do.	do.	,865	76,7	22,1	do.	do.					
9	,942	60,3	1,9	do.	do.	,992	73,7	17,2	cm.	do.	,957	77,3	20,6	c.m.	do.	,902	78,3	23,6	n.w.	do.	,901	78,	23,5	n.w.	do.					
10	,968	62,	2,1	do.	do.	,019	72,8	10,7	w.	do.	,979	78,	17,5	w.	do.	,932	78,5	24,0	w.	do.	,929	78,3	23,6	w.	do.	,940	68,5	2,7	do.	do.
11	,973	61,8	1,6	do.	do.	,021	71,3	10,0	do.	do.	,966	78,5	18,9	do.	cu.	,905	79,5	21,4	do.	cu.	,892	77,	18,4	do.	do.	,910	73,7	11,3	do.	do.
12	,920	60,8	5,7	do.	do.	,963	71,	15,6	n.	do.	,892	76,5	24,9	n.	cl.	,847	77,	25,1	n.	cl.	,845	76,	21,2	n.	do.	,756	72,3	9,9	do.	do.
13	,902	63,2	4,9	do.	do.	,943	74,5	14,5	do.	do.	,906	77,5	18,9	do.	do.	,845	77,	19,1	do.	do.	,838	76,5	14,6	do.	do.	,849	75,	15,3	n.	do.
14	,856	64,	2,1	do.	ci.	,940	70,5	8,4	cm.	ci.	,874	77,5	18,9	n. e.	ci.	,823	78,0	19,9	n. e.	ci.	,823	76,5	17,4	n. e.	cis.	,842	74,5	14,5	cm.	do.
15	,899	64,5	4,1	n.w.	do.	,943	72,	9,3	n.w.	do.	,886	78,3	14,5	cm.	cl.	,830	80,3	18,1	n.w.	do.	,831	78,5	17,0	n.w.	cl.	,866	76,7	14,1	n.w.	do.
16	,939	64,5	3,9	cm.	cl.	,992	74,5	13,1	n. e.	cl.	,949	79,3	17,9	n. e.	do.	,901	80,3	18,1	n. e.	cl.	,890	79,3	18,9	n. e.	do.	,897	77,7	18,7	n. e.	do.
17	,983	64,5	4,3	do.	do.	,034	73,7	13,2	cm.	do.	,995	77,8	15,8	n.w.	do.	,931	80,	18,8	n.w.	do.	,929	78,7	17,4	cm.	do.	,969	75,	12,9	cm.	do.
18	,994	66,6	4,1	do.	cu.	,040	74,5	9,1	do.	do.	,981	78,7	19,3	w.	cu.	,925	80,3	17,2	w.	do.	,915	79,3	16,0	w.	do.	,931	75,	9,1	do.	do.
19	,012	65,5	4,0	do.	cl.	,026	74,5	11,5	do.	do.	,970	78,	16,7	n.	cl.	,898	79,5	20,4	n.	do.	,893	77,	15,0	n.	do.	,905	73,5	9,2	do.	do.
20	,904	61,4	3,2	do.	do.	,997	74,8	18,6	n.	do.	,969	76,	23,7	do.	do.	,902	76,	19,3	do.	do.	,902	77,	18,4	do.	do.	,915	75,3	15,8	do.	do.
21	,979	61,	2,2	do	do.	,022	73,5	12,8	m.	do.	,970	78,5	17,0	n. e.	cu.	,880	78,5	20,7	n. e.	do.	,878	77,3	15,5	n. e.	do.	,896	75,7	15,2	do.	do.
22	,882	62,	2,5	do.	do.	,939	72,3	16,0	do.	do.	,892	77,3	16,8	cm.	cl.	,830	78,	17,7	n.w.	do.	,830	76,	14,2	cm.	do.	,832	72,7	9,6	do.	do.
23	,952	62,3	3,3	do.	do.	,990	73,	14,8	do.	do.	,924	77,3	18,0	n. e.	cu.	,882	79,	34,6	cm.	do.	,877	77,3	19,5	do.	do.	,889	73,7	13,1	do.	do.
24	,949	64,7	2,8	do.	do.	,989	74,3	10,0	do.	ci.	,932	79,	15,2	n.	do.	,864	79,3	15,7	n.	cu.	,858	78,7	16,6	n.	do.	,866	74,	8,9	do.	do.
25	,928	64,5	0,2	do.	cis.	,972	74,	9,2	do.	cu.	,935	78,3	14,4	n. e.	do.	,865	80,6	18,6	n. e.	cl.	,860	78,5	16,2	n. e.	do.	,877	76,	7,1	do.	do.
26	,928	67,5	3,9	n.	cus.	,979	74,	8,9	do.	cis.	,933	77,5	11,3	do.	cis.	,880	78,	13,9	do.	cis.	,880	77,3	13,1	do.	cis.	,897	75,7	11,0	do.	do.
27																														
28	,971	67,	5,0	do.	do.	,022	76,	19,3	n. e.	cl.	,964	79,5	21,8	do.	ci.	,911	80,	22,4	do.	ci.	,912	78,7	18,0	do.	cl.	,918	76,3	14,2	do.	do.
29	,983	66,3	6,9	n. e.	cis.	,044	73,6	12,2	do.	cus.	,009	76,3	15,1	do.	cu.	,929	77,3	15,9	do.	cu.	,929	76,3	15,1	do.	cis.					
30	,988	63,3	1,2	cm.	cl.	,036	72,7	8,3	cm.	cl.	,980	78,	15,8	do.	cl.	,930	80,3	22,3	do.	cl.	,928	79,3	20,8	do.	cl.	,954	75,	5,9	do.	do.
Mean	29,914	64,6	3,2			,959	73,8	12,3			,916	78,0	17,0			,858	79,2	19,2			,853	77,9	17,4			,862	75,2	10,8		

Abbreviations. In the column "wind," small letters have been used instead of capitals; *cm.* means *calm.* In the column "aspect of the sky," *cy.* is *cloudy*; *cl. clear*; *rn. rain*; *ci. cirrus*; *cu. cumulus*; *cs. cirro-stratus*; *cus. cumulo-stratus*; *cc. cirro-cumulus*; *n. nimbus.*

Brass Surveying Rod. 25 feet long

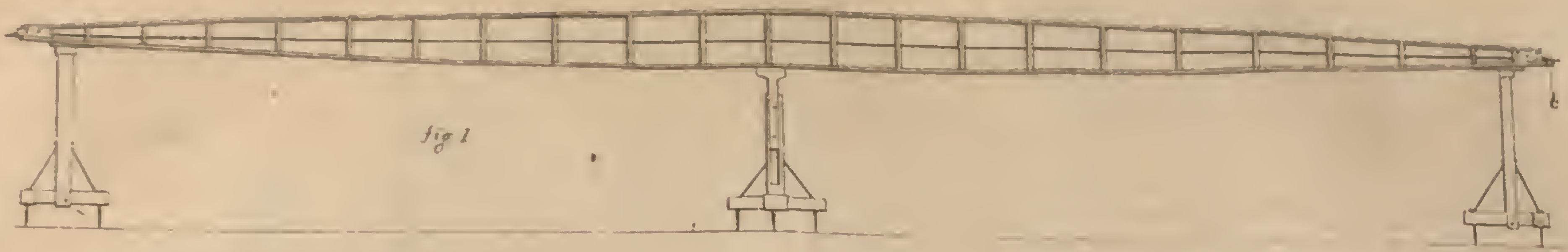


fig 1

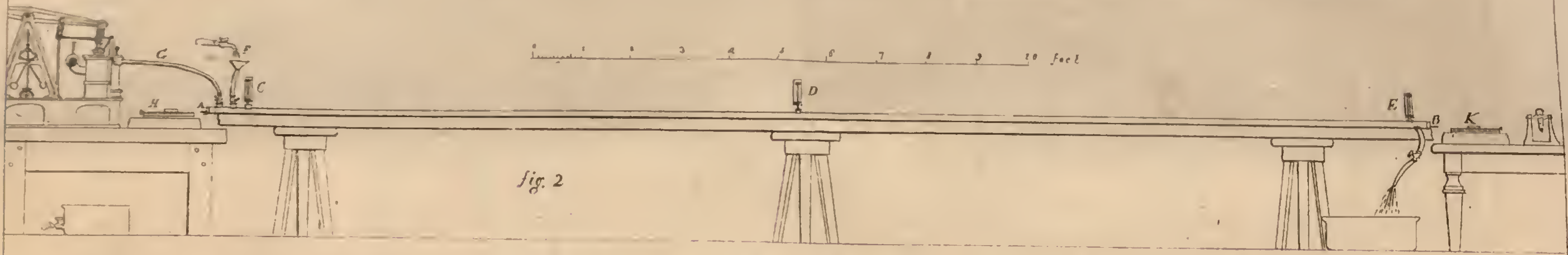


fig. 2

Apparatus for measuring the expansion of the Rods.

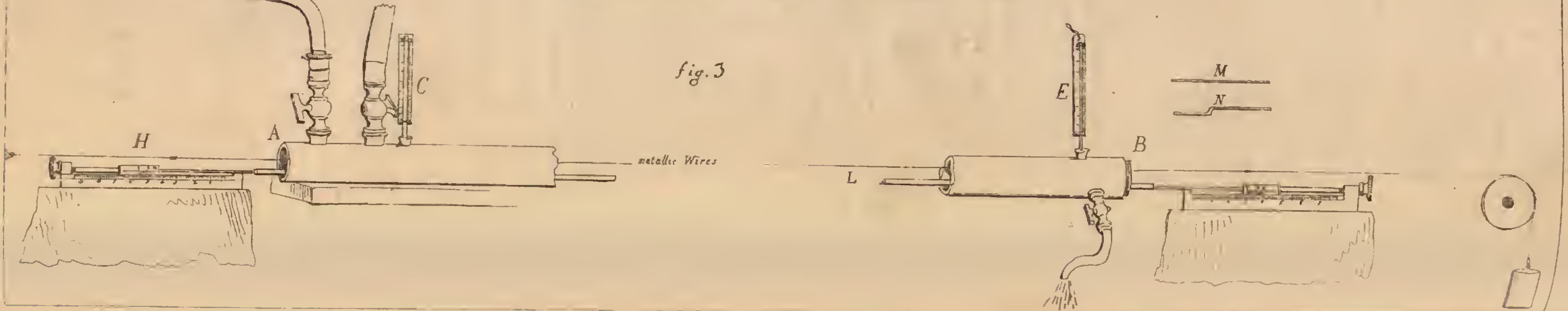


fig. 3

GLEANINGS

IN

SCIENCE.

No. 36.—*December*, 1831.

I.—*Expansion of Metals by Heat. By* J. Prinsep, Esq. F. R. S.

Having been requested by Lieutenant Wilcox, the officer lately in charge of a trigonometrical survey of the Brahmaputra river, to ascertain the rate of expansion of the brass rods used in measuring the base of his series of triangles at Rangamatí, I think it will not be uninteresting to put on record a brief account of my experiments, although they may not offer any great novelty either in the process adopted, or in the results obtained, and although the near accordance of the latter with former experiments of a like nature, can hardly hope to be regarded as any confirmation of the labours of the eminent philosophers who have, at different times, devoted their attention to similar researches, with means of much superior accuracy.

Lieutenant Wilcox's measuring rods are formed of brass wire, one quarter of an inch in thickness, and twenty-five feet in length, supported by a trussed frame-work of deal-wood, constructed on the plan adopted by Captain Herbert in his Himalayan survey; one of them is represented in plate XVIII. fig. 1: the curve given to the longitudinal pieces of the wooden frame is the same as they were found to assume when laid horizontally, supported only at the two extremities. The scantling of the wood-work, one inch square, is not sufficient to give perfect stiffness to the frame, even when supported by a tripod in the centre as represented in the plate, but the brass rod is itself dressed in a horizontal position, by means of a fine wire extended along the axis nearly in contact with it; the weight employed to stretch this wire is seen hanging down to the right of the frame.

To measure the dilatation of so long a rod, it was necessary to provide the means of maintaining its whole length of an equable temperature, at two distant and determinate points of the thermometric scale. The experiments of Roy and Troughton, and those of Lavoisier and Laplace were made on bars of five and six feet in length respectively. These were immersed in ice for the lower fixed point, and in a long trough of water, kept at the boiling point by means of a number of lamps, for the upper degree of the scale. This apparatus was found inconvenient in management, especially at the boiling point, which it was difficult to maintain with regularity: it was evidently quite inapplicable for a bar of five times the length, to say nothing of the expence of constructing its various parts. I therefore made choice of the pervading action of steam as a means of communicating the higher temperature; and for the lower, I was constrained to be content with a stream of water at 82°. The apparatus fitted up for the experimental application of these two agents is represented in fig. 2. A B is a leaden pipe of one inch bore, 24 feet 11 inches long; it rests horizontally upon a stout plank, supported on tripods. Into this pipe the brass rod is inserted, its two extremities protruding through corks fitted into the pipe, with a freedom of motion so as to prevent any flexure within the pipe; indeed when one end of the rod was pressed in with the hand, the protrusion at the other extremity was found by trial to agree precisely in amount.

C, D, and E, are three thermometers inserted through corks into the centre of the pipe; they were previously compared together, and corrected by a standard thermometer.

F is a pipe and cock for the admission of a stream of cold water from a large cistern.

G in like manner admits a current of steam from the steam-pipe of a small engine provided with a boiler in an adjacent apartment. There is an ejection pipe at the other end of the tube near E at which the water and steam pass off into a cistern below the table.

The length of the rod, or rather the increase of its length, was measured by means of the contact of two small wires, M, interposed between the ends of the rod and the verniers of two sliding scales H and K, borrowed for the occasion from two of Wollaston's thermometric barometers. This arrangement is shewn on a larger scale in fig. 3. A different form of wire N was necessary to measure the expansion of the leaden pipe by contact with it under the cork at B.

The experiments were conducted in the following order:

1. A stream of water was allowed to pass through the pipe for an hour, or until the temperature was perfectly equable throughout: the readings of the two micrometers were then taken, both for the brass rod and for the leaden pipe.

2. Steam was next admitted, which quickly displaced the water and raised the temperature to the boiling point: the heat of the steam as it passed through the steam-pipe of the engine remained steadily at 218°, but from the contraction of the stop-cock passage G, and the free escape of the steam at both ends of the leaden pipe, the temperature in the latter never rose above the boiling point: it was even remarked, that the thermometer at C generally stood a degree *below* the boiling point, while that at E, farthest from the source of heat, stood as much *above* it; the central thermometer at D remaining constantly at 212°. These two opposite effects are easily explained on the same principle:—the first arises from the expansion of the steam on entering the larger pipe after passing through the small connecting pipe G; the other is caused by the afflux and increased tension of the steam at B, necessary to drive it through the ejection pipe with the observed velocity.

As soon as the temperatures were deemed steady, the micrometers were again read off; after which the steam-pipe was closed, and the cold water again admitted. It was generally observed, that the contractions measured fell somewhat short of the expansions, unless a considerable time was allowed for the cooling down of the apparatus, even after the thermometers had returned to the prior temperature.

The verniers read off to the two hundredth part of an inch, and by estimation to the 2000th, which would be sufficient to ensure accuracy to the sixth place of decimals, were it not evident from the table of results that the errors of observation and those arising from other causes were considerably in excess of this limit.

As it is usual to express the linear dilatation in the "*dimensions which a bar takes at* 212°, *whose length at* 32° is 1,000000," I have reduced all the experimental results to these terms.

In addition to the measures of the two metals already mentioned, I was enabled to try the expansion of wrought iron upon a half-inch wire-drawn rod of twenty-five feet long, prepared for the purpose by Captain Baker, superintendent of iron bridges; unfortunately it only occurred to me towards the conclusion of the operations, or the series for iron might have equalled that for the other metals.

I now proceed to the experiments themselves, which are here presented in a tabular form:

Number of Experiment.	*Range of Degrees.*	*Dilatations between 32° and 212°.* Brass Rod.	Lead Pipe.	Iron Rod
1.	128°.2 ascending,	1.001921		
2.	125 .8 descending,	1.001904		
3.	128 .2 asc.	1.001880	1.002953	
4. rejected,	126 .8 desc.	1.001855	1.002914	
5.	125 .7 after 2 hours,	1.001896	1.002929	
6.	125 .7 asc.	1.001919	1.002913	
7.	125 .6 desc.	1.001910	1.003028	
8.	128 .6 after 2 hours,	1.001911	1.003040	
9.	128 .6 asc.	———	1.002921	1.001278
10.	128 .6 desc.	———	1.002933	1.001234
	Means	1.001906	1.002954	1.001256

The expansions of these three metals, as given in Ure's Chemical Dictionary, vary considerably according to the quality and form of the material, and nearly as much under the different trials of various experimenters: those which accord best in circumstances with the foregoing are as follows:

English plate-brass in rod, ..	Roy,...........	1.0018928	1.0019114
Brass wire,..................	Smeaton,........	1.0019300	
Round iron, wire-drawn,.......	Lavoisier, ...	1.001235	1.001278
iron, ...	Smeaton,........	1.001258	
iron wire,........	Troughton,......	1.001440	
iron, ...	Dulong and Petit,	1.001182	
Lead, ...	Smeaton, ...	1.0028670	1.0028587
	Lavoisier, ...	1.0028484	

The greatest difference observable occurs in the expansion of lead, which appears in the present experiments to be one-thirtieth greater than was before estimated: the very near agreement of the first two results tends at least to establish confidence in the present mode of operating, although it be considered presumptuous to say that it affords any confirmation of the more elaborate deductions of Roy, Smeaton, and Lavoisier. At any rate it must be allowed, that in applying the correction for temperature to the measurement of a base with metallic rods, no influential error can be introduced by making use of the expansions given in the tables of these three philosophers. The iron wire of Troughton appears to be anomalous, and Dulong's method of measuring the expansion of solid metals by immersion in mercury seems liable to objections.

If the temperature of the measuring rods could be ascertained within a degree of the truth, which does not strike the mind as at all beyond the power of a careful operator, the error of the whole correction for heat would hardly be appreciable: being less than half an inch per mile on an iron rod, and about two-thirds of an inch for a brass rod, which is surely less than would arise from other sources of irregularity in any but the most refined measurement.

While the present apparatus remained at command, I was anxious to avail myself of the opportunity of verifying the tabular expansions of other metals; I accordingly procured a series of wires of gold, silver, copper, brass, steel, iron, zinc, and tin, all of the length of twenty-five feet. These were extended through the leaden pipe in a similar manner to that followed with the rods, excepting that they were kept stretched by weights, as represented in fig. 3, proportionate to the size of the wires. The results, however, were far from satisfactory: in the first two trials when weights from 500 to 900 Sa. wt. were used, owing to the want of rollers for the weights, I could not be certain that the force of tension was precisely equal at both temperatures; for the stretching of such long wires by the weights necessary to keep them even, was nearly as much as their expansion: when rollers were applied and the weights diminished to 300 and 200 Sa. wt. the discrepancies were even greater, especially with the unannealed wires (brass and iron) which perhaps changed their form without elongating in proportion:—the metals rendered thoroughly soft by annealing, [gold, silver, copper, and steel,] afforded results nearly accordant in every case, although some of them differ a good deal from the expressions in Ure's table. The zinc wire became ductile at 212° and stretched permanently nearly an inch; the tin wire also stretched more than five inches at the same temperature with a very small weight. Nothing therefore could be ascertained concerning them. The expansions of the rest for 180 degrees were as follows: expressed as before.

Gold; pure, annealed wire, ...	1.00146
Silver; pure, ditto, ...	1.00157
Copper; ditto, Piano wire, ...	1.00142
Brass; thick elastic wire, ...	1.00159
Steel; annealed Piano wire, ...	1.00122
Iron; thick unannealed wire, ...	1.00108

It is probable, that all of these expansions are too small, and in different proportions: and I fear the whole must be pronounced unworthy of confidence, although some few agree pretty well with former determinations: when any circumstance shall put it in my power to operate upon rods of copper, and of the more precious metals, the apparatus employed upon the present occasion can be fitted up for the purpose, in a few minutes, and indeed it is the exceeding simplicity of the whole operation which forms its principal recommendation to those who may be desirous of making similar researches.

II.—*On the Copper Works at Singhána near Khetrí in the Shekháwatí Country.*

Lat. 28° 05′ N. and Long. 75° 53′ E.

The mines whence the copper ore is extracted are situated one *kós* south-west from Singhána, in the range of rocky hills which run for some distance to the southward of that town, and seem to be impregnated with metallic ore throughout their whole extent; mines are also wrought at Khetrí and Bubaí, producing many valuable minerals, such as copper, *tamba;* blue vitriol or sulphate of copper, called by the natives *lila tútia,* or *leelo toto;* alum, *phitkarí,* and a mineral called *sehta,* which requires a more particular description.

This *sehta* looks like a fine grey sand, having the appearance of iron-filings mixed with minute particles of silex and mica; its value, at the mines, being from 40 to 100 rupees per maund. It is only produced at Bubaí, and is used as an ingredient in making glass, *kanch,* or women's wrist-ornaments, *chura,* which seem to be made of a vitrified substance, coloured with lac, *lah,* and other pigments.

fig. 1.

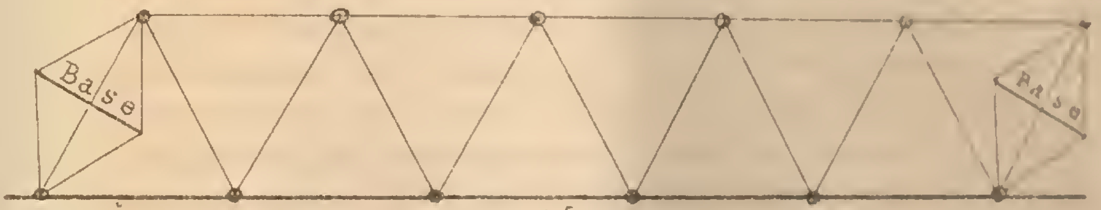


fig. 2.

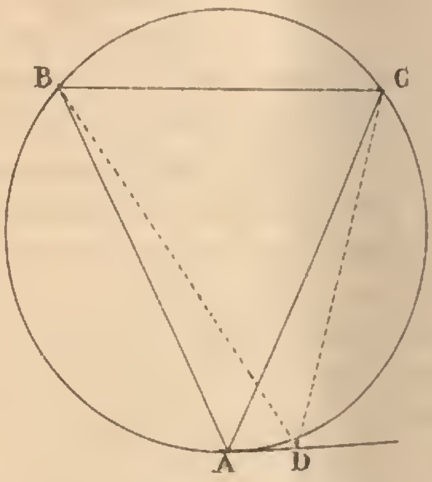


fig. 3.

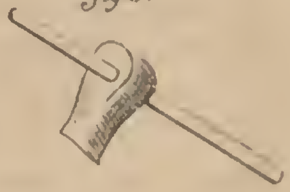
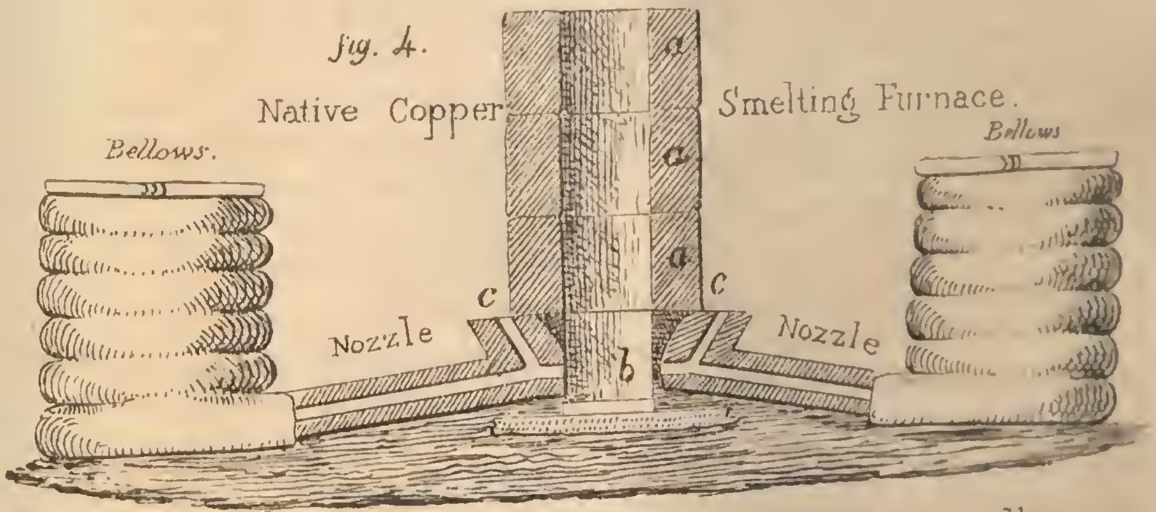


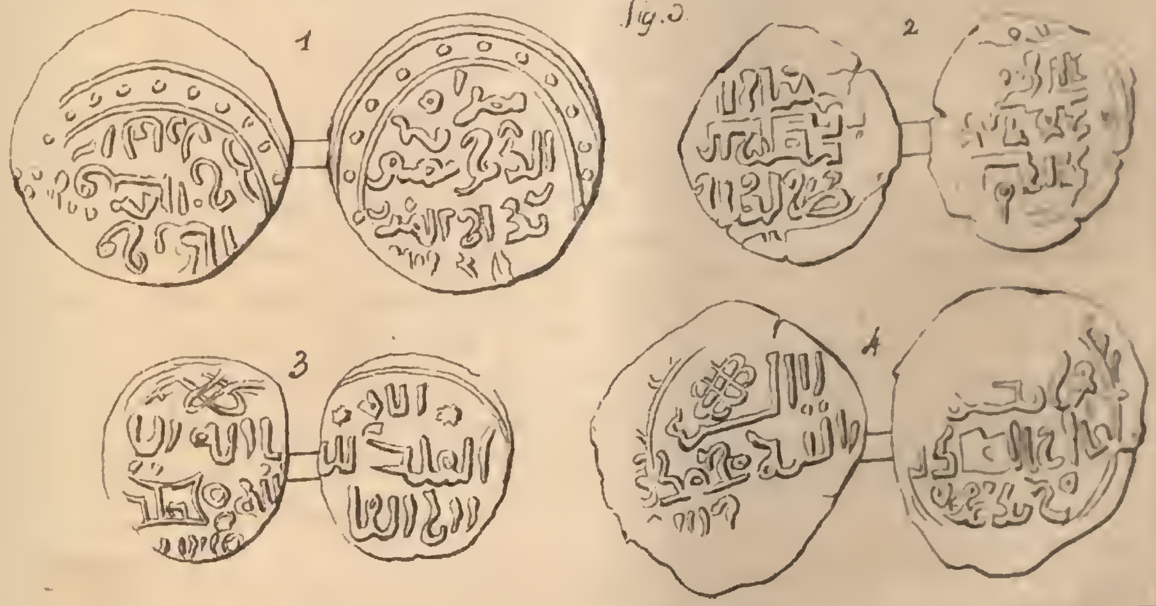
fig. 4.

Native Copper Smelting Furnace.



Ancient Gold Coins brought from Persia by L^{t} Conolly.

fig. 5.



J. B. Tassin Lith.

To return however to the copper mines at Singhána. On approaching the rocky ridge in which those excavations have been carried on for many generations, the openings of numerous shafts may be observed, giving access to the galleries by which the hills are honey-combed in every direction, to the length of a *kós*, if the natives are to be believed. These shafts descend in a very irregular manner, but to a considerable depth; their sides being notched and cut in such a way as to allow for ingress and egress without the help of ladders, and their section seems to be a rude oval about 5 feet by 4, or 4 by 3 feet. When the shafts have reached a sufficient depth, galleries are driven out in various directions to follow the veins of ore, which are imbedded in a very hard matrix, and the following device is resorted to in order to facilitate the operation of extracting the metal.

At the head of the mine, *kán*, a quantity of firewood is collected, and stacked in a compact manner to the amount of 150 or 200 maunds, which being set on fire, the miners make their escape as fast as they can, to avoid the chance of their being smothered in the gallery, for some fatal accidents are said to have happened in this manner. On the third day, the workmen descend into the mine and find that the interior of the rock has been rent and split into huge masses by the violence of the heat; and they then proceed, if the mine be sufficiently cooled, to carry on the drift in the following manner.

Each labourer is provided with a lamp, *diya;* a hammer, *hatorí;* a mining chisel or gad, *tankí;* and a small wicker basket, *tokrí.* The lamp is placed uponthe workman's head, and not only affords light for the execution of his work, but enables him also by watching the glittering particles of metal, to detach only such portions of the ore as may promise to give him the best remuneration for his labour. While at work he seats himself upon his heels, with the lamp upon his head as above-mentioned; the hammer is in his right hand, the gad in his left, and the little basket upon his knees, in which he receives all the fragments of ore that are struck off by the chisel.

The very confined posture in which the miners are obliged to work, and the exceeding heat and closeness of the galleries, together with the want of fresh air, render their lives almost a constant round of painful toil, and they may be fairly said to live entirely "by the sweat of their brow;" their almost naked bodies are constantly bathed in perspiration, and their breathing is very laborious; their constitutions in short are said to be so quickly broken up by this pernicious employment that they commonly die at the ages of 35 and 40 years. Their fixed wages are two annas a day, for which however they are only obliged to furnish one basket-full of ore; an industrious man can earn much more, as he receives an extra sum for any additional quantity he may furnish over and above the regular quantum; and by this means he can give himself a holiday once in 8 or 9 days.

I have been informed, that the mines are only wrought during eight months in each year, from about the festival of *Dasera*, at the beginning of October, to the setting in of the rains, after which time a considerable quantity of water filters into them, and is again baled out at the commencement of the ensuing season. The labourers are also obliged to work during the night, discontinuing their employment early in the morning, or the excessive heat might otherwise be fatal to them[1]: I have however seen those labourers, many of whom are *Muselmáns*,

[1] We should have thought that the temperature would remain constant day and night.—Ed.

coming from the mines in the evening, with their little basket of ore and mining implements, apparently just relieved from their task; but this may perhaps be owing to the unusual fineness of the season, as the hot winds have not set in, which is an extraordinary circumstance at the end of April. When the day's work is completed, the miners return home with the proceeds of their labour, which is collected at a public *chabutra* near the smelting furnaces, *mandári*, of Singhána, and is there sold in retail, by auction, to the proprietors of the different furnaces, of which only seven or eight are now at work.

As I have not the means of giving an accurate mineralogical description of the copper ore, nor of the rock whence it is obtained, numerous specimens of the former have been procured for the purposes of chemical analysis by some one who is better acquainted with the subject: it will perhaps be sufficient in this place to say, that its mineral character appears very simple; its structure is laminar, and nearly all the specimens present a hard quartzose matrix of a grey colour, thickly interspersed with bright metallic particles of a golden colour, whence the natives call it *sona-mukhí*, and they make use of this substance as a collyrium for the eyes. It is procured in small lumps the size of an almond, or of a small hazel-nut, and being grated or rubbed into powder upon another stone, it is then applied to the eyes, like the ore of antimony, *surma*, though rather medicinally than as a cosmetic.

When brought from the mines, the copper ore, *dhát*, is partly in small shingles of a few ounces weight, partly in nodular fragments of various sizes, from a walnut to a pea, and partly in a state of dust or powder; and the whole of it must be reduced to this condition before the operation of roasting is commenced. A heavy stone anvil, *sil*, is bedded in the floor of the triturating shop, a little below the level of the ground, which is hollowed out and paved so as to form a small basin, 2 or 3 feet in diameter; which, with a heavy iron hammer, *ghan*, weighing 8 or 10 seers, forms the whole apparatus of the Crushing Mill.

The operator sits on the edge of this hollow, with his feet resting on the anvil-head, and as both hands are required to manage the sledge-hammer his toes are employed in raking together the particles of ore which require to be pounded, and in cautiously thrusting them toward the spot on which the hammer descends. The handle of this tool [fig. 3.] projects sufficiently towards the front to allow of a fair grasp for the right hand, which assists the left hand in raising it far above the head, and it is then brought down with great force between the feet, so that this must be a very laborious operation, and is only performed by able-bodied men who receive 4 rupees per mensem: women and even children are employed in other parts of the process to be described hereafter.

When the ore has been thoroughly pounded, it is sifted, and the coarser parts of it are again passed under the hammer, until reduced to a powder sufficiently fine to be employed in the second part of the operation, which is this: A quantity of cow-dung, *gobar*, is kneaded up with the pounded mineral, in the proportion of 5½ maunds of the latter to 1½ of the former, and it is then moulded by the hands into small sausage-shaped masses, *pindi*, about 5 inches long and 1¼ inches in diameter, which are all laid out in regular order to be dried by the sun previously to their being burned in the kiln. After they are sufficiently dry, they are stacked into small circular heaps, forming the segment of a sphere, about 4 feet broad and 1½ feet high; which is covered with a single layer of dried cow-dung cakes, *úpla* or *kanda:* and being set on fire during the evening, it is left to burn all night.

In the morning, when the kiln is cool, the burned *pindis* (which are now of a red colour) are carefully separated from the white ashes, and are set aside for the smelting furnace, which is now being prepared, as the forge requires to be rebuilt every morning. The refuse of the kiln is also carefully collected and formed into balls, the size of a large orange, that nothing may be wasted.

In preparing the blast furnace, *mandarí*, a quantity of common sand is first spread upon the floor of a circular hut, in the centre of which is formed a small hollow, of the shape and size of a common brass kneading-dish, *thall*, that is to say 12 or 15 inches in diameter and 2 or 3 inches deep. In this is first laid a stratum of fine yellow sand, and then another of ashes, *rákh*, to prevent the melted metal from adhering to the bottom of the receiver. Two clay nozzles, *mús*, are then placed on opposite sides of this shallow pan, and a third one between them, leaving the fourth side vacant to allow the melted dross to escape. A quantity of moist clay is at hand, with which these nozzles are connected together, and a little mud wall is built a few inches in height to serve as a basement for the three vessels of fireclay *(a, a, a,)* which are placed upon one another to form the body of the furnace, as in fig. 4. pl. XXIII.

Each of these annular vessels called *kothí*, is about 15 inches in exterior diameter, 9 or 10 inches high, and perhaps 3 inches in thickness. They are used over and over again, but the lower portion of the furnace requires to be renewed daily as above-mentioned. Three ordinary Hindustaní bellows, *phonkní*, of goat skin, are attached to the outer end of each nozzle, and are worked by men, women, or even children. Before the furnace is loaded, a quantity of charcoal is burned within the chamber *(b,)* in order to drive out all moisture from the newly moulded clay receiver. The fire is poked at times through the openings *(c, c,)* which are then closed again with moist clay.

The quantity of materials which a single furnace will consume during a day of 3 or 3½ *pahírs*, (9 or 10 hours,) is said to be 3 maunds of charcoal and 2½ maunds of the *pindís* formerly described, to which are added 2 or 3 maunds of the scoria of iron, (brought from a distance of 4 *kós* to the south eastward,) which are thought to act as a flux, and purifier of the melted ore, and are used for this purpose under the name of *kint*. Four persons are employed at each furnace, (perhaps a man, with his wife and two children,) the party being paid a total of 10 rupees per month. The head man prepares the furnace and feeds it, occasionally taking a hand at the bellows to relieve any one of the party who may require his assistance, for the blast is kept up without intermission from the three bellows.

When the ore is sufficiently fused, all the metallic particles sink down into the receiver at the bottom of the furnace, and the dross, *mail*, or vitrified earth, *khangar*, passes off in a fluid state, and when coagulated, is thrown away. These scoriæ have apparently been accumulating for ages, and have at length formed a line of small hills several hundred feet in length, and from 30 to 60 feet high: there are four insulated stone bastions built on one of these artificial mounds.

On the morning after this first melting, the mass of copper is removed from the receiver, and the impurities which adhere to it are knocked off as far as is practicable, before it is sent to the refining furnace, *guzáb*. It is here subjected to a violent heat in a small vessel which receives the blast of a single pair of bellows, worked by three men, one of whom uses his hands, and the other two assist him with their feet, supporting their bodies by grasping small ropes which are attached to the roof of the hut. Close to the furnace is a line of clay moulds, each of which is but little more than a foot in length, and very narrow and shallow; into these the melted metal is cast, and forms small bars or ingots, *salak*, weighing 2 or 3 seers each, and which are now supposed to be fit for the purpose of coinage.

These ingots are removed to the mint, *taksál*, and are there divided with hammers and cutting punches, *chéni*, into small pieces, of the weight of a pice, *paisa*, or about 5 drachms, and are then fashioned into the usual circular shape in the following manner: A small charcoal fire is kindled in an earthen pot, and round the burning fuel is arranged a number of the half-wrought pieces of copper, each of which is taken up with a pair of small sharp-pointed spring-tongs, in the left hand of the workman, who is seated opposite a smooth stone, having in it a small cavity which would hold about one third of the pice when set upon its edge. By continually turning the metal blank round in this cavity, and at the same time striking it with the hammer in his right hand, the coin is completed, and is ready for any farther finishing operation that may be deemed necessary, such as comparing it with a standard weight, or striking it with a die.

I have not yet succeeded in obtaining an accurate account of the quantity of copper produced annually from the Singhána mines, nor the expense of working them. The master smelters are of course inclined to reduce the apparent profits of the concern to the lowest possible quantity, as the Khetrí Raja is said to receive one-sixth of their amount, in addition to the 14,000 rupees for which the concern is farmed. They stated the returns of pure metal to vary from one to three seers from a maund of ore, (i. e. from 2½ to 7½ per cent.) but I should think this to be far below the true average.

It may be remarked in conclusion, that this method of extracting the metal appears to be far more tedious, more expensive, and more laborious than the process adopted at the copper works of Basáwar in the Bhartpúr district. At Singhána the ore is not merely broken up into lumps, but is pounded into powder; then worked up with cow-dung; formed into lumps; dried in the sun; burned in a clamp; and finally, mixed with the scoria of iron before it makes its way through the blast-furnace, as detailed above: instead of which the Basáwar ore is only broken with a hammer into fragments the size of a nutmeg, and is then thrown into the furnace with a due admixture of charcoal. The copper produced by this simple process is, I think, of a very superior quality as compared with the Singhána metal, which is lilac-coloured and brittle; yet the Basáwar ore is of so poor a quality that it does not now pay its own expenses, and the smelting works have in consequence been abandoned.

Camp Singhána, April 30, 1831. A. E.

III.—*Alum Works in Kutch.*

The Alum Pits at Mehr have been worked for the last century. They are said to have been first opened by a Muselmán in the reign of Rao Goharjí[1], who accidentally tasting the earth became convinced that some profit might be derived in extracting the saline particles from it. He disclosed his secret to a relative at Nalia, a merchant who had carried on an extensive trade with Bombay and other ports; and being directed by *Asapúsa* in a dream, they succeeded in their first experiment of fabricating alum. The manufacture of this article was carried on secretly for a few years, until stopped by Rao Goharjí, on hearing of the advantages which government might secure to itself by taking the management of the concern into its own hands. He was however induced to leave it to the Muselmáns,

[1] Rao Goharjí mounted the throne in 1716, A. D.

receiving from them a certain portion of the profits, placing a servant there to superintend the sale of the alum, and report on the progress made in manufacturing it. This plan has continued with a few interruptions up to the present day. The system is simple, and subject to excessive abuse. It is not little extraordinary, that as the Alum pits in Italy were for many years under the peculiar control of the Pope, every Christian soul being excommunicated and given over to the comminations of the Church who should buy alum elsewhere, or attempt to fabricate it in other lands; so here the pits are under the special protection of Asapúsa or Parbatí, who has forbidden the produce to be made in any other way than that now adopted, and has assured the inhabitants of Mehr that no alum earth is to be found in any other part of Kutch; consequently she, or her minister in her name (the Rajah of Mehr), takes no small share, as her right, for having bestowed such a blessing on the town. The peculiar form of crystallization which the salt takes, is said to have been the work of the goddess, resembling one of the minarets of her old temple.

About fifteen or twenty of these pits are now open. The Kutchís, being afraid to penetrate far under ground, have made no very extensive galleries, they work a small narrow passage for a few yards, and then diverge to the right or left, as it suits their fancy. The alum earth is found at the depth of twelve in some, and twenty feet in other parts. In the older pits it occurs crystallized in most delicate capillary fibres, and in very large quantities. In others, the ores are rich, containing much sulphur, of mottled colour, heavy, clayey, and brittle.

The finer native alum is called by the workmen *Tejim Túr*, from the acicular crystals. The coarser kind *Melta*. The first undergoes a process different from the latter, though this may be, and is also manufactured in the same way. It is taken to some square beds, and by the aid of a small running stream of water, strongly impregnated with alumina and iron, and thinly laid down; over it some red burnt earth of the worst kind of volcanic aluminous ore is thrown; this is called *Banna*, and the scrapings of these beds, after the contents have been removed, or *Búkki*, mixed up with it. The water drills through the banks and moistens the earth, or is sprinkled over in small quantities. It remains in this state for 15 days, when it exhibits an efflorescence of sulphate of alumina, and is called *Rejri Túri*. This is carried to some distance, where the sheds and boilers, and other instruments for manufacturing the article are, and is there cast into large boilers with the mother water, well stirred up, till it is liquified; and then a certain proportion of *Shora-khár* or nitre thrown into it; during this stage of the process, the sulphur seems to evaporate and the sediment or earthy particles being taken out, the whole is drawn off into small open-mouthed earthen jars, where it settles for three days and becomes *Kanni*, apparently the pure salt of alum mixed up with earth: when dry, it is again thrown into a boiler and boiled for six hours with little or no water added to it; in its liquified state, it is called *Ras*, and being poured into earthen jars, goes into its last stage of crystallization, called by the natives *Phaltakarí*.

The difference in the way of bringing the coarser alum to this state, is in the first stage of the process; when extracted from the pits, it is also spread on the ground in small squares; but none of the burnt earth, *Banna*, is thrown over it. The *Búkki*, or the sediments scraped from these beds, is mixed up with it, and water thrown in large quantities over the whole. After four days, it becomes *Phull Túri*, yielding a much smaller quantity of the sulphate of alumina, though not differing in quality.

When taken to the Karkhaneh, or manufactory, it there undergoes the same process as the *Rejri Túri*, and is mixed with it.

IV.—*Case of Hydrophobia.*

To the Editor of the Gleanings in Science.

Sir,

I beg to be allowed a little space in your columns to give a short account of an accident from Hydrophobia, which lately befel my dogs, and which may be of some use in shewing that we cannot be too careful when a mad dog has made an attack on a dog kennel, although not the smallest mark of a bite may be found at the time.

On the 7th of March last, about day-break, a mad dog ran through my camp, and seizing a tame antelope, which was lying near my tent, unaware of any danger, tore a piece of skin about the size of a half-crown piece from between the ear and the eyes; the cries of the deer brought to her assistance two setter dogs, who drove the *paria* off and gave him a sound drubbing; he at the same time did not appear to be idle, and by his exertions speedily got off, and was seen making his way at full speed across the plain. All this happened within the space of half a minute; the dogs were very carefully examined, and I thought myself exceedingly fortunate, that not a single mark of a bite or scratch was found; the poor deer however was much hurt, but the wound was dressed by the natives in their usual way by applying pounded turmeric, and it speedily got well.

On the 19th of March, I was informed by my servants, that the deer was ailing, and on examining it, I found that the wound had slightly opened, and the animal at the same time had all the appearance of being affected by Hydrophobia; it endeavoured to eat, but could neither swallow meat, or drink, and was much inclined to venery, a symptom common to all the dogs which were afterwards infected, and always at the commencement of the disease: on the morning of the 21st, it fell into fits, and had them occasionally throughout the day, and after suffering much distress, died on the morning of the 22nd.

The dogs continued perfectly well till the beginning of April, when one of them began to get restless, running to and fro, and careless about his sports, which I attributed to the heat of the weather. On the 15th, however, his peculiar bark and the manner he lapped water, as if eating or devoured it, shewed too plainly that the disease had taken effect; his bark became a disagreeable howl, and latterly he was unable either to masticate or swallow food, however often he attempted it; and after much suffering, he died on the 23rd. The circumstance of his living so long under the disease was, I conceive, owing to the great care taken of him, and by forcibly passing soup and little bits of meat down his gullet; this however was latterly impracticable, from the swelled state of the throat and tongue. On the 18th of May, a poodle dog was infected, and died on the 20th. On the 28th, a young setter dog died of the disease; the other setter dog, which had attacked the paria dog, died on the 15th of June, and on the 20th of the same month, another young setter also died. None of these animals had ever the smallest appearance of being bit at any time, and all died in a similar manner, under the symptoms which made their appearance in the following order:

1st.—Extraordinary inclination to venery, and restlessness.

2nd.—Great thirst, lapping as if devouring the water, and yet no diminution of the quantity.

3rd.—A howling bark; the animal endeavours to eat, but the power of deglutition completely stopped. The pupil of the eye scarcely appearing from under the upper eyelid.

4th.—Great prostration of strength; spasms,—in one of which the animal ends its miserable existence.

The following usual symptoms of Hydrophobia were not observed :

1st.—Neither the deer or dogs had at any stage of the disease a dread or antipathy to water.

2nd.—There was nothing like ferocious savageness; on the contrary, the animals retained to the last their usual good temper and were sensible of kind treatment.

Having seen many animals, as well as men, attacked by this disease, I beg to be allowed to add the following remarks. In no instance have I known infection to take place when the parts was immediately cauterised by the action of fire; among many cases occurring within my own knowledge, I beg to cite the following: A sepoy and two bull dogs were bit at the same time by the same dog, the dogs immediately had their wounds burnt with red hot charcoal. I saw them alive and well five years after the occurrence. The sepoy was torn in the breast, and merely had a common plaster put over the wound, which soon healed; he also ate a piece of scarlet cloth, which at his request, I provided him with; the natives think this a certain cure, and why should we laugh at them for such an idea; its efficacy is probably as good as the far famed Arm's Kirk nostrum, which to this day is much sought after by civilized Englishmen: in all ages and countries we may find much to ridicule, even the sage Pliny recommends for a horse that has the gripes, to shew him a duck swimming in a pond, and when at this day we see the gentry of England running after Mr. Long, who reaps the benefit of their credulity at the rate of £10,000 per year, we may have charity to find an excuse for some similar credulity on the part of an unsophisticated Hindoo. The first symptoms of the disease appeared in the sepoy in about 30 days after he was bit, he complained of a pain in his shoulder and want of appetite, for which he was bled and got well immediately; the Surgeon who then attended him, not being aware he had lately been bit by a dog, discharged him from the hospital, he soon came back under decided symptoms of Hydrophobia, and died in a few days.

Where the wounds are deep, (as is almost always the case from the bite of a Jackal,) I have known them to be filled with gunpowder, after being dried as much as possible, and the powder fired off, this was repeated twice, and no bad effects were experienced either from the wound or poison: of course lunar caustic may be better, but it is not always to be had on the spots at a distance from medical advice and attendance. Z.

Búlandshehr, Sept. 1831.

V.—*Note on the Chirú.*

To the Editor of the Gleanings in Science.

Sir,

I am indebted to your 25th No. for a knowledge of Major H. Smith's remarks upon the Chirú. These remarks have suggested to me the following observations:

If Ælian's Kemas had a white tail, resided in woods, and was addicted to swimming, it cannot be the Chirú of Tibet; since that animal has the tail coloured (like the proximate parts) upon the upper surface; never—so far as my information goes, lives in woods, and is not prone to swimming. Its peculiar habitât is the *Eastern* portion of the trans-Himálayan plains of Bhote or Tibet, one of the barest and driest regions on the face of the earth. It is never found in any of the cis-Himálayan mountainous tracts, including the snowy ones, up to the ridge of Emodus; nor, to the best of my present knowledge, amidst the mountains descending from the crest of the Hemáchal into the Tibetan plains.

There is certainly some variety of report upon the subject of its habitât: but the above is the substance of my latest and best information. By Bútán, Major Smith probably means Bhote; though the Deva Dharma Raja's cis-Himálayan dominions alone constitute Bútán. Major Smith's "Chandrang, *North-west* of *Digurchi*, in the Himálaya mountains," is scarcely so pardonable an error.

I do not remember ever having contributed a paper to the "Oriental Miscellany." The dimensions of the Chirú, taken from that work, by Major Smith, are very inaccurate, erring chiefly by being too large. The neck, in particular, is extremely faulty. Major Smith is, no doubt, correct in conjecturing that the Chirú is devoid of suborbital sinuses and moist muzzle. In the account furnished to you I gave its sinuses—an error which I ought, ere this, to have corrected; having done so in the copy I sent home. It is not worth while to mention here the grounds of this error, having given them publicity elsewhere.

Major Smith alludes to, and draws his information from a variety of odd sources. How comes it that he never turned to the brief but authentic notices by Dr. C. Abel, in the Government Gazette of the day, reporting the Asiatic Society's Proceedings?—not, I am sure, to deprive me of the honour therein done me; though, by the way, Major S. seems to disallow my pretensions! That is a matter of little moment; but, query, who was likely to be best informed upon it? the Nomenclator, a zealous Naturalist, *on the spot*—or, Major A. Smith, an able Zoologist indeed, but, *at the distance of* 12000 *miles from us?*

Nipál, July, 1831. I am, Sir, &c. &c. H.

VI.—*Earthquake near Delhi.*

To the Editor of the Gleanings in Science.

Sir,

I beg leave to send you a short account of a smart shock of an earthquake which occurred in my neighbourhood on the 24th October, at half past noon. I am encamped in north latitude 28° 34′ 00″, and longitude 78° 04′ 26″ east from Greenwich. The wind was west, from which quarter it has been blowing steadily for some days, but just previous to the earthquake was in strong gusts; the horizon was hazy, but there were no clouds, and no noise was heard; the motion was apparently perpendicular, if any thing from the north to the south; it continued for a full minute, and was the most severe, many persons in my camp say, they ever felt. Books moved from their places on the table, and the tent was literally shaken, and the mango trees appeared as violently shaken, as if a branch was seized and shaken, for the purpose of throwing off the fruit; a palanqueen near the tent moved, as if shaken; and it was with difficulty we could stand on the ground. My bearer actually laid hold of the *kanáts* of the tent, and every one got sick, as if we had been at sea; but the most extraordinary circumstance is, that though the earthquake was equally strong, and perceptibly felt to the southward, none of my parties who were detached to the northward three or four miles, felt it. The shock was so strong and continued, that I sent to the village distant about a quarter of a mile to know if any accident had occurred, and was informed, that although the people were much alarmed, no damage was sustained.

From all the information I can hear, I am inclined to believe, that though so awfully alarming at this spot, it was very partial and confined, tending to prove the theory of some French philosophers, that partial tremblings of the earth of this nature, are caused by the subsiding of the matter of the earth into a more solid mass, and are not to be attributed to the usual causes of combustion and explosions.

Camp, 26*th October*, 1831. B.

Since writing the above, I have heard that at a large village called Khanpúr, two miles south-west of this, the people ran out of their houses for fear of their tumbling down; many people were thrown down, and some stones fell from the northern gate.

VII.—*Notice of the Fall of an Aerolite. By* J. Malcolmson, *Madras Medical Establishment.*

On the 2d of last January, at 3 A. M. the inhabitants of the village of Mangapatnam, in the Talúk of Jamalmadágú, in the Cadapah district, Lat. 14° 43′ north, Long. 78° 19′ east, were alarmed by four successive loud reports as of a gun, passing from north to south, and by the appearance of a bright light, as if robbers had lighted torches previous to an attack on the village, and compared by the inhabitants to "day," or the "fall of a great star." The villagers immediately ran out and saw a large ball fall on the bank of a nullah, south of the village. It had sunk in the ground and was broken to pieces, some of which were sent to the collector. It appears to have been more than half a foot in diameter; the external surface is black, round and polished, but this coating is very thin: within, it is of a light grey color, granulated and glistering with metallic particles. A specimen was examined by an able chemist, Mr. Bannister, of the Mint at Madras, and found to contain nickel and the other usual ingredients. It deserves to be mentioned, that when first examined, the stone easily crumbled down in the fingers, but became hard on exposure. This and the phenomena attending the fall, seem to confirm the theory of the formation of these stones in the atmosphere.

A small specimen will be forwarded to you by H. Lacon, Esq. the Collector, to be presented to the Asiatic Society.

Note.—We trust that our correspondent will favor us with the promised specimen, that it may be compared with four other Indian aerolites now in our possession.—Ed.

VIII.—*Overland Journey to India.*

[Continued from page 357.]

It was stated at the conclusion of the preceding paper, that we had made arrangements for travelling to Herát, under escort of Shah Kamrán's army. The better to describe the occasion of its coming to Meshid, it may be well to refer to the history of the Afghâns.

The great empire which Ahmed Shah Dúraní founded A. D. 1747, fell to his son Timúr, in 1773. Shah Zemán, the eldest of Timúr's many sons, came to the throne upon the death of his father, A. D. 1793, but he was deposed and blinded in the year 1801, by his half-brother Mahmúd, who owed his rise less to any merit of his own, than to the bold enterprize of Futteh Khán, chief of the powerful tribe of Bárikzye, whose father had been executed for treason by Zemán Shah, and who at once satisfied his revenge and ambition, by dethroning that monarch, and making himself Mahmúd's vazir. The usurper's reign was short and unsettled. Military force alone upheld him till the summer of 1803, when he was deposed in a religious tumult at Cábul, and prince Shújah-úl-múlk, full brother to Zemán, was raised to the throne by the people.

Shújah kept the throne till 1809. Mahmúd, who by his brother's clemency had only been confined at Cábul, unfortunately was allowed to make his escape thence. He fled to Futteh Khân, (who had retired to his castle at Girishk on the Helmand,) and that ever ambitious and daring chief did not rest until he had again made him king. Shújah, who deserved a better fate, was fain to fly from his country into the Punjâb, and finally to seek an asylum in British territory, within which he has since lived with his family.

Mahmúd was again nominally king at Cábul, but Futteh Khân as grand vazír ruled the kingdom as though it was his own, and took the surest means of strengthening his authority, by placing many provinces in the hands of his near kinsmen[1].

The growth of this man's power was so rapid, that the fears of Mahmúd and of the heir apparent, prince Kamrán, were excited. They conceived that he aimed at supreme power, and consulting only their jealousy, they first seized and blinded, and next most cruelly assassinated, the man who had done so much for them.

The immediate consequence of this inconsiderate act, was, that all the kinsmen of Futteh Khân rebelled and made head against Mahmúd. This weak king, self-deprived of the support which had throughout upheld him, was sensible of his own incapacity when it was too late : he was long in marching his troops to quell the rebels, and when at last he neared them with a force four times exceeding theirs, he still hesitated to engage them : naturally of a timid and vacillating character, he lost heart, and became suspicious of those around him, and finally put the seal upon a series of unaccountably weak acts, by deserting his army suddenly by night, and flying with his son Kamrán by the directly west road to Herát. With the exception of this province, the whole of Afghánistán fell into the hands of Futteh Khân's brothers, who portioned it into petty governments, and ruled, 2 or 3 in concert, at the different seats.

The relative situations of the Royal and the Bárikzye families have remained the same up to the present time, but the Afgháns have lost to the Sikhs, Cashmere and all their country east of the Indus ; the Sindees have become independent; the Belóches nearly so ; and on the west, the domestic troubles of Persia have alone prevented that country from encroaching upon its fallen neighbour.

Mahmúd died at Herát in the winter of 1829, and Kamrán succeeding to the name of king, bethought him of attempting to recover his country. The misrule of the rebel brothers at Kandahar gave him hopes of success there ; but he feared lest while he should be absent against the capital, his only place of retreat, Herát, should fall into the hands of the Persian Khorasán chieftains. He therefore made friendly overtures to the most powerful man among them, Réza Kouli Khân Kúrd, and through him sent amicable professions to the Shah of Persia. Réza Kouli Khân was at issue with the Túrkmáns, and he being a subject of Futteh Alí Shah's, Kamrán affected to testify his regard for the Persian monarch, when he sent 5 000 horse to co-operate with the Kúrds. In return for this act of friendship, Réza Kouli Khân, it was understood, was to be a check upon any one who might threaten Herát during Kamrán's absence.

The allies marched into the desert, but made no impression upon the Túrkmáns, and after narrowly escaping starvation, they returned to Meshid, and determined to repair to their several homes.

[1] These were 22 brothers of this family.

The country between Meshid and Herât may be shortly described.—South of Meshid, there is a break in the Paropamisan mountains, which now bend down to the east of Herát, and then turn up to meet the Hindú Kúsh.

A small branch runs down from the main range to the south of Herát, which is useful in describing the political divisions of the country.—To the west of the centre of this branch is Túrbut-e-Hyderah, a town which, once much larger, now numbers about 1000 houses. It is the seat of Mahomed Khán, of the Kará-í, or black tribe, a name well suited to them. Mohamed Khán should be subject to the Shah of Persia, but this has not been a point much attended to by the chiefs of Khorasán, and Mahomed Khán has ever been not only regardless of the Shah's authority, but at war with all his neighbours. His extenuators say, that he was prompted to this lawless mode of life when his father Issák Khán was murdered by Prince Wali Mahomed Mírza at Meshid, but as he has turned his spite upon unoffending persons to his own great profit, this may be doubted : the Persians say that he has sold 50 000 persons to the Túrkmáns during his rule, and travellers, as may be imagined, now pass seldom through his country. Those whom necessity takes this road, go "Tewakul be Khoda," (trusting in Providence.) As Mahomed Khán is always at variance with somebody, his country is often invaded, and his people therefore raise only grain sufficient for their own consumption, though their country is a fine one.

88 miles S. E. of Túrbut is Khaff, where is seated the chief of the Teimúrí tribe, and west between these two places is the province of Túrshish, which is a perfect garden.

To the east of the small branch described, between it and the main range, are found the Súni Hazárehs ; a turbulent tribe, who live in tents, and who have rendered allegiance to the Persians and Afgháns, as these powers were severally able to enforce it.

These are called *Súni* Hazárehs in contradistinction to the *Sheah* Hazárehs, who hold the mountainous country between Herát and Cabúl. They are violent professors of the Súni religion, and their features tell that they are descendants of the Tártars : these, or their thievish sympathies, have connected them closely with the Túrkmáns, to whom they sell those whom they have the fortune to lay hands upon. In order to have such convenient friends at hand, they allow them the range of their country, and consequently it is depopulated to the very neighbourhood of Herát.

On the 13th September, we took glad leave of Meshid, and rode with the rear guard out 20 miles to "Tungul Shor," a brackish spring of water, near to which Kamrán's army was assembled.

There were 4000 Afghán cavalry, and 1000 Súni Hazáreh horse ; and also 500 Kúrds under a son of the chief's, sent to give countenance to Kamrán's projected attempt upon Kandahar. The prospect of travelling so unsafe a road in security, had caused a large Káfila to assemble : there were 120 camels bearing cajávas, many others laden with food for man and beast, mules and yábús (ponies) similarly laden, and a crowd of horse, donkey, and footmen. Every member of the Káfila was called upon to pay a heavy tax to the generalissimo for his protection, and those who demurred, were appealed to with heavy whips. On the march the Káfila kept one line, (about 12 camels abreast where the country was plain,) the Afghán troops marched in dastehs (regiments) on one side, and far off in all directions parties of Hazáreh horse kept a look out. We travelled for the first part of the way by an unfrequented road, professedly out of Kamrán's regard for the Shah of Persia's province of Khorasán ; but as in marching up to Meshid, the Afgháns had taken the liberty of supposing part of it to belong to Mahomed-Khán Kará-i of Túrbat-e-Hyderah, and had wasted his lands accordingly for an old grudge, the sirdar got less credit for his delicacy than for his prudence, for it was rumoured that Mahomed Khán had leagued with the Serrux Túrkmáns to fall upon the Afgháns on their return.

We made 10 marches from Meshid to Herát (a distance of about 225 miles) through a naturally fertile, but deserted country. Our halts depended upon water and forage, as we carried with us all necessary provisions; and after the day's march all thought it a luxury to spread their carpets on the ground, and sleep securely through the clear cold nights. On the second day, after marching 30 miles over plain country, we entered the hills of the main range running down to Herát. We quitted these on the 5th day's march, and passed in sight of Túrbat-e-Shékh Jam, a small town of 200 houses, which is in the course of the usual Káfila road. The 6th day saw us at the Hérirud or Herát river, the pebbly bed of which was dry, except where water had been kept in pools. On the morrow, we passed through Kousan, a fine town which had only been the year before entirely deserted, on account of the inroads of the Túrkmáns. To Rosának, the country was uninhabited from the same cause, but from that place we journeyed 40 miles to Herát, by many little fortified villages, and well watered lands of cultivation: as we advanced these crowded on each other till they filled the valley, and our road lay through them to under the very walls of the city.

Herát is a well fortified town, ¾ of a mile square. It contains about 45000 inhabitants, the majority of whom are Sheahs; and there may be 1000 Hindús settled there, and 40 families of Jews. The outside wall is thickly built upon a solid mound formed by the earth of a wet ditch, which filled by springs within itself, goes entirely round the city. There are five gates, defended each by a small out-work, and on the north side is a strong citadel (also surrounded by a wet ditch) which overlooks the town. The interior of Herát is divided into quarters, by four long bazârs, covered with arched brick, which meet in a small domed quadrangle in the centre of the city. It contains 4000 dwelling houses, 1200 shops, 17 caravanseris, and 20 baths, besides many mosques, and public reservoirs of water. The city itself, is I should imagine, one of the dirtiest in the world, but without the walls all is beauty.

Herát is situated at four miles' distance from hills on the north, and 12 from those which run south of it. The space between the hills is one beautiful extent of little fortified villages, gardens, vineyards, and corn fields[2]; and this rich scene is lightened by many small streams of shining water, which cut the plain in all directions. A *búnd* is thrown across the Hérirúd, and its waters are thus conducted over the vale of Herát, so that every part of it is watered.

The most delicious fruits, of every kind, are grown in the valley; the necessaries of life are plentiful and cheap; and the bread and water of Herát are proverbial for their excellence. The climate of this country is said to be salubrious; the heat is excessive for two months in summer, and in winter much snow falls.

On the 24th of September, the thermometer stood at 85° (in the shade, at the hottest time of the day): between that date and the 8th of October, it fell gradually to 65°; and on the four last days of our stay at Herát, it stood at 70°. The nights were very cold, and winter was evidently fast approaching.

Abbas Khán, a Persian nobleman, in Shah Kamrán's service, with whom we had made acquaintance on the road, gave us a small house to live in during our stay. The second night, after our arrival, we were subjected to an inquisitorial

[2] There are 450 villages of Súni population immediately round Herát. Their lands are watered by 8 large canals, and 125 kahrézes, and the yearly produce of wheat and barley is averaged at 22000 khur-wars, or asses' loads of about 725 lbs. English each.

visit from the kotwâl of Herát, who, with 20 armed attendants got into our residence at midnight, from the roof of an adjoining house, and took us asleep. I believe it was thought that I was a wealthy Russian merchant, travelling to spy the land, and as an excuse for their outrage, they brought a rascal who deposed that we had robbed him of 800 tománs at Damghán, in Persia, a place which we had not seen. Our effects were most rigorously searched, but had we been thieves, we could hardly have been proved such by our property; for except (in his estimation) a rather superfluous quantity of *camizes*, the kotwâl found nothing to call forth an exclamation, and we had an opportunity of shewing our civility by letting him out at the door.

As the outrage was committed in the house of a nobleman, high in favor with Kamrán, we guessed who had ordered it, and sat down under the affront: indeed, we were congratulated upon it the next day by some friends, who assured us, that we might now travel where we would, since no one would suppose us possessed of any thing valuable, if the kotwâl did not find it. I forwarded a letter, which Sir J. Macdonald had given me to Shah Kamrán, and was told that I should have an audience, and be presented with a dress of honor; but as these distinctions were being bestowed upon those whom the Shah had engaged in his projected attempt upon Kandahar, I feared lest he should represent me as an ambassador extraordinary from the British Court, and so civilly declined the honor.

Our residence at this beautiful place would have been delightful, had we not been exposed to the many evils attendant upon poverty. The money which we had obtained at Meshid, only paid our debts there, and a "commander of ten," of Kamrán's horse, who with great shew of good nature, had forced a loan of 15 ducats upon the Syed, during the march, having acquired considerable doubts of our solvency in consequence of the kotwâl's unprofitable visit, used to walk upstairs daily, to know if we meant to pay him when his cash became due. The Yezd merchant too pressed us unfairly for his money, and set a host of relations upon us, who scrupled not to hint that they considered us little short of swindlers. We pawned every thing that would be taken in pledge; no news of our messenger came, and our prospects were so gloomy that we did not like to think upon them. We were relieved however from our difficulties, in a manner which I have pride in relating, as it shews how fair a character my countrymen have acquired abroad; and I am happy to have an opportunity of making known the man to whom I am so especially indebted.

Syed Muhín Shah is the *pír-khâneh*, or elder of a family of Syeds, who live in the valley of Pishín, three marches south of Kandahar, and who are supposed by the superstitious Afgháns to inherit the power of healing diseases, charming the elements, &c. and of blessing or cursing their neighbours with sure effect.

Syed Muhín had come to Herát to recover a debt, and hearing that a foreigner was there in distress, he called upon me. He had been in India, and by using the names of Mr. Elphinstone, Sir John Malcolm, and other gentlemen high in office there, I satisfied him that I was an Englishman. On learning our difficulties, he at once engaged to assist us: he had often, he said, been brought in contact with my tribe when trading in India, and had assured himself that they never gave their words falsely; and though he had expended all his money in purchasing horses for the Indian market, "Inshallah" [3] his word was good for any sum, and he would be security for us. We found many who would accept our friend's bond, but they would only give us merchandise for it: still, we determined to proceed on our journey at any sacrifice, and so, after spending a few days in useless attempts to procure cash, I bought Cashmere shawls to the amount of 910 ducats, or 4500

[3] Please God.

rupees. These we sold in the bazár for about 1900 rupees, with which we paid our debts. Syed Muhín became security for me, and we prepared to journey on to India under his escort.

With Syed Muhín Shah we travelled safely from Herát to Dehli. Words would not enable me to express the kindness and delicacy of this man's conduct towards me during the whole of the journey. All his friends laboured to convince him that I was an impostor, and he was exposed to extreme vexation and danger on my account: yet he never relaxed in his endeavours to promote my safety and comfort; he paid all our expenses, and never alluded to my debt to him.

We quitted Herát on the 19th of October, in company with our patron and a dozen of his friends, and rode in eleven marches 365 miles to Kandahar. We chose what was stated to be the worst road of three: it led us through a hilly, but not difficult country, well watered, but uncultivated. The tribes who inhabit it live a pastoral life, and, residing in felt tents, wander with their flocks among the vallies away from the road. We generally commenced our march late in the afternoon, and riding till certain stars were down, halted to sleep; and again continuing our journey at dawn, we rested during the heat of the day. We met but few people on the way, and were only aware of the number of the inhabitants, when at night the lights shone out all round us from *khails*[a], or sheep-folds. At some of the stations we were able to procure flour, and also grain for our horses: those who might have been inclined to molest us, when they found who headed the party, seemed to think that they could not shew him sufficient respect. When we halted near a khail, the sick were brought, that Syed Muhín might lay his hands upon them, and many who saw us from a distance, would hasten to beg a blessing from the Syeds of Pishín.

Our fifth day's halt was upon the bank of the Feri-rúd; a quick, clear stream, then (at its lowest) 50 yards across, flowing through a fine valley, in a broad bed of soft pebbles. On the 8th March, we crossed the Bramjoe and Kash-rúd rivers, both at that time shallow streams in broad beds, which are filled in spring, when the melted snows run from the mountains. At Washír, (224 miles on the road,) we crossed the frontier of Kamrán's province. Thirty miles beyond this place we quitted the hills, and the country was plain before us 110 miles to Kandahar. We halted two days at Girishk, upon the bank of the Helmund, which was then at its lowest. The stream of this river when we forded it, was stirrup deep, flowing smoothly but with force, in a clear stream of 300 yards breadth; 60 miles beyond it we crossed the Arghandáb, still a quick stream, though so much of its water had been drawn off for the fields of cultivation which marked its course from a great distance. From this point we rode by many villages, and over well cultivated lands, across the country to a small fort 16 miles south of Kandahar, where some of Muhín Shah's relations resided.

I had fallen sick on the road, and during the nine days that we remained at Syed Muhín's fort, I was confined to my bed with jaundice. My companion however, Syed Kerámat Ali, went to the city, and gave the following, I am sure, correct description of it.

"The city of Kandahar is a third larger than Herát. In shape it is a long square: a bastioned mud wall surrounds it, and the sirdars have added a ditch to its defences, but it is not a place of strength. There is a citadel, but not a strong one; water is conducted, by three canals, through the town into the ditch; this water might be cut off from the outside, but there are many wells in the town. There is a large covered bazar like the one at Herát, and supplies seemed plentiful and cheap."

[a] Camps.

Were Kandahar the seat of a just king, it would be the centre of a large circle of rich cultivation. The soil is so good, and water in such abundance, that even under the oppressive government of the Báríkzye sirdars much cultivation is carried on. We had means of judging of their rule by contrasting it with that of one who appeared to us any thing but a " Núrshiwan." At Herát we thought Kamrán an oppressive governor, but all the way to Kandahar the people were earnest in asking us if the report of Kamrán's coming were true, and a prayer was invariably added for his success against the zálim usurpers.

The climate of Kandahar is not so good as that of the country about Herát ; in summer the heat is very great, and more rain than snow falls.

On the 10th of November, we marched from Syed Muhín's fort, 16 miles to the Dúrí river, a stream of excellent water. On the 12th, we crossed the bed of the Kudaní, which only holds water in winter and spring. We halted that night in the Khojeh Amrán hills, which are a broad range, of no great altitude, running S. S. W. by N. N. E., and the next day we reached Shadírí, the *khail* of the best families of the Syeds, on the bank of the Lora[5] in the valley of Pishín.

We were with these Syeds eight days. Many Afgháns who had purchased horses for the Bombay market, waited for Muhín Shah, knowing that his influence would greatly protect them, both in their own country, and in Belochistán ; and when he marched, he was accompanied by a strong, well armed party, who possessed between them about 400 horses.

We made two easy marches to Quetta, a small town of 400 mud houses, the petty capital of the Beloche province of Shaul. The town is distant eight miles from a high range of mountains called Takkatú, which commencing here, run easterly to the Indus. The inhabitants are Beloches and Hindús. Káfilas to and from Hindústan pass this way, and the town is of more importance than its appearance warrants. The climate here is very fine, the soil is good, and plenty of water can be conducted from the many springs in the hills. We halted at Quetta nine days: the Hakim had grain to sell, and report saying that our road was occupied by some banditti of the Káker and other tribes, it was resolved to wait the arrival of some more horse dealers. When these came, we purchased the services, in addition, of forty matchlock-men, and continued our journey.

31 miles from Quetta we came to the Kurkléké hills, the first of a very high series, which cover the country as far as the plain of Dádur, and which have a general inclination up to the Takkatú range. We slept in a narrow valley, and from it the next morning entered a close defile called the pass of Bolán. At first there was but breadth for a dozen horsemen abreast between the rocks, which rose like walls on either side to a great height. Afterwards the road lay broadly between the mountains, occasionally opening out. It was like the beach of a sea, formed of loose pebbly stones and sand, and it ran in sharp angles of from 150 to 200 yards length. This was the nature of the pass for ten miles to Khajúr. The minutest description could hardly convey a just idea of its strength ; it is a defile which a regiment of brave men could defend against an army. At Khajúr, a full and rapid stream gushed out from the foot of the rock, and preceded us on our way. Here the mountains break off from the road, but they still command it for nineteen more miles to a point called Bibínaní, where this formidable pass ends. We journeyed through it with skirmishers thrown out, fearing to encounter the reported enemy ; but we met not a soul, and slept securely at Kírta, or *garm-áb*, a spring, the water of which was hot after sunset, and cold in the day time[6].

5 Lora is the Pashtú for river.

6 Such springs are not uncommon in Afghanistán.

The next march was through a stony valley, and across many small lakes of water[7] that lay in it, to Dádur, a small town of 400 houses, distant seven miles from the mountains, which when viewed thence, had the appearance of one high range, coming up north from the sea, and crossing the Takkatú range at a right angle, so as to separate distinctly the mountainous from the plain country. Dádur is situated in an arid plain, which, were it not watered by a stream from the hills, would scarcely be habitable. The river Nári[8] comes through it south from the Takkatú range, and the lands within reach of its waters are cultivated with *jawarrí*, *bájra*, and cotton.

We followed the course of this stream 36 miles to Bágh, a town of 2000 houses and 300 shops, for many miles round which there were extensive fields of *jawarrí*. Much gun-powder is manufactured here, which finds its way to Afghanistán and Sind, and the Hindús seemed to enjoy a brisk trade, chiefly in the common sorts of grain[9].

Proceeding hence, we travelled through an unsettled country, 75 miles, to the commencement of a thick jungle of low trees, which running east and west, marks the *sir-had* between Belochistan and Sind. South it is only interrupted by the Indus, whose banks it fringes : many villages of a few wretched houses each, occupy small spots cleared away from the jungle ; tracts crossed each other in many directions, and we had difficulty in finding our way to Shikarpúr.

We computed the distance from Kandahar to Shikarpúr to be about 410 miles. Both the Syed and myself had watches, and during the whole of the journey from Astrabad, we calculated that we rode four miles an hour ; an average which is little if at all in excess, as the horses amble. In the day time I was able occasionally to note the direction by a pocket compass : we travelled much at night, but the stars always shone clearly, and I think that we were able to lay down our route with tolerable precision.

Shikarpúr is a very large walled town, which is chiefly inhabited by wealthy Hindú bankers and merchants, who have commercial connexions all over the East. Around the city are fine gardens, and groves of luxuriant Indian trees ; the appearance of the place is beautiful, but the heat during the greatest part of the year is such as would kill any body but a Hindú.

Since the last revolution in Afghanistán, a Hâkim has ruled here on the part of the Hydrabad Amírs. When it was understood that we wished to proceed to the north of India, we were told that we must first go to Khyrpúr, and we set out accordingly.

We rode 17 miles through a jungle, and just as the sun was setting, found ourselves at the end of it, and upon the high bank of the Indus, which was flowing past us in one calm broad stream. From where we stood, we commanded

[7] It is probable, that the periodical rains that come up from the Indian ocean, are stayed by, and gathered in these mountains ; they deluge the plain of Dádur, but are hardly felt at Quetta. The hills are bare rocks, and the stony vallies are full of standing water. At one place we found the road through the valley blocked up by a lake too deep to be ridden through. In summer, the sun acting upon these pent up waters, causes a pestilent air, and the road from Quetta to Dádur is shut.

[8] The course of the Nári from the Takkatú, or as they are here named *Lári* hills, is south to 42 miles beyond Bágh, then it goes off to the right. It is during the periodical rains that its bed is filled. The cultivators form strong dams across it, and so retain the water for a second crop.

[9] The Afghâns take many camel loads of jawarri hence to their own country. They both make bread of it for themselves, and give it to their horses,

a view of two other broad reaches, and the scene altogether was one that for quiet grandeur and beauty could hardly be surpassed. We slept on the bank, and the next morning were ferried over, in boats which held two camels and three horses ; we were towed up the bank for some distance, and then loosing, we were rowed across diagonally with the help of the stream. The water ran at the rate of about 2½ miles per hour, and its breadth was half a mile. Though the right bank was high, the left one was here hardly defined ; the bed was of earthy sand, and the water was in appearance like that of the Ganges.

We proceeded 19 miles to Khyrpúr, a very large open town, built among fine trees, the seat of the descendants of Amír Sohrab. Here an exorbitant duty was taken for our horses, and we were then allowed to proceed to Rohrí, the capital of the Sogdii in the time of Alexander the Great, now an old town on the rocky bank of the Indus, looking upon the island fort Bukkar, which is strongly built of brick and stone upon a flint rock that rises from the centre of the river. The water covers part of this rock at one end, and forms a little islet on which is a Mahomedan temple embowered in trees, the resting place of so great a saint, that the very fishes come up from the sea to swim a *ziarat* round it ; and to mark their respect for the shrine, they never once turn tail on the journey up. The natives have a curious mode of catching fish here : they lay their stomachs upon large empty jars, and holding a line or a net in their hands, they use their feet as paddles, and float about with their faces close to the water.

From Rohrí, we journeyed 240 miles up to Bahawelpúr ; the first 90 miles of the road were through the Khyrpúr Amír's country, the soil of which, though very good, was neglected and over-run with jungle. As soon as we entered Bahawel Khán's territory, we were sensible of a great difference. The wood was greatly cleared, and the ground well tilled ; the people also seemed better off, and more orderly.

The soil became lighter and more sandy as we advanced ; 40 miles or so from Ahmedpúr, we got upon the border of the desert, separated as if by a line from the good soil on our left, which was well cultivated as far as the eye reached.

Ahmedpúr is a large and flourishing town, now the residence of the Khán. We travelled from it 35 miles to Bahawelpúr, which has rather decayed since the time when Mr. Elphinstone described it, owing to the preference which the Khán gives to Ahmedpúr, chiefly I believe that he may be further from his unpleasant neighbours the Sikhs.

We concluded our travel by journeying across the great desert to Hissar. This is not, as has been thought, altogether a desert of deep sand. What loose sand there is, lays upon a hard subsoil, and it bears no proportion to the good land. Neither is the country uninhabited : we passed through several well sized fortified towns, at which we got common necessaries. We were obliged to feed our horses upon Bajera, the staple food of the people. Of this grain, and of Môt, (a pea,) crops are raised by the periodical rains. This desert is evidently a high table land : water is only found at a great depth below the surface, some of the wells were 300 feet deep. At many of the stations the water is kept in cisterns, and sold to passengers. The country is greatly covered with grass and weedy jungle, and many thousands of camels and oxen are pastured in it. Many tracks cross each other, leading to wells dug in the desert, to which the beasts are driven every second day to water.

The people for the first 80 miles owned the authority of Bahawel Khán : beyond this we travelled through the quiet country of the Bikanir Rajah, and to our great joy, crossed the British frontier in Feb. 1831, at Tibbí, a small out-post, where we found a Resallah of Colonel Skinner's Horse. Three days afterwards we reached Hissar, and in the hospitable mansion of Captain Parsons, superintendant of the Stud, I had once more the satisfaction of hearing my own language spoken.

Note.—In Plate XXIII. fig. 5, we have given fac similes of the four ancient gold coins brought from Khorasán by Lieut. Conolly, which are alluded to in the Report of the Proceedings of the Asiatic Society, 7th Sept. page 295: the characters of three of them are evidently Kúphic, the second is more like a Hindí inscription. There may be perhaps among our readers, some antiquarian or orientalist who may feel disposed to try his skill at decyphering the legends.—Ed.

IX.—*An Essay on the Game of Billiards.*

[Continued from p. 369.]

When the passive ball lies directly between the active ball and a pocket, the winning hazard is most easy, and according to the deviation from that position, it, in like proportion, becomes difficult; for the part to be hit cannot be chosen so accurately, nor seen so distinctly in this, as the former case; and the same angular variation from the proper line of direction, will err further upon the passive ball's surface, than when the hitting point is less distant, and the declination consequently not so great—(see fig. 18.) But, in the above situation, the losing hazard is most difficult, for the walking motion (which is necessary to execute it) should be strictly vertical; and, since angular relation with a pocket varies as the distance, the hitting spot depending upon that interval, cannot therefore be absolutely defined; however the manner of hitting, most favorable for that purpose, perhaps may; which seems to be, when they are half opposed to each other at the time of aggression: for thus the resistance will neither be great enough to make the active ball apt to twist, nor direct enough to give much efficiency over the angle to a walk, (the simple motions being less fallacious) while the hitting spot, not being far from the middle of the ball, the declination cannot be very considerable: at the same time it is evident, if the hazard made from that measure of opposition, with moderate force, be allowed the most convenient or eligible, the angle which the situation of the passive ball should make, is (a posteriori) relatively ascertained.

A ball is more reflected from another at a distance, by a strong stroke, than a weak one; because, neither the progressive motion, nor the twist which in some measure at first accompanies it, from the necessary elevation of the butt-end (when the ball is struck with force, and no higher than the middle) is so completely overcome, before it hits the other ball.

For the same reason, a ball struck with violence, if the direction be inclined to the cushion, will be reflected more towards the player, making the interior angle less, than if played easily; as also because, the form of the impression, made against the cushion, is rather the arch of an ellipsis than a circle, till the part first hit recovers its place; but, in the mean time the ball is advanced, and the further part of the cushion (see fig. 19) embracing it exactly, will reflect it more abruptly, elasticity not returning the other with quickness enough to prevent it[1].

[1] In playing bricole when necessary to hit the cushion very obliquely, the inexperienced player seldom does it soon enough to answer his purpose; for, the more distant the point of contact (i. e. the fulcrum) from the line of direction, and the less the progressive violence, the more operative in lateral exertion is the power, which in some measure thus deceives him.

A ball, somewhat obliquely hitting another, close or near to the cushion, after being repelled to some small distance by the kiss, frequently returns to the cushion, or runs into an adjacent pocket. This (at first view) may seem extraordinary; but, it is to be noticed, that, without increasing the progressive velocity of the ball, a force may be superadded, which will carry it farther; and, that the progressive velocity which remains after hitting, may be completely destroyed, without necessarily annihilating the rotary motion also. For (see fig. 20) suppose A and P, vertical sections of two balls centrically opposed in the line of motion, and placed laterally to view: though the progressive of A, may be stopped by the kiss from P, yet, the walking rotary momentum, derived from its weight with the impulse given by the cue b, and denoted by the curved line c, is not consequently stopped also: but making the point of contact the centre of motion, raises the ball with a conatus, from d toward e[2], and moreover, should those sections not be in the same plane, will co-operate with the horizontal or lateral rotation produced by this obliquity, as has been already explained, and both be expressed by the curve, it afterwards describes (see figs. 21, 22, 23.)

Hence, a ball hitting another near to the cushion, and not far from a pocket, is more frequently holed[3] in this manner, than is generally imagined; because, the hitting, and kissing, are too simultaneous to be well distinguished by the noise: but it may be remarked, the active ball is often holed thus, (a walking stroke being always most apt for the purpose) which would be thought impracticable, where a kiss could not take place[4]. Hence also, the active ball is more apt to bounce, than the other; and, if the view would not be thought too minute, it might be said, that the passive ball being quiescent, and dwelling with its weight upon the cloth, sinks lower than the ball in motion, which rises therefore immediately after contact; but, the other not till after reflection from the table also, by which its force is much weakened.

When one ball hits another close to the cushion, in an acute angle with it, the tendency upwards from its rotary motion is much enhanced by not hitting both exactly together; for, then the ball, meeting, as it advances, with a kiss below

[2] Hence the reason, why a ball played with much force against a cushion, is more apt to bounce up after a walking than a twisting stroke.

[3] The word held, when applied to the ball in this sense, is not English; holed being the inflection of hole, but held that of hold: neither is the word immissible, which is sometimes used (by those who should know better) to signify not to be missed; but with this view the fabrication can have no excuse—both are instances of a very confined education.

[4] A similar effect may (notwithstanding) be produced without the intervention of a kiss, when the passive ball lie not far from the cushion, yet so far as to admit being hit with a considerable degree of opposition, and on its return not meet the other, provided the walking stroke be made with a violence somewhat extraordinary, and according to the distance: for, the rotary momentum thus received, which it partly retains after the progressive motion be destroyed by the passive ball and cushion afterwards, brings it again forward (as has been already shown) in the generation of this curious result.

The opposition (as above) should be considerable, that the active ball may only lose as much as possible of the progressive, and not have it also turned against the object intended, by assaulting the fixed, and more repulsive power of the cushion: and the distance from the cushion should not be great, that the walking power may neither be too much wasted, nor fallen into a smoothness of motion, after the hitching it receives from the passive ball, as is explained in the next paragraph.

its centre, or touching the cushion above its most prominent part, rises, and is carried by the progressive over the table.

Should the active ball by any means hop on the passive, somewhere about half way in or near the arch between its middle and summit, with only a small degree of progressive force, it will be driven backwards : for as in this case, it urges the other to pass through the table, its forward motion is impeded, not only by the resistance and re-action of the passive ball; but by similar properties in the table also, and must be returned from their ascendency, and according to that direction wherein they are assailed.

The active ball after hitting the passive has (cæteris paribus) the same degree of latitudinal range with it : but, if the interval between them be small, and the active ball invested with those subsidiary powers, from which the other is debarred, it may have more than twice as much, and traverse a circle entirely, (as shewn at the beginning of this essay, see fig. 2 :) whereas, the passive ball is subject to a government, the limits whereof cannot by any means or situation be extended to half the compass, and its influence diminishing in direct proportion with the interval, the space accordingly will become contracted as they are approximated, till distance vanishes, and it be reduced to a single line. Or (by conversion) supposing them thus in contact : as the hitting point cannot be altered by any manner of striking the active ball, neither can the direction of the passive be capable of latitudinal variation ; and, in proportion as they are removed, the arch intercepted between the tangents b, c, and d, e, (see fig. 18.) formed on opposite sides by the motion of the active ball, will increase; but on account of their divergency after intersection, as at f, or any where else, as at g, cannot (however great the distance) be equal to a semicircle. Hence a losing hazard occurs much oftener than a winning one, and dexterity the effect of practice, gives it with most players the preference. Yet they cannot well be compared; at least, their comparative facility should not be decided by the distance from the pocket only, but also by the arch, on the surface of the passive ball intercepted between the middle, and the part which it is necessary to hit for the respective purposes. However a person executes that best, which he is most accustomed to play for, and fancy the offspring from success, assists execution. Players therefore equally good may have different design.

A cannon, or losing hazard, is made with less certainty, if the first ball be within the distance of an inch or two from the second, and the third one or p. c. somewhat remote, than when extended to that of so many feet ; because the manner of striking the ball must be more precise, to avoid complication from the various motions which are in the beginning more particularly apt to occupy it, as before explained.

A cannon is more easily made than a hazard, if the distance be the same ; because, should the first ball after hitting the second, move within three diameters of the third, it must be made ; but no table has the opening of its pockets so wide.

If the progressive motion of a ball be slow before it hits a cushion, it is often observed to be somewhat accelerated after ; the increase arises from a coincidence of motions by reflection, which had been at variance in progression.

In the winning and losing game, a winning hazard made of the adversary's ball is generally of less value than a losing one, as the fewer balls left upon the table, the less obviously must be the remaining chance ; on which account, good players will frequently give it up in favour of a worse hazard, and relinquish a cannon beside, for as much attention should be paid to the consequences[5], as to the immediate object of the stroke.

Players of the old school (as they call themselves) bigotted to former habits, have but little relish for this game: they think it so much under the dominion of chance, that experience, judgment, and execution, have not their meet rewards; and that Tyros carry off a larger share than their merits give just claim to: but they do not place the game in its proper light; for, though it be allowed absolutely a game of more chance than the winning only, and of much more than the white game, still that conclusion may be disputed; for, suppose in this the chance be as two to twelve, which is the sum total of the game, while in the other it be as six to twenty-four: though it may be said, there is three times the chance, that is six to two; their respective proportions are only one-fourth and one-sixth; but, if the winning and losing game were extended to thirty-six, (which perhaps would take up no more time in playing than the white game,) they might then be viewed correlatively also, and chance being overpowered by numbers, would lose that extraordinary influence which now forms the objection: however, for obvious reasons, an alteration to this effect, at public tables, is not likely to take place.

Besides the white and cannon games here mentioned, there are others; and upon the same principle of variety (which is merely numerical) there may be many more; but additional balls, without diversifying the manner or effect, by increasing still further the predominancy of chance, abridge the exercise of those faculties which chiefly render a game entertaining, and enhance this objection unprofitably. To enumerate the several games at Billiards, with their rules and laws, &c. not being within the scope of this essay, they are only transiently alluded to.

A cue should be chosen with a degree of stiffness, or otherwise, according to the force which the player is capable of using; for if it be too weak, it will be overcome by too small a measure of resistance; and its reaction, upon which the ball's velocity depends[6], must be feeble in the like proportion; and, if it be too stiff, the power cannot make it bend effectually, to excite a sufficient quantity of elastic force; but it is best adapted, when moderate power produces the greatest comparative violence; for violence of aggression does not altogether depend upon the degree of power, but also upon the closeness of the bounds wherein it is exerted: this will be more manifest, by supposing the impelling power to consist of ten parts in arithmetical progression, as 1, 2, 3, &c. beginning with unity; and, the elastic force capable of being excited, divided into the like number[7]; the violence of effect upon the ball, will be directly as the power, but inversely

[5] This is the reason why good players make more voluntary misses than bad ones, and few perhaps give so many as they ought, the game being often won in one hand from the advantage gained by ill-timed frugality.

On the same account, if a player think he can make an hazard, as well as a cannon, or even more, by one stroke; it is frequently better to take them separately, not only because he will then be more certain of marking, by contracting his views, but also enabled to provide for those which follow, with more exactness and advantage in the end.

[6] This will be evident if by reversing the cue, and using the butt-end as the point, the effects of both be compared: for the power, manner, and weight being the same, the difference can be ascribed to nothing else.

[7] The power, when excited to the utmost, can scarcely be comprised within the limits of ten inches, but the elastic force resulting from only the difference in the length of the cue, before and after it has been constrained by the stroke, can scarcely exceed one-fortieth part of that distance.

as the distance in which it is made to act, that is greatest when the stroke is shortest, because, the ball having less time to make its escape, the resistance arising from inertness, and other impediments to motion, which bend the cue, is increased by suddenness of opposition; but, if the stroke be extended, or lengthened by continuation to a greater distance, as when playing for a walk, though the quantity of power employed remain the same, by the time the fifth or sixth degree arrives, the resistance will be subdued, and the elastic force beginning to expand itself, the ball will either be driven too fast for the successive numbers to overtake it; or should it not be detached, the opposition being so small, they will discharge themselves to little purpose, merely pushing it forward, while the elastic force, instead of being augmented, relaxes, and the cue immediately recovers its form.

It will be endeavoured to render visible how the measure of aggression, which evidently depends upon the power, is increased by contracting the distance wherein that power is exerted. Suppose, therefore, *b*, (see fig. 25,) the point of a cue drawn back to *c*, with any degree of quickness, and immediately returned for the purpose of striking the ball A. If its motion (assuming the power of the hand for that of gravity) be admitted as uniformly accelerated, in the order of 1, 3, 5, 7, 9, 11, &c. like that of bodies falling from a state of rest; an Isosceles in analysis, as *d*, *b*, *e*, taking the first division of the area as comprising a given degree of celerity, or primitive quantity of power, represents the same ratio of arithmetical increase during its emotion: and under the above law of acceleration, by supposing the cue further removed to *f*, (that is twice the distance,) with *b d* produced to *g b e* to *h*, and then joining *g h*, the relative spaces, degrees of celerity, and quantities of power, may, by transposition be obtained at each consecutive interval, and the last will express the aggregate on its return to the ball. Or two triangles, constructed equal and similar to the given one, and placed as in the figure, will exhibit the progression more concisely, with an initial of the like proportion, as 1, 3, taking the first triangle for unity. But if twice the quantity of power be excited within the same distance, the increments of acceleration will be doubled also, and (pressed between parallels at similar intervals) driven into lateral expansion, and require twice the space to range in, as may be seen in fig. 26. Again, suppose the cue drawn back to *c*, as before (see fig. 27), and then, for an instant stopped (as is the practice with some players), the momentum will by this intermission, be destroyed, the advantage acquired from it lost, and the force must originate there de novo, by which the aggressive effect (as the spaces indicate) will be no more than half, though the active power be unimpaired. Hence it appears, why bodily or muscular strength, without the art or knack of compressing its powers by a sudden jerk or the like, is so often unavailing.

A cue should always have a little preponderance forward from the part where it is usually held, and in this the weight should chiefly be; for if behind it, the same weight will alter the preponderance to the other end, or if before, it will press too much upon the bridge, to move with sufficient lightness; and reducing the weight to correspond with the distance, is cutting off a principal source whence the momentum and elastic force take rise.

Before the butt-end of a cue be used, it is often material to know the transverse section there; for, if at the time of striking the ball, it makes with the table the interior[8] angle less than a right one, the point of aggression will be under the middle; if greater, over; but if neither, the middle will be struck exactly, and the consequences resulting—twisting, walking, and the progressive respectively, as

[8] (That is) the angle opening towards the player.

before explained: the elevation of the hand should therefore accord with the design.

The habit of applying the hand or finger to the top of a cue during play, is a bad one; for the moisture exuding through the pores, being somewhat oleaginous, makes it slippery; yet a smooth-pointed cue, though of less compass than a rough one, is often more certain in effect, if by striking the ball centrally it does not slip upon the surface.

The rule, which requires the marker to hold the cannon ball in his hand, till another which occupies its place be removed, is slovenly, ill chosen, and should be altered: to give it a corresponding situation at the other end, or (should that also happen to be engaged,) to place it in the middle between the two side pockets, would be a much better one.

A stone foundation upon a ground floor is the best for a billiard table, because it cannot lose its level, or be affected by walking or stamping around it: whereas, if it be placed upon a joisted floor, supported only at the ends, it often requires adjusting, and the balls are more likely to be influenced by any violence that takes place on the boards with which it is connected.

Whether the general tendency of such causes be to retard motion, or accelerate it, is perhaps scarcely to be ascertained by any practical observation: but as in particular cases the effect (however small) may sometimes be material, it falls within the tenor of this treatise to seek the issue theoretically.

In favour of retardation it may be said, because the motion communicated proceeds from a pressure of one kind or other directly upon the floor, the agitation excited is necessarily perpendicular; and the surface of the table which lies parallel to it, will vibrate in like manner, till the action of their elastic force subsides: consequently, this tendency of up and down motion imparted to the ball, must be a corresponding incurvation of the right lines in which it was moving, and therefore a contraction of the distance; but (it may be objected) this incurvation being the effect of attraction, operating uniformly without increase, or variation of direction, over the ball as it moves, cannot therefore be the means of contracting the distance, by any extraordinary influence: on the contrary, should this power, which is the principal impediment to its motion, be opposed directly by any force or cause (as in the present instance) it must for the time be equivalently diminished: and, unless the ball be entirely detached from the table, (by which the motive power will be consumed in simple revolution (that is) without advancing it) a single elevation, which does not deprive it of the advantage arising from attrition, will add energy to the momentum, and the result be acceleration—besides, if any power acting in a line perpendicular to the centre of a ball at rest, produces no horizontal motion[9], and that some effect of that nature must take place afterwards,

[9] This is in the presumption that the centre of the ball, and that of gravity, are the same: otherwise, if the ball be raised above the table, by any violence from beneath, it will incline to turn from the perpendicular, towards that direction wherein the centre of gravity (which takes the shortest way downwards) happens to lie.

When a ball is said to rest upon the edge of a pocket, and afterwards without any apparent cause falls into it, the present law at billiards declares the effect as a kind of chance-medley; and since it would be hard the adversary should suffer, through the impertinent interference of such an agent, visible or invisible, the sentence dismisses the claim as of no account. This chance, be it besides what it may, is certainly a very wonderful and convenient menstruum, for it dissolves difficulties by wholesale; and were it only as comprehensible as it is efficacious, or the narrowness of human understanding somewhat enlarged, perhaps its reputation might make its way beyond when changed from that state; since the ball is advancing, while the impression from the table is successively communicated through its parts, its centre must be supposed to have passed beyond the perpendicular line, before it be totally disengaged from the action of the surface whereon it rolls, rather than to have occupied any retrograde position. From this view follows the same conclusion as before, and both seem to shew a preponderance in favour of acceleration.

A stroke is said to be foul, when the cue is not parted from the ball played with, before both balls touch[10]. If the ball played at be hit in the middle, or near to it, the foul stroke is more obvious; because the striking ball cannot be supposed otherwise to follow it with much motion: but, if only a small portion of it is opposed; because the striking ball is therefore less retarded, its motion afterwards is generally attributed to that circumstance only; and the stroke called fair, though it be often really foul. For, suppose two balls A and P, (see fig. 24,) one inch asunder, if the cue moves in the direction *b*, *c*, farther than from *d* to *e*, after striking A, before it be detached; it constitutes a foul stroke: but in the direction *f*, *g*, it may be advanced as far as from *h* to *i*, before the balls touch; still it is much suspected, that the motion of the cue, is frequently not confined even within these limits: for in the latter case, or where the ball is struck as *k*, *l*, so that it may hit less obliquely, making *m*, *n*, the interval before contact; there is so little caution used, that the cue is often driven twice the distance.

Yet, sometimes it is difficult to decide, and the best judge, the most unqualified, by being the player; for, if foul, he will have felt an opposition to his cue, greater than he has been accustomed to meet with from a single ball: but as no one's opinion is asked where he is interested, the best criterion by which a judgment can be formed, on the nature of ultimate effects, when the intermediate elude the senses, appears to be obtained by adverting to causes more remote; and therefore the distance between the balls, the fulness or obliquity, and the force of the stroke, with the manner in which it is made, whether short or otherwise, added to the experience of the person in a similar situation, to whom the question is referred, are, if not the only documents the case admits, the surest guides to direct his answer.

the confines of a billiard-table; but, until those who have discovered this impenetrable secret grow a little more communicative—'tis probable, those who have not yet been so unfortunate, will be stubborn enough to attempt the solution through the medium of common sense: accordingly, presuming a ball, once stopped, can never of itself begin to move again, they may ascribe the hazard to the effect of the stroke, saying the ball stopped to appearance only, but was really at that time in motion nowever slow, either by gradually pressing upon the pile of the cloth, where it loses of its thickness as it turns round the edge; or, suppose the centre of gravity not in the centre of the ball and the equilibrium just beginning to be destroyed, &c. It seems as if this law (like others of a higher nature dignified for their uncertainty) was made for the sake of disputation only, and in harmony with its principle, as it begins in error, it often ends in discord.

[10] But, as frequently there are no means of ascertaining this, which is allowed to be the proper criterion of that character, if a foul stroke were made to turn upon the distance between the balls, before the stroke takes place, for instance, an inch or half an inch, it would prevent many disputes, and be the same to both parties.

Perhaps it would be still better, to do away a foul stroke of this kind altogether except when the balls touch; for, supposing a near situation be generally advantageous to the striker—which is very much doubted, both players have an equal chance to profit by it. The other kind of foul stroke is, when the cue touches the ball a second time in the same act of impulsion.

Thus, all the motions which can be given to a Billiard ball, and the different ways of producing them, have been set forth, simply, as well as in composition; with every other circumstance that occured, as connected with the game, or distantly relating to it; and however extraardinary some effects may at first appear, they will be found on examination to be the genuine result of principles long known, and well established on the basis of unerring laws[11].

There are few games (if any) where the united efforts of judgment and execution are so indispensably occupied in such a diversity of situations, as that of Billiards; no wonder, therefore, it be a fund of so much entertainment : neither perhaps any, which affords at all times more temperate, and salutary exercise, or diffuses it so equally, with less danger of excess. Surely then, while health claims concern, the game before us is entitled to some regard ; and these two characters, which comprise so much of the utile dulci, should be sufficient not only to preserve it in estimation, and to those unengaged in avocations of greater moment, to make it a favorite, and give it a prior place to other games not possessed of those advantages.

Perhaps at the same time, no game admits of more deception ; for, execution being the chief department, and success depending upon the concurring excellence of so many agents directly under influence from the nerves, it is often extremely uncertain, whether an effect proceeds from previous intention, or unavoidable control ; here opens a large field for feints also, whereby determined purposes may be made to pass for accidents, and the highest degree of executive excellence, for the lowest of inferiority; but here indifferent players (excepting those whose perspicacity sees design in every casualty) though generally most suspicious, are much more apt to be deceived.

Games of judgment and execution are the proper sources of amusement for man, as they may be creditable to his talents or ingenuity ; but those merely of chance, never can : where all pretensions to superiority are relinquished, his exalted nature becomes inactive, or nugatory, and the most insignificant animal of the creation, may have an equal claim with its votaries, to the favours of that capricious deity who presides.

The eye being the organ first employed in this fascinating game, as a communicating medium for the judgment to act upon, it should at least be free from imperfection ; and the objects conveyed to the mind clearly and unconfused, that the judgment may give its orders with precision. But, though the sight must not be defective, extraordinary acuteness is by no means necessary to play well, neither does a superior degree of excellence, turn upon this hinge.

The visual rays darting in right lines alike to all, if the eye presents them distinctly, that the perception may be transmitted to the sensorium in a proper dress, it does its duty, can do no more, and should not be made further accountable. To place it in a station where its powers may be used to the best advantage, by choosing proper bearings, is a different affair, and belongs to the mental faculty : when this also is done, and the eye enabled by practice to recover

11 To enter into the practice more particularly by adducing cases, would lead to a detail irksome to the last degree, and unavailing in the end : besides, a knowledge of the minutiæ in this department, like all other arts, must ever be very defective while instruction depends merely upon precept. The practice already shown is chiefly elementary, and although otherwise somewhat copious also, still it is only verbal. To complete the player, the greatest difficulty yet remains to be surmounted—to turn it into use by making that practice actual—" hic labor hoc opus est."

that point with facility and exactness, as far as circumstances will permit, the judgment likewise should be free from blame. But to arrive at eminence in the game, so much depends upon execution, for the final issue; and more particularly on the address of the back-hand, (as before noticed,) to which is committed so large a share, that it is the grand desideratum of the whole, and the judgment feeble and of little value without it: besides, the doors of judgment are always open to receive, and its dispensations not confined to any period of life; but the executive manner is of more limited access; and if not acquired early, while the muscles and sinews are yet tender, flexible, and may be formed to the game, it is hopeless, with any assiduity, to court it afterwards, when the stubbornness of age renders them callous to impressions they have not been accustomed to, and the affections of younger days fixed, and unalterable by any practice, however persevering.

The rays of light may shoot with nature's charms, and bear her blossoms without toil or care, through the lapse of many years; the seeds of judgment, though not sown till late in life, by cultivation substituted for loss of time, may quicken, and the crop grow to maturity with less of nature's aid; but the scions of art, if not grafted upon youthful stocks, and cherished with attention beside, vegetate slow and sickly; for, notwithstanding they may germinate, and even push forth some branches, they are of that cramped and stunted growth, which cannot flourish; and though appearances may flatter with the promise of some fruit also, the idea of its ever coming to perfection will most assuredly be indulged in vain.

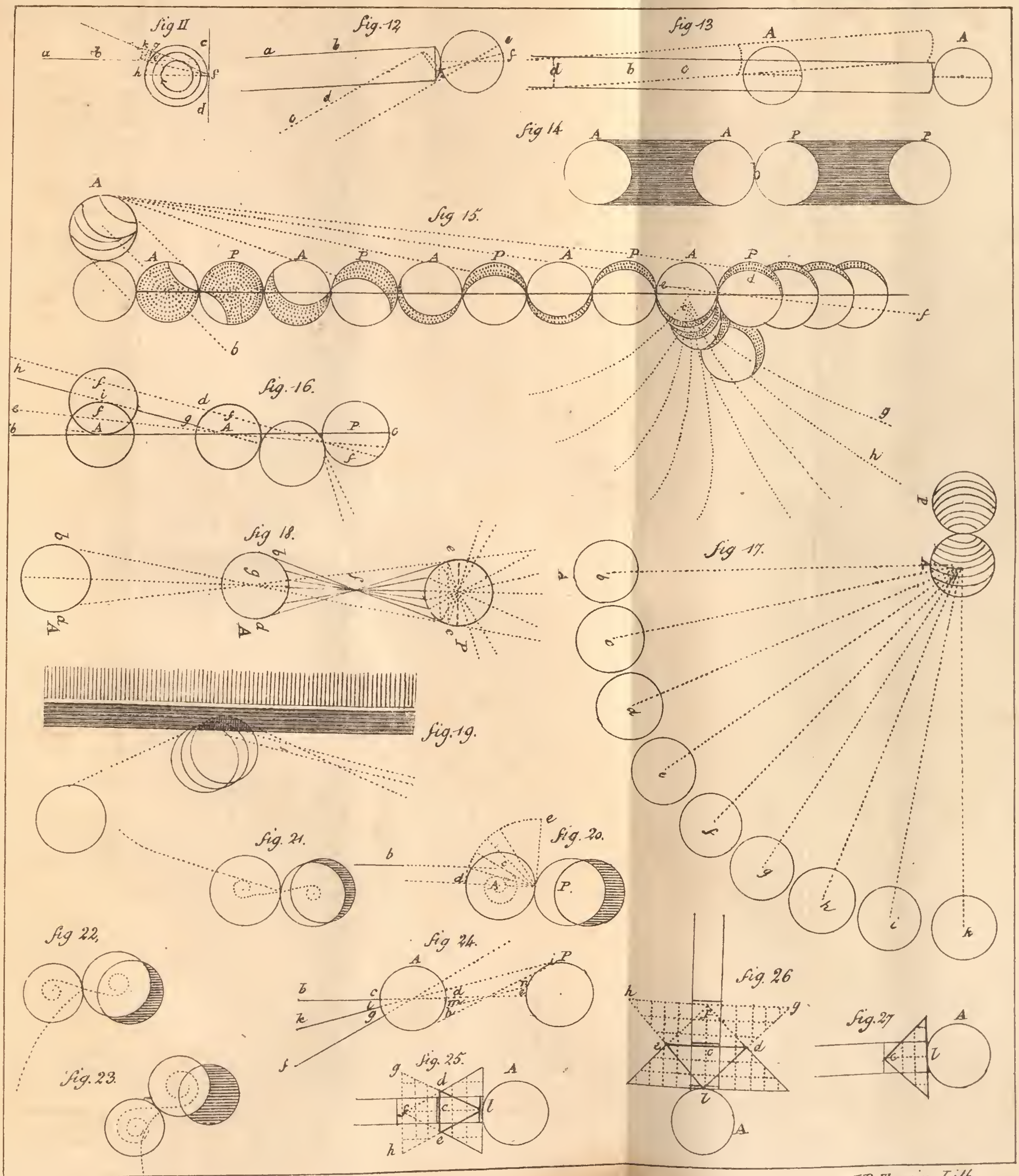
PHILOBILL.

APPENDIX.

After the Note in p. 119, read—In like manner a balk may be frequently made, by a player dexterous in the use of it, when it is not otherwise to be attempted from the danger of kissing, and the ill consequences attending it, viz. if the cannon ball be only a small distance from the side cushion, and a little beyond the string-line, with the active ball somewhat further on; so that the striker may be apprehensive of the cannon-ball meeting on return with his own.

Note to the second paragraph of p. 181.—It is advisable to have always the same part of the cue uppermost, for the accomplishment of similar designs; as,the more precisely it be held, the less apt the player is to be deceived by any want of uniformity about the point, or in the length of it; and although otherwise, or at any time, no more than the edge, and a little within it,would require chalking,(for those parts nearer to the middle can never touch the ball,) a much less portion will obviously be sufficient by following this advice—if the cue be not perfectly straight, it should be held (when striking the ball) in such a manner, as to have the bent either up or down, that its elastic force may not be exerted laterally

But, notwithstanding the above form be thought most convenient for general use; if a player wish to have much within his power, and understand how to manage it, the point should be a little sloping and somewhat rounded at the sides only, having the most backward part sloped still more, to about the eighth of an inch from the edge; for with such a point, a ball may be made to twist or walk to an extraordinary degree (without relinquishing any efficiency over those between), by holding it up or down, according to the occasion. But as first-rate players pertinaciously adhere to that knowledge which combined with execution has already ranked them so high, they form their judgment in the aggregate, and vain of the superiority they have acquired, yield with reluctance, from accustomed habits, to any novel means that may be recommended, appreciating them as the wild suggestions of a speculating unpractised theorist.



J.B Tassin Lith.

Game of Billiards.

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X.—*Register of Rain fallen at Ságar, Central India.*

To the Editor of the Gleanings in Science.

Sir,

If you consider the accompanying Registers worthy a place in your Gleanings, they are much at your service.

Your's, &c.

Duncan Presgrave.

		1828.	1829.	1830.	1831.
March,		....	....	....	1.500
April,		....	....	0.735	....
May,		....	....	0.908	....
June	5,	....	....	....	1.751
	10,	0.190	1.038	....	2.720
	15,	4.226	....	....	5.263
	20,	....	2.664	2.067	6.975
	25,	4.433	4.489	4 879	11.577
	30,	7.452	14.800	6.185	13.152
July	5,	....	....	6.998	....
	10,	....	17.646	7.465	....
	15,	8.402	....	9.187	16.196
	20,	9.474	21.201	11.202	18.229
	25,	12.744	24 558	12.456	19.224
	31,	15.962	29.324	15.198	21.663
August	5,	17.199	29.938	18.476	22.381
	10,	18.860	33.061	19.731	29.466
	15,	19.102	35.725	20.172	36.805
	20,	22.303	36.270	....	38 518
	25,	22.407	39.092	25.518	40.246
	31,	22.787	42.880	28.260	43.401
September	5,	23.652	46.366	28.969	46.014
	10,	25.642	....	30.121	48.245
	15,	28.073	....	....	....
	20,	....	....	32.033	52 571
	25,	29.323	....	....	54.076
	30,	....	46,531	....	55.382
October	10,	....	....	....	....
	20,	29,772	....	.... Nov.	56.420
	30,	31.156	....	... Dec.	64.762
Totals,		31.156	46.531	32,033	64,762

Shewing the Quantity fallen in each Month during the Years

	1828.	1829.	1830.	1831.
	Inches.	Inches.	Inches.	Inches.
January,	....	....	....	....
February,	....	....	....	....
March,	....	....	....	1.500
April,	....	....	0.735	....
May,	....	....	0.173	....
June,	7.452	14.800	5.277	11.652
July,	8.510	14.524	9.014	8.512
August,	6.825	13 556	13.061	21.738
September,	6.535	3.651	3.773	11.980
October,	1.834	....	....	....
November,	....	....	....	1.038
December,	....	...	....	8.342
Totals,	31.156	46.531	32.033	64.762

The same rain gage, consisting of a glass decanter and a brass funnel, has been used throughout the four years' observations, and has always stood exposed in the same situation, about four feet above the flat roof of the Ságar Mint Building.

The funnel is of a conical shape; the mouth of it, which receives the rain, is surmounted by a cylindrical brass ring, one inch in height, and of such thickness as to afford additional strength to the funnel; its diameter is accurately adjusted (on a lathe) to present an area to the falling rain of exactly ten square inches; the upper exterior edge of the ring is rounded off, leaving a somewhat sharp angle in the inside.

The tube that conveys the water into the decanter, is long and narrow, to counteract loss by evaporation. At its upper end, it is cemented into a waxed cork which fits firmly into the mouth of the decanter. A conical broad rim of brass is soldered to the bottom of the funnel just above the cork, projecting beyond the mouth of the decanter, over which it fits close, and prevents any rain from getting into the decanter from the outer sides of the funnel.

The height of water fallen in inches, is estimated by weighing the water in the decanter.

XI.—*Table of the Fall of Rain at Tavoy, from* 1*st May to* 31*st October,* 1831, *in inches and decimals.*

[Communicated by G. Swinton, Esq. Chief Secretary to the Government.]

Day.	May.	June.	July.	August.	September.	October.
1	0.5	0.5	3 1	1.3	1.0	..
2	..	..	1.0	1.5	2.6	2.0
3	1.5	..	4.0	5.0	1.0	0.5
4	..	2.4	2.1	2.2	1.1	1.4
5	3.2	2.0	1.7	..	..	2.0
6	..	2.5	5.9	..	2.0	0.3
7	..	..	3.3	3.0	3.0	1.0
8	..	1.7	2.4	2.0	..	1.5
9	1.0	..	2.0	2.0	..	0.5
10	..	1.5	4.3	2.0	..	1.5
11	..	0 5	..	..	1.5	1.0
12	1.0	0.2	..	3.8	3.0	1.4
13	2.4	0.5	..	..	0.5	..
14	..	1.0	..	0.5	..	4.0
15	0.4	4.8	..	1.2	..	..
16	..	4.8	0.5	2.0	..	..
17	..	3.2	0.3	1.9	2.0	..
18	2.3	2.0	1.2	0.5	..	1.2
19	2.0	0.6	3.0	..	2.2	..
20	2.1	..	2.5	4.3	0.3	1.1
21	..	0.2	..	..	..	..
22	1.1	0.6	0.5	0.5	1.0	1.0
23	1.3	1.5	0.4	0.6	2.7	0.2
24	1.4	2.2	0.3	..	1.1	..
25	1.3	2.3	..	..	..	1.5
26	0.5	..	1.5	..	..	..
27	..	0.9	0.5	2.6	1.0	0.3
28	..	..	1.5	1.2	0.5	1.8
29	1.3	..	0.5	..	..	0.3
30	..	0.5	0.4	0.6	2.2	..
31	1.0	..	8.5	0.5	..	..
Totals,	23.3	36 4	51.4	39.2	28.7	24.5

Total of Rain in 6 months, 203.5 inches.

XII.—*Memoir of Major Rennell.*

[Extracted from the address of the President of the Royal Society, Davies Gilbert, Esq. M. P. at the anniversary meeting, 30th Nov. 1830.]

"Having now, for the last time, to address you in reference to the loss of eminent persons sustained by the Society in the preceding year, I cannot but congratulate you on the difference between the list now read, and that which we had the misfortune to hear twelve months ago. Several individuals of great distinction, of extensive acquirements, and of splendid talents, are undoubtedly brought before us on the present occasion: but advanced age or long absence from this metropolis tend in some instances to lessen the pain we should otherwise feel on the recital of their names. While in the former case, persons at the very head of different departments in science, of our own ages, and daily conversant with our social habits, were suddenly taken from us, leaving the higher paths of science (as we feared at the time) without a foot that might in future trace their windings; and our more familiar society without that sparkling of intellect, which invigorates the understanding, and at once elevates and refines the common intercourses of life.

The individual, who unquestionably demands our first attention, is Major James Rennell, taken from us in his eighty-eighth year, lamented by all those who are capable of appreciating his science, and by every one conversant with his active virtues, or with the simplicity and kindness of his manners.

I have endeavoured to collect some particulars respecting this distinguished person in his early years.

Major Rennell was descended from an ancient and respectable family in Devonshire, said to be of Norman origin. His father was a Captain in the Royal Artillery, and fell at the siege of Maestrich. James Rennell was born at his father's house, Upcott, near Chudleigh, in Devonshire, on the 23rd of December, 1742. He entered on the naval service of his country at a very early age, where his spirit and exertions soon attracted the notice of Sir Hyde Parker, with whom he sailed in the *Brilliant* frigate to India. After the conclusion of peace, his eager desire for active service induced him to quit the navy, and he obtained a commission in the corps of engineers belonging to the East India Company. His zeal and ability in discharging the duties belonging to this station obtained for him the friendship of many superior officers, and especially of the great Lord Clive; and he was soon promoted to the station of Surveyor-General in Bengal.

The fatigues attached to this civil employment were sufficient to exhaust the strength of any European constitution, conducted as were the surveys, with indefatigable industry, along the banks of the great rivers, periodically overflown and perpetually damp. But these were not all: Major Rennell, in encountering dangers which are inseparable from military renown, had suffered wounds so severe that he was, I believe, twice left exposed on the field of battle, and never recovered from their effects up to the latest period of his life. These altogether compelled his return to England, and alone prevented him from attaining the highest military stations.

Retired to private life, the whole energies of his mind were directed to scientific and literary pursuits. We have, founded on his exertions in India,—An Atlas of Bengal—A Map of the Mogul Empire—Marches of the Army in India—A Map of the Peninsula.

But the mental powers of Major Rennell were far from being confined to one region of the world.

We have from his pen a work on the Geography of Africa. And with a vigour of intellect that may well call to our recollection the greatest of the Roman censors, he acquired at an advanced age a competent knowledge of Greek for consulting the early writers in that language, and gave to the world, The Geographical System of Herodotus, including the Expedition of Darius Hystaspes to Scythia; The Site of Babylon; The Temple of Jupiter Ammon; The Periplus of Africa, &c.; and A Dissertation on the Locality of Troy.

The attention of this great investigator of every thing connected with the surface of our globe, extended itself from mountains and plains to the waters of the ocean; and produced a most curious investigation of the currents prevalent in the Atlantic, and of accumulations caused by certain winds in the English channel.

And lastly, I would mention a very ingenious mode of ascertaining distances, and connecting with their bearings the actual localities of spots in the Great Desert, by noting the average rate at which camels travel over those worlds of sand.

This is a very imperfect catalogue of the works published by Major Rennell; and I am happy to add that several more exist in manuscript, destined, we may hope, at no distant time, to appear.

Major Rennell has been honoured by the Copley Medal from this Society; by the Gold Medal from the Royal Society of Literature: he was a Corresponding Member of the Institute of France, and a Member of various other Societies.

Our regret for such a man, exerting his intellectual powers with so much energy and to such useful purposes, throughout the course of a long life, and up to his eighty-eighth year, must always be strong and sincere; but we console ourselves with the reflection that he had attained the utmost ordinary limit of human life, amidst the respect and esteem of all who knew him, and that his memory is revered."

XIII.—*Questions concerning the Jews of Malabar.*

The following questions have been submitted to the Asiatic Society by the Rev. H. H. Milman, M. A. who is well known to be engaged upon an elaborate history of the Jewish nation. Any correspondent who can supply information upon the various subjects of his enquiry, may either address their communications direct to that gentleman at Reading, or consign them to the Asiatic Society for transmission.

1. Is the date of their migration to India in or about the year (according to their reckoning) 4250 (answering to A. C. 508) generally agreed upon?

2. Have they any Hebrew writings besides their copies of the Scriptures—if so, what is their nature?

3. Have they any religious traditions—and if so, in what respect do they hold them?

4. What books do their Scriptures contain? more particularly have they the books of Ezra or Esther? or any of those which we call the Apocryphal books?

5. Have they any synagogue—if so, what is its form? what is its reputed antiquity? in what manner is the service conducted?

6. How is the community governed? by a religious or a civil head? by a Rabbi or a Magistrate?

7. Have they any religious teachers? what is their character and authority?

8. Has the mass of the people any knowledge of the Hebrew language? Is it used among themselves for the purposes of commerce, or on any other occasions? (It would be curious to ascertain whether, as is stated of the Chinese Jews, their Hebrew is infected with Persian idioms.)

9. Do they keep themselves entirely secluded from their neighbours, or do they in any case, inter-marry with them? Do they scruple to consort with concubines of other races?

10. Do they observe the Sabbath? and with what degree of rigour?

11. What fasts and festivals do they observe? more especially the feast of Purim, which commemorated the deliverance of the people under Esther.

12. Do they rigidly adhere to the law as regards meats, &c.?

13. Do they practise commerce, and to what extent?

14. Have they any knowledge of or connexion with more remote communities of the Jews in India, those said to exist in Thibet, or with those in China?

15. What are their notions about the Messiah, and the restoration to Palestine?

16. What are their feelings towards Christians and Christianity?

On the Black Jews.

1. In what points do the black Jews differ from the white?

2. How far do the black Jews conform to the usages of the law?

3. From what race of blacks do they appear to have derived their complexion? Have they any thing of the Negro caste of countenance?

4. In what estimation are the black Jews held by the white? Do the white acknowledge their superior antiquity?

5. Are there any distinct traditions of their migration into India, or of the quarter from whence they came?

6. Is there any thing either in the character or tradition of the people to justify or refute the opinion, that the black Jews are descendants of the whites, inter-marrying or consorting with any of the native races; with tribes of Arabian descent, or with foreign slaves from any other quarter?

The question relating to government, usages, copies and contents of copies of the sacred writings, would be more satisfactorily answered, if addressed separately to each race.

XIV.—*Miscellaneous Notices.*

1.—*Population of Central India.*

The following proportion is the result obtained from a census of population taken in a district comprehending 27 square miles, situated in one of the central provinces.

283 inhabitants to 1 square mile.						
The proportion of males to females is		as		1.12	to	1.
Ditto	ditto boys to girls	do.	do.	1.19	to	1.

The district is generally fertile and well cultivated. I may add that the average number of inhabitants per square mile in the whole of England is 222, and average quantity of land to each individual 3.1 acres; in the district under review it is 2.20 acres.

The land not fit for cultivation (including sites of villages, roads, &c.) is to the whole area as 1 : 4.422.

As far as was ascertained, it appeared that the average proportion of the gross produce paid to the zemindar as rent is $\frac{1}{3}$ of the whole. The highest rent paid for any considerable quantity of land is 8 Rupees per bigah, or rather more than 15 rupees 1 an. per acre.

From an average of 9 years' collections it appeared, that on account of the whole division (in which the above 27 square miles are comprehended) the zemindars had collected from the cultivators and tenants 89 per cent of their demand (upwards of 2 lakhs). Of the collections thus made, the land-tax paid to Government amounted to 56 per cent. Assuming the zemindar's demand to be one-third of the produce, the land-tax will be equal to nearly one-sixth, a much smaller proportion than is frequently stated to be extorted.

2.—*Composition of Sealing Wax.*

1 lb. of Chuprah Lac.	$\frac{1}{4}$ dr. of Camphor.
$1\frac{1}{2}$ oz. of Lavender-water.	$\frac{1}{4}$ dr. of Myrrh.
$\frac{1}{4}$ dr. of Musk, or	or
$\frac{1}{8}$ dr. of Ambergris.	$\frac{1}{4}$ dr. of Frankincense.

Strain the Lac thus,—break it into small pieces; melt it over the fire in a long bag, which being twisted at the ends, will cause the Lac to exude, when it is to be taken off with an oiled knife, and thrown into cold water. The Lac is to be taken up by means of a stick, (such as is in use among wax-makers) and warmed over the fire; then pressed, kneaded on a stone (oiled), and beaten. The colouring matter is then to be added, and well mingled with the Lac; after this, having spread open the wax, pour upon it about $\frac{1}{4}$ of a spoonful of the perfume; close the wax over it; beat and knead as before; after which more perfume may be added, if thought necessary. The camphor and other ingredients must be well pounded and mixed; after which, spirits may be added, and the mixture exposed to the sun for one or two days.

3.—*The Van Diemen's Land Tiger.*

The animal described under this name by Dr. Grant in the 30th No. of your valuable "Gleanings," and of which the specimen, from which his description was taken, may be seen in the museum of the Asiatic Society, belongs to that genus of the *Marsupiata* which has been instituted by Temmiock, under the name *Thylocinus*, for the reception of the *Didelphis Cynocephala*. Harris.

In the last edition of the Règne Animal, this genus is admitted as a subgenus of *Dasyurus*. The animals appertaining to it are distinguished from the *Sarigues* by the hind feet being destitute of a thumb, by the tail being hairy, and non-prehensible, and by having two incisors less in each jaw. The number of the cheek teeth is the same. Thus they have 46 teeth, but the outer border of three large cheek teeth is salient and trenchant, and resembles the carnivorous tooth of the dog: their ears are moderate sized, and hairy. The animals belonging to the new genus *Phascogale* Tem. have the same number of teeth as the *Thylacini*, but in the former the middle incisors are longer than the others, and the cheek teeth are more bristled with points —a circumstance approximating them to the *Sarigues*, which they resemble in point of size. The *Dasyuri* differ from the *Thylacini* in the number of their teeth, having four molars less, *though not in each jaw*, as accidentally stated by Cuvier. The *Parameles* have the two digits next the thumb united by skin as far as the nails, and differ in many other respects from the *Thylacini.*

The teeth of the *Sarigues* are as follows: incisors $\frac{10}{8}$ canines $\frac{1\,1}{1\,1}$, cheek teeth $\frac{7\,7}{7\,7} = 50$, and those of the Thylacini, (there being two incisors less in each jaw,) incisors $\frac{8}{6}$, canines $\frac{1\,1}{1\,1}$, cheek teeth $\frac{7\,7}{7\,7} = 46$. This is the number found in the specimen of the Van Diemen's Land Tiger. Dr. Grant having (most probably in his unwillingness to injure the specimen by a minute examination of the stiffened parts about the mouth) overlooked a small cheek-tooth on each side of the upper jaw.

"Of the genus Thylacinus," says Cuvier, "only one species is known, from Van Diemen's Land, of the size of a wolf, but lower on its legs, of a grey colour, with stripes of black on the crupper. It is very carnivorous, and hunts all kinds of small quadrupeds."

I presume that we cannot admit the Van Diemen's Land Tiger as a new species; its characters being decidedly those of the Thylacinus Cynocephalus.

4.—*Chloride of Lime, a purifying and dis-infecting preparation for the use of Ships and Residents in Warm Climates.*

The valuable properties of this preparation in correcting every species of infection and effluvia, arising from animal and vegetable decomposition, have long been known to the faculty; but from the difficulty and inconvenience attending its application, the use has been hitherto confined to dis-infecting apartments and buildings, from which the inhabitants were previously removed; and, of course, it could not be employed on board ships, or in private houses.

The dis-infecting preparation is now presented to those engaged in shipping, or exposed to noxious atmospheres, in a form by which these difficulties are entirely obviated, and its properties equally preserved. The instructions for its use are perfectly simple; no injury or inconvenience can possibly arise from the application, and the means of preserving health, from the influence of noxious vapours, are brought within the power of every one, at a trivial expence.

A few instances will illustrate its powerfully beneficial effect when prepared, as follows:

To one pound of the powder, pour gradually five gallons of water; taking care to break all the lumps; stir the mixture well; allow it to settle; and draw off the clear liquor, which is then fit for use.

The hold of a ship is sometimes insupportable from the confined air, and wind-sails produce little or no effect; but this liquid sprinkled from a watering-pot, will entirely correct it in a few minutes: from which will be perceived its value on board convict and other vessels, where numbers are confined in a small space.

The most offensive water for ship's use may be made pure, and fit to drink, by adding a few ounces to a barrel; and the precaution should be particularly attended to, when the water-casks are filled abroad, as the water of most rivers in warm climates, is impregnated with substances highly prejudicial.

Deep wells and sewers unopened for many years, which would occasion death to any one attempting to descend into them, may be entered without the least risk, by previously throwing in some of the liquid.

To the powder, laid along the crevices of doors and windows of houses, in places suffering from infectious or contagious disorders, has been attributed the preservation of the inhabitants.

The foregoing instances are sufficient to satisfy the most sceptical, that the effects of the preparation are powerful; and, at the same time, most beneficial in all cases arising from infection or contagion; the proof of its salutary influence is in the power of every one, and the trial may elicit a more extensive application.

On board ship, the liquid may be beneficially and economically substituted for vinegar, as it is cheaper, and will be found much more effective. The proportion of one pound of powder to five gallons of water, will answer all the ordinary purposes of sprinkling the hold, whilst taking in, and particularly in discharging cargo, as well as the decks during the voyage, every morning and evening. The most baneful effects are frequently experienced, when vessels are in port, in a warm climate, from the miasmata, arising from vegetable decomposition on shore; and it will be found of great service (in addition to sprinkling the decks twice a day), to allow a small quantity of the liquid to remain in open dishes between decks during the night. After discharging cargo, especially, if from warm climates, the whole of the inside of the vessel may be advantageously washed with the solution, well-stirred, and put on with a brush; and it may be found a preservative from the dry-rot, if the cause lie in the effect of confined air in the timber. A vessel may be freed from rats, by adding to the clear solution two or three ounces of oil of vitriol, or a pint of common vinegar; the solution being placed in a dish, at the bottom of the hold, and the hatches well stopped, to prevent the escape of the gas which will be thrown off.

In the East and West Indies, the Mediterranean, America, and on the Coast of Africa, the properties of the purifying and dis-infecting preparation will be fully estimated. To the European inhabitants of those countries, equal benefit may be derived from similar use of it in their habitations; and it remains to be proved by experience, whether it may not obviate many causes of death in those climates.

All orders will be punctually attended to, if addressed to, Frederic Fincham, *Manufacturing Chemist.*

Or to the Agents for the party at Lloydfield, Manchester, London, Liverpool, and Bristol.

For the convenience of shipping, the preparation is put up in casks of 50lbs. weight, at 3*d.* per lb. in a dry state, as it occupies less room than its solution, and salt water will extract the purifying qualities as well as fresh.

Those who prefer the solution may have it in carboys, containing about 10 gallons, or 100lbs. at 3*d.* per lb. of which about one point, or pound, may be added to five gallons of water.

In the sick wards a flat dish, containing the solution or powder, should be suspended, which will in a short time destroy the effluvia. When the dysentery prevails, its use will be still more beneficial; for it has been considered, that when from the numbers confined cleanliness cannot be so immediately observed, the effect has added to the cause. Its use will lead materially to the comfort of those who have water-closets in their cabins, as a very small quantity added to the water in the pan, will destroy every particle of effluvia.

The best criterion for the proper use of the solution is the effect of the chlorine itself: as soon as the gas is perceptible to the smell, it is in excess, and the solution should be removed.

After the solution has been made and the clear liquor drawn off, and applied to any of the foregoing purposes, the lime which remains should on no account be thrown away, but thinly spread on a board between decks, and *as far as it goes*, it will absorb the carbonic acid of the respired air and correct its deleterious properties; or it may be better, instead of suspending the solution, to put the powder itself thinly in the dish, and then both operations will be going on at the same time, the chlorine destroying some of the noxious vapours, and the lime absorbing the carbonic acid.

When the surgeon of the ship has ascertained how small a quantity of the solution will effect the purpose of purifying the air between decks, that quantity should be strictly adhered to; and when, from the effect of coming into a warmer latitude, he finds more is required, he should *then* increase the quantity. It may be farther useful to remark, that when once the quantity required is known it is of no consequence how much it is diluted, provided the whole mixture is employed, and not allowed to run away before it has given out its gas: indeed, the more a given quantity is diluted, the more readily will its chlorine unite with the surrounding atmosphere by acting, or being acted upon by, a more extended surface. I should also recommend the chlorine diluted solution to be sprinkled between decks, after they have been washed, as grease would diminish the effect.

In my first paper, I did not state what quantity of the powder would purify water; and in my last, I have only stated the effect in Harrowgate water, (1lb. to 250 gallons.) Having no fetid Thames water to try with, I can give no specific directions; but I would strongly recommend trying the smallest quantity first, and gradually increasing till the effect is produced, otherwise a prejudice might be excited in the minds of the crew. The experiment can be as well tried in a bottle, or a butt.

NOTE.—In the journal of the Royal Institution for 1831, there is an able paper by Doctor Ure on the subject of the Chlorides; it strongly recommends the addition of a little sulphuric acid to the powder, without which the Chlorine is but imperfectly and slowly disengaged.—ED.

5.—*The Population of the Netherlands.*

The population of the Netherlands has increased very nearly 11 per cent. in ten years, i. e. from 5424502 in 1815 to 6013478 in 1825. In these 10 years, the births have been 2015646, the deaths 1421600, being as 67 : 47 nearly, the marriages 430247. The number of divorces was 605, or 1 to every 711 marriages.

A comparison of the statistics of the Netherlands, Great Britain and France gives the following proportions.

	Netherlands.	*Great Britain.*	*France.*
100 are born for every	2807 inhabitants	3534	3168
100 die,	3981	5780	4000
100 are married,	6575	6667	6745
100 marriages produce	468 births	359	426

From these numbers, it may be concluded that life is most valuable in England, next in France, and least in the Netherlands; the two latter being nearly the same, while in Great Britain it is more valuable in the proportion of 3 : 2. We also see that fewer births take place in England, the reason of which it is difficult to conceive. We may further infer, that in England, the chances of death and marriage are nearly equal, being as 67 to 58, whereas in Holland and France the chances are nearly 2 to 1 against marriage. The proportion of those who annually marry, to the whole population, is nearly the same in each country, namely, 1 in 67.

6.—*Height of American Mountains.*

Chimborazo has long passed for the highest of the Cordilleras; and until the discovery (measurement) of the Himalaya, was supposed to be the highest mountain in the world. M. Humboldt, as he himself observes, had the pleasure of seeing a greater extent of mountains than any other geognost (geologist), but he did not pursue his travels to this part of the Andes, where subsequent travellers have ascertained the height of the Ylimani to be 21,800 feet above the level of the sea, exceeding that of Chimborazo by 350—no very great difference, it may perhaps be said, in subjects of such vast dimensions; but still quite sufficient to take from the latter the palm of superlative magnitude and grandeur in the great chain of the Andes. Mr. Pentland, who measured the Ylimani in 1826, gave me his calculations with the remark that *they required revision*, consequently they were not intended to go forth as accurate.—*Temple's Travels in Peru.*

We have inserted the foregoing, not as thinking old Chimborazo, for whom, as a particular friend of the celebrated Humboldt, we have a great regard, should be deposed from his high and palmy state as sovereign of American mountains, but simply for the information of our readers; for we think, not only that 380 feet is no very great difference in subjects of such vast dimensions, but also that an error to this amount may so very easily be committed in the measurement of so lofty a mountain, that we cannot receive Mr. Pentland's result as established, till we have a full detail of the instruments he used and the methods he followed.

7.—*Birds described by Hardwicke, or from his papers. By* J. E. Gray.
From Griffith's Cuvier.

Brown Penang Pheasant. Hardw. MSS. *Phasianus castaneus.* Belongs to the section with naked orbits and short tail.

Bright chesnut brown, back, wing coverts, and secondaries, minutely black speckled: chest, brown and black varied, streaked with white: abdomen black lunulated with white; middle tail feathers, slightly black banded: spurs very short; head feathers deficient, length about 18 inches. Penang. Mus. Gen. Hardwicke.

The following have orbits covered with feathers, and short tails—they are perhaps more allied to the partridge than the pheasant.

Black-headed Pheasant. Hardw. MSS. *Phasianus Melanocephalus*, Gray.

Varied black and white, small undulated band with white spots, surrounded by a large black ring: neck and small wing-coverts, orange-red: chest, orange-red; with white-eyed black spots: belly with black spots, including a smaller white one; head and upper part of neck, black; crest erectile; orbits feathered like *Ph. Satyra*, but not having either horn or wattle. *Female*—pale brown: back, varied with black lunate spots, and small black edged, white spots; wings, with angular black bands; crown crested, black and brown banded; neck bright red; lower part lunulated pale brown, with black curved lines; beneath paler, with indistinct blackish lunated bands; tail, undulated, black and brown, punctately banded; spurless. Almorah. Gen. Hardwicke.

Brown Nepal Pheasant. Hardw. *Phasianus Nepalensis*, Gray.

Female—pale brown: each feather with several curved blackish punctated lines, near the end: beneath paler: lower part of the neck, wing, and body, with triangular white spots, edged with black in the centre of each feather; loins and rump with a black spot on the centre of each feather; thighs, pale, blackish banded: quills and tail, pale chesnut, with cross bands of black dots. Like female of *Lophophorus Impeyanus*, but orbits, feathers, bill, and plumage different. Length 20 inches. *Male*—above, darker; the quill and tail feathers, blackish brown, with 5 or 6 irregular pale, yellowish bands; and a short blunt spur. Under that division of the genus Strix, which Cuvier has denominated Bubo (*Ducs*), we find in Griffiths' translation of the Règne Animale, the following additional note by Gray.

"Others have all the appearance of the Ducs: but the tarse and taes are quite naked, shielded in front and reticulated behind."

Hardwicke's *Naked-legged Owl. St. Hardwickie*, n.

Pale brown: feathers of the upper part marked with a broad longitudinal band: beneath marked with a narrow longitudinal band, and some obscure cross ones: wings and tail banded with deep brown. Length 22 inches, India—perhaps the *Hectum Owl*, Lath. Hist. 1. 13."

As errors in a work like that we have quoted from, should be exposed *in limine*, perhaps some of your correspondents will be kind enough to state if in the bird in question (*Hardwicke's Naked-legged Owl*) the legs and feet are "shielded in front and reticulated behind," as described by Gray, or *reticulated as well before as behind.* This to many may appear a very trivial circumstance, yet the difference, trivial though it be, has frequently of late been resorted to as a generic much less a specific distinction.

8.—*Climate of Ava.*

The following Register of the weather at Ava, communicated by Major Burney, has, we are ashamed to say, laid neglected for many months amidst the accumulated papers in our printer's hands: it is a continuation of the former register published in the second volume, page 200; with the exception of a few blanks the series now given completes the year's observations, and as the times are judiciously chosen so as to shew the daily maximum and minimum both of the barometer and thermometer, these tables will be highly valuable in fixing our knowledge of the climate of a part of the world to which our access is but recent and may prove transient.

Meteorological Diary, kept at Ava, by Major Burney, Resident.

1830. June.	Thermom. in air. 6 A. M.	Noon.	4 P. M.	9 P. M.	Baro. at 10 A. M.	Ther. atthd.	Baro. 4 P. M.	Ther. atthd.
25..........	79	89	88.5	84	29.540	88.5	29.488	90
26..........	80	90	92.5	87.5	730	89	620	93.5
27..........	81.5	90	93	89.5	..	..	594	94
28..........	82	91.5	95	90.5	..	..	472	96
29..........	84	92.5	96	86.5	550	89.5	414	97
30..........	83.5	91.5	91	88	596	89.5	490	92
July.								
1..........	84	89	89	87	594	87.5	460	90
2..........	84	89.5	89.5	86	600	87.5	482	90.5
3..........	82	89.5	92	86.5	652	88	496	93
4..........	81	89	92	84	664	86.5	522	93
5..........	81	85	82.5	79	652	84	510	83.5
6..........	78.5	83.5	86	77.5	636	82	514	87
7..........	77 5	85	84.5	79.5	628	83	520	86
8..........	76.5	85	87.5	80	634	83.5	518	88.5
9..........	77	85	88.5	84.5	660	85	582	89.5
10..........	77.5	84.5	87.5	82	670	83	570	88.5
11..........	78.5	81	82	80.5	622	82	548	83
12..........	77	83	85	83	612	81.5	538	86
13..........	79	84	86	83	668	83.5	542	87
14..........	80	84.5	87.5	85	672	84.5	532	88.5
15..........	81	87.5	89	87	648	86	506	90
16..........	81.5	82.5	86.5	84	642	81.5	510	87.5
17..........	79	85.5	87	85	624	84	504	88.5
18..........	81	86.5	87.5	85.5	604	86	472	88.5
19..........	82.5	85.5	84.5	82	546	87	458	82
20..........	79.5	82.5	85	84.5	526	82	410	86
21..........	79	85.5	84.5	82	500	83.5	406	85.5
22..........	79.5	83	85	82	552	82	430	86
23..........	80.5	80.5	82.5	81.5	546	83	430	83.5
24..........	79.5	82	81.5	79	564	81.5	472	82.5
25..........	78.5	81.5	84	82	578	81	486	85
26..........	78.5	84	84.5	84	630	82.5	500	85.5
27..........	78	83.5	84	84.5	616	84.5	528	85
28..........	79.5	83	86	83	624	82.5	490	87
29..........	78.5	85	87.7	83	616	83.5	508	89.5
30..........	78.5	84	86.5	82	630	82	510	87 5
31..........	78	84	86	82.5	616	83.5	490	87
August.								
1..........	78.5	84.5	86.5	83	602	84	486	87.5
2..........	78	86	88	84	630	83.5	524	89
3..........	79	86	88	81.5	676	83	548	89
4..........	77.5	83.5	84.5	81	652	82	546	85.5
5..........	77	84	87	82	638	82.5	510	88
6..........	79	85	86	82	668	84	590	87
7..........	78	86.5	88.5	81	712	83 5	602	89.5
September.								
10..........	78	82.5	..	81	640	83	..	..
11..........	78.5	84	..	81	670	82.5	..	..

1830. September.	Thermom. in air. 6 A. M.	Noon.	4 P. M	9 P. M.	Baro. at 10 A. M.	Ther. attHd.	Baro. at 4 P. M.	Ther. attHd.
12	77.5	85	86	83	29.700	83	29.522	87
13	77.5	85	86	85	608	83	472	87
14	81	85.5	87	85	610	84.5	494	88
15	82	85	85.5	84.5	648	85	500	86.5
16	79.5	83	84		654	82	540	85.5
17	79.5	85	85.5	84	712	83	596	86.5
18	80	87	88	85.5	750	85	592	89
19	80	87.5	89.5	84·5	718	85	562	90.5
20	79	88	89	84	638	87	520	90
21	78.5	86.5	89	84	672	85	568	90
23	80	85	86.5	84.5	668	84	518	87.5
24	78	78	79	79	652	79.5	512	80
25	78	79.5	82.5	82	660	79	554	83.5
26	80.5	81.5	84.5	84	650	81.5	508	85.5
27	82	83	86	85	586	83	428	87.5
28	80.5	82	85.5	79.5	522	82.5	402	86.5
29	78.5	80	82	80.5	538	80.5	434	83
30	78	83	83	82	590	82	476	83.5
October.								
1	79	82.5	83	..	672	81.5	558	84
2	79	84.5	83.5	83	714	82.5	576	84.5
3	79.5	85	85	85	714	83.5	530	86
4	80	85.5	86.5	85.5	690	84.5	550	87.5
5	78	82	83	82	672	80	558	84
6	79	82	85	83	722	82	600	86
7	79	83	86	84.5	778	81.5	682	87
8	79.5	84	85.5	82	742	83	614	86.5
9	78	83	..	82	762	81.5	..	..
10	77.5	82	84.5	83.5	776	80.5	642	85.5
11	78.5	85	87	85	764	83	630	88
12	80	79	79	80	800	80	674	80
13	77	80.5	83.5	83	838	80	676	84.5
14	78.5	82	85	84	858	82	654	86
15	76.5	78	79	79	836	78	678	80
16	76.5	79	82.5	81	800	70.5	650	83.5
17	77.5	79.5	82	79	792	79.5	662	83
18	76.5	77.5	80.5	77	804	77.5	692	81.5
19	75	76.5	..	76.5	796	76.5	..	..
20	74	75	76.5	76.5	852	75.5	758	77.5
21	75.5	77.5	80	79	888	77 5	750	81
22	78	79.5	82.5	81	746	79.5	724	83.5
23	76	80	82.5	81	786	78.5	638	83.5
24	78.5	80	84	81	760	79	624	85
25	78	80	83.5	83.5	768	79	664	84.5
26	78.5	81.5	82	82	846	82	720	83
27	..	82	85	83.5	816	81.5	686	86
28	80	82.5	85.5	83	760	81.5	640	86.5
29	80	83	85	83	800	82	666	86
30	80	81	83	80.5	836	81.5	692	84
31	79	80.5	83	82	760	80	586	84
November.								
1	78.5	80.5	77.5	78	618	80	490	78.5
2	76.5	80.5	83	80.5	532	79	440	84
3	77.5	83	84	81.5	738	81	652	85
4	76.5	81.5	...	81	794	81	..	..
5	77	79	80.5	80.5	772	79	690	81.5
6	76	76	76	77.5	888	77	764	77
7	74.5	74.5	74.5	73.5	940	76.5	818	75.5
8	70.5	71.5	72	70	958	70.5	860	73

1830. November.	Min. night.	Thermom. in air. 6 A. M.	Noon.	4 P. M	9 P. M.	Baro. at 10 A.M.	Ther. atthd.	Baro. 4 P. M.	Ther. atthd.
9........		70	72.5	75	74	29.996	71.5	29.870	76
10.		73.5	75	77 5	76	980	75	778	78.5
11.........		73.5	75.5	78.5	78. 5	882	75	780	79.5
12....... ..		73	75.5	77	77	872	73.5	760	79
13........		74	76.5	79	78	850	76	760	80
14........		74	77	80	78.5	904	76	788	81
15..		74	76.5	80	77	874	76	738	81
16........		74	75	79	77	852	74	742	80
17........		71.5	75.5	79.5	76.5	856	73	772	80.5
18.........		70	74	78	75	902	73.5	792	79
19.........		71	73	77	74	894	72	788	78
20........		71.5	74	77	73	890	73.5	778	78
21........		72	74	76	72.5	916	72.5	832	76
22........		68	71	79	74	964	68	850	77
23.........		69	71	75	75	924	69	782	76
24........		71	75.5	76	75	882	71	766	77
25.........		68	72	76	72	924	69	804	77
26.......		64	69	75	69.5	890	68	760	76
27........		64	69	73.5	70	854	67	738	74.5
28........		64	70	..	70	858	67	..	..
29........		64	70	73	70	840	66	734	74
30..	60	63	67.5	72.5	71	838	65	714	73.5
December.	61								
1........		65	69	74	71	810	67	706	75
2........	62	64	68	74	71.5	850	68	732	75
3........	62	65	71	74	71	850	68	710	75
4........	61.5	66	70	73	71.5	806	67	702	74
5........	63	67	72	74.5	72	818	68	740	75.5
6........	63	66	70	74	73	880	68.5	740	75
7........	64	67	70	74.5	73	900	69	788	75.5
8.........	61	67	76.5	74	72	948	68.5	812	76
9........	..	65.5	..	75	73	928	68	812	76
10.........	..	68	71	74	74	920	68	812	75
11........	63	68	71	75.5	73	922	68	820	76.5
12........	61.5	64	70	74	72	976	68	850	75
13.........	58.5	64	70	74	69.5	972	68	817	75
14........	57.5	64	67	73	68	958	66	864	74
15........	57.5	61	67	72	70	946	65	843	73
16........	58.5	62	68.5	..	68	906	66	..	..
17........	59	62	67	72	69	30.000	65	912	73
18........	58.5	62	67	72	69	018	65	940	73
19........	59	63	67	71	70	29.982	64	880	72
20........	59	64	67	71.5	69	992	65	902	72.5
21........	62	64	69	73.5	71	992	67	878	74.5
22........	59	64	67	70.7	69	30.006	67	890	71.7
23........	54.5	62	66.5	69	68	014	64	912	70
24........	55.5	60.5	65	69	66	006	62.5	880	70
25..	58	59.5	64	67	66	000	62.5	906	68
26.........	54	60	66	70	67	000	63	888	71
27........	57.5	61	64	70	67	29.994	62	882	71
28........	57	62	65	70	68	944	63.5	830	71
29........	..	63	66	74	67	930	63	822	75
30........	55.5	62.5	66	71	67.5	936	63	826	72
31........	56	61	65.5	76.5	68	892	62	746	71.5
Jan. 1831.									
1........	55.5	63	64.5	71	67.5	850	62.5	728	72
2........	54	62	64	69	66	790	63	708	70
3........	54.5	60	60	68	65	872	59	760	69
4........	54.5	61	60.5	64	63	914	60	802	65
5........	55	57.5	59	62	58.5	902	59	820	63
6........	53	57.5	..	63	61	924	58	814	64
7........	50.5	57	58.5	62.5	61	968	58	856	63.5

1831. Feb.	Thermom. in air. 6 A. M.	Noon.	4 P. M.	9 P. M.	Baro. at 10 A.M.	Ther. atthd.	Baro. 4 P. M.	Ther. atthd.	Min. of Ther. night.
8	56	55	59.5	60	30.010	54	29.900	60.5	50
9	57	61	66.5	64	058	57 5	958	67.5	55
10	59	62	71	67	080	59.5	962	72	..
11	62.5	..	..	..	..	..	..	..	..
15	..	66	72	68.5	062	64	948	73	
16	61.5	..	70.5	68	044	64.5	948	71.5	55.5
17	59.5	65	71	67	026	62	910	72	55
18	62	66	71	..	29.984	62	870	72	54
19	62	65	71.5	68	980	61.5	856	72	54
20	61	64	70.5	68	954	62.5	830	71.5	56
21	60	64	70.5	68	950	62.5	834	71.5	58
22	60	68	71.5	68.5	964	62.5	868	72.5	57
23	58	65	71	66	988	60.5	856	72	54.5
24	59	64	71	66	30.000	61.5	846	72	55
25	58	63.5	69.5	67	020	61	912	70.5	54.5
26	59	63	70.5	69	000	60.5	868	71.5	54.5
27	60	66	71.5	..	29.958	63	818	72.5	58
28	63	67	73	70	910	65	800	74	62
29	61	66	72.5	69	900	66	810	73.5	59
30	62	67	74.5	69	964	64	842	75.5	57.5
31	60	66.5	73	67.5	884	63 5	770	74	58
Feb.									
1	57.5	69.5	77	69	870	63.5	740	74	
2	58.5	70	76.5	70	822	64	710	74	
3	60	..	78	70	..	..	710	75	
4	61	..	80	73	830	67.5	730	76.5	
5	62	75	80	72	860	68	740	77	
6	59.5	76	80	72	864	67	7.0	77.5	
7	63	77	81.5	73	830	69	750	78.5	
8	64	78.5	82.5	72	..	..	770	79	
9	64	78	83	75	868	69.5	736	79.5	
10	66	78	85	76.5	812	72	736	81	
11	66	80	83.5	74	828	72.5	700	80	
12	63	76.5	83.5	73.5	828	6.95	730	80	
13	61.5	74.5	82	73.5	822	67.5	788	78.5	
14	64.5	78.5	..	74	814	69.5	..	..	
15	66.5	78	84	76 5	830	93.5	780	80	
16	70	85	87	75 5	800	80	764	86	
17	67	79.5	84	78	842	73	722	83	
18	67	79.5	85.5	77	872	72.5	730	82.5	
19	71.5	76	79	75	974	74	810	78.5	
20[1]	73	72	74	72.5	966	72	840	74	
21[2]	68	71.5	75	72.5	934	71	826	75	
22[3]	69	80	84	71.5	936	77.5	820	82	
23[4]	67.5	71	79	69	952	68.5	892	76.5	
24[5]	67	75	82.5	76	900	71	776	80	
25[6]	67	79	86.5	78.5	876	73	874	82	
26	67.5	79	85	76.5	900	73	784	82	
27	66.5	80	86.5	78.5	880	74 5	784	83	
28	66	83.5	88	76.5	850	72.5	746	83.5	
March.									Rise of the river above its lowest level. feet.
1	65.5	80.5	88	73	824	72.5	700	85	5.5
2	71	79.5	85	78	816	74	742	82	6
3	64.5	74.5	82	74	930	72	812	80	5.5
4	62	76	83.5	75	924	70	800	81.5	4
5	64·5	77	84	75.5	832	69	700	80	3.5
6	64.5	79	87	79	830	71.5	756	83.5	3
7	67	79.5	..	76.5	800	72.5	..	..	2.5
8	67	81.5	89	79.5	806	75	794	86	1.5

[1] Rain. [2] Ditto.
[3] Fog in the morning, violent north-wester in the evening with lightning.
[4] Fog in the morning, northwester in the evening but no rain or thunder and lightning, river rose 3 feet during the night.
[5] North-wester. [6] Eclipse of the moon.

9.—*Note on the Stalagmitic Balls of the Kasya Caves.*

[Read at a Meeting of the Physical Class As. Soc.]

I lately went to see the cave in this neighbourhood. It would be thought a very fine one by every person who have not seen the other near Pandua, which exceeds it greatly in the dimensions of the halls, &c. I went particularly to endeavour to ascertain the mode in which the round balls, of which I formerly sent you specimens, are found;—but I cannot even form a conjecture how they can possibly obtain that shape. They are found in abundance in only one spot, about 30 yards from the mouth, to which you descend about 7 or 8 feet, and the balls in the level space between this and the next ascent, which may be in length 30 feet.

They commence at A A, and are there almost all smooth, and of the size of from a grape shot to a small pea. At B B, they are larger, and are encrusted with the cauliflower looking matter that gives them the appearance of the native sweetmeat, called *luddoo.* It is impossible, as you will see from the situation of the place that they can rounded by a stream running through the cave at any season of the year. They seem, however unaccountable it may appear, to be formed by dropping from the top, but how to account for their assuming a shape almost spherical, I know not. One would suppose that they would necessarily be flat on the side upon which they rest—and in fact a few are found of that shape, not differing in other respects from the round ones. There is a layer of the balls almost six inches thick, and under that two feet of white spar formed by the drippings from the roof, and similar to the stalactites which depend from it; below these is a mixture of whitest clay and species of broken lime-stone. I shall dig deeper hereafter in some other place, being unwilling to disturb the balls by blasting, for they are almost peculiar to this particular spot, a very few only being found in advance. No bones were found except some very recent ones, apparently those of bats.

10—*Note on Billiard-cue Wax.*

The friend who obliged us with the essay on Billiards, has further contributed for the benefit of our Mofussil *Philobills* the following receipt for making the wax which the French use for fixing the leather tip to the point of the cue, and which holds better than glue in damp and rainy weather. It is in fact the pure resin of lac obtained by dissolving shell-lac in rectified spirits of wine.

Receipt.—Put into a bottle as much coarsely pounded shell-lac as will half fill it. Upon this pour highly rectified spirits of wine, filling up the bottle. Shake the bottle frequently for a day or two, and then allow it to stand for a few days more, when a pure clear solution will be obtained. Pour this off into a metal cup and set fire to the spirits of wine. When the flame goes out, pour the hot lac on a piece of glass, plate, or any smooth substance, damping or greasing the surface to prevent the adhesion of the wax. When nearly cold, the wax will come off in a flexible state, and may be rolled into sticks. It will continue to be of a pliant or tough nature, instead of being hard and brittle like ordinary sealing wax. A little of this melted in the flame of a candle and dropt on the point of the cue, is to be held near the candle until the wax is quite fluid. In like manner a little is to be dropt on the smooth side of the leather tip, and this also should be made hot by holding it on one side of the flame, while the point of the cue is held on the other. When the wax is well melted on both, quickly attach the leather to the point of the cue. Unless these precautions are taken, the wax is apt to be cooled on coming into contact with the cold surface of the leather or wood, and does not attach itself firmly.

The dregs of the solution remaining in the bottle may be strained through a piece of cloth, and a further quantity of wax will be obtained by the above process; but it is not so pure as the first.

Instead of setting fire to the alcohol it may be draw off by heat, and if performed in a proper vessel, be collected again for making a fresh preparation of wax.

11.—*Note on the Arbelon Problem.*

If the translation of Hákím Abdúl Mojéd's solution of this problem is correctly given in your last number, it appears destitute of formal demonstration, although the steps taken towards the proof are correct enough.

The following perhaps better expresses the Hákím's meaning :

Join AD BD : then the triangle ADB is right angled. Describe upon AD BD respectively the arcs AID and BLD. Then by the law of the hypothenuess,

The arc AID is equal to the arcs AEC CHD : and, the arc DLB is equal to the arcs CMB DRC.

But the arcs CHD and DRC constitute the circle CRDH, and the arcs AID DLB are equal to the arc ABD.

Therefore the arc ABD is equal to the sum of arcs AEC CMD and the circle CRDH ; and by subtracting the arcs AEC CMD which are common to both, the remainders will be also equal ; therefore the circle CRDH is equal to the figure DAKBMFCT. Q. E. D.

XV.—*Proceedings of Societies.*

I.—Asiatic Society.

Physical Class.

Wednesday Evening, 21*st December*, 1831.

The Hon'ble Sir Edward Ryan, President, in the chair :

1. A complete series of Volcanic specimens from Mount Vesuvius, was presented by Sir Edward Ryan, President.

This interesting collection was made by Mr. Babbage, from the Museum at Naples, and comprises specimens of lava of almost every eruption of Vesuvius, from the year 79 A. D. down to the present time.

2. A letter from Mr. William Cobb Hurry was read, presenting to the Society, on the part of Mr. Lea of Philadelphia, a box of American Shells, land and fresh water.

Among these were enumerated 25 varieties of the *Unio*, chiefly from the Ohio;—3 varieties of *Venus*, 4 of *Melania*, and several other univalves and bivalves.

Mr. Hurry also presented, on the part of Dr. Burrough, of the same place, some skins of American birds, in testimony of his thankfulness for the assistance afforded him by the Government of Bengal in his pursuits of Natural History, when in this country.

And lastly, on the part of Dr. R. Harlan, a Pamphlet on the Fossil Bones of the Megalonyx, discovered in " white cave," Kentucky.

3. Specimens of a stuffed bird and a lizard, calculated to resist the destructive influence of a Bengal climate, were presented in the name of Dr. Pearson of Midnapúr. The Society expressed a hope that the donor would apply his very successful mode of preparation extensively in the service of their Museum, which, at present, exhibits such symptoms of decay, from the dampness of the apartments, as naturally to restrain many from depositing in it the results of their labours in the wide field of Indian Natural History.

4. A letter was read from B. H. Hodgson, Esq. forwarding to the Society a paper on the Mammalia of Nepal.

5. A Letter from Dr. Strong stated, that the Boring experiment was once more actively proceeding, the 100 feet of rod which were broken into the shaft sometime ago, had, by dint of great exertion, been extracted ; 70 feet of large tube had also been let down into the upper part of the bore, and upwards of 100 feet of smaller tube were prepared to sink below ; the auger is now at 135 feet below the surface, rapidly recovering lost ground.

6. Dr. Ward's sketch of the Geology of Penang and the neighbouring Islets was read, and the specimens of rocks, in illustration of his remarks, laid on the table.

The Island does not offer much variety of interest to the Geologist—the main land is composed of granite, the copious detritus of which forms the soil of the cultivated plains : the extensive disintegration of this granite was also noticed by the Rev. R. Everest, as similar to what prevails in France and in India : argillaceous schist, grey-wacke, and slaty limestone, conformably stratified, crop up above the ocean in the Boonting Isles to the North, in the Kra to the S. E. and in the Saddle Island to the S. W. : the inclination of the strata being directed outwards from the main island, as a central ridge. In the course of his tour, Dr. Ward discovered limestone and iron ore in abundance, both hitherto unused by the inhabitants : stream tin works were once established, but the return did not compensate the expence, and the jungle on the hills is so thick, that no attempt has been made to seek for the ore in situ.

2.—Medical and Physical Society.

3d December, 1831.

Messrs. Drummond, Phillipson, and Reid, and Dr. Goodeve, were elected Members of the Society, and Dr. Desnoyes of the Mauritius, a Corresponding Member.

The following communications were then laid before the Society :

1.—A letter from. Dr. White of the Bombay Service, inclosing a Register of the Pluviameter at Púna, from the 1st June to the end of October, by which it appears, that during the period above specified, 20.83 inches of rain fell at that station.

2.—A letter from J. P. Grant, Esq. of Penang, addressed to John Grant, Esq. of Calcutta, giving an account of a Native Christian woman at Pinang, above fifty years of age, who had borne no children for fifteen years, and who having care of one of her own grand-children, (whose mother had died), endeavoured to pacify the child by putting it to her breast, the result of which was, in a few days, an abundant supply of milk, and the infant has been very well nourished for eight months, by this old nurse.

3.—A letter from Dr. Neil Maxwell, inclosing a drawing of the plant named by the natives *Undha Oolie*, which was mentioned in the Society's Circular of last month, as having been successfully used by the Natives in the vicinity of Benares in the cure of snake-bites. The plant, preserved in spirits, has been since received.

5.—An account of the Epidemic Catarrh, which prevailed at Penang, in July and August, 1831, by Dr. Ward of Pinang.

6.—A second communication on Dracunculus, from Dr. Mylne of Bombay.

7.—Dr. J. R. Jackson's account of a singular disease in a Hindú child.

8.—W. Cameron, Esq. presented a copy of his printed Report on Vaccination in Bengal, with tables containing the numbers vaccinated during the last ten years, and a series of statements, in an Appendix, shewing the great mortality from small-pox in 1829-30, in districts where the natives were precluded from availing themselves of vaccination, with many examples of the necessity of maintaining an extensive and efficient vaccine establishment in Bengal. During the late Epidemic Variola, the natives, in several populous districts, were forced to acknowledge their confidence in the protection afforded by vaccination, and it is painful to observe that, in several instances, there were not means to afford them the benefit of the prophylactic, when they most earnestly sought for it.

9.—Remarks on the mode of performing the operation of Vaccination, by J. Hutchinson, Esq. in which the author advises the vaccine lymph to be inserted into the usual puncture in the arm, by means of an ivory point in preference to the lancet, as he thinks the lymph is more apt to be pushed back along the blade of the lancet instead of being effectually insinuated into the puncture.

The following communications were then read and discussed by the Meeting :

Mr. Brett's case of Lithotomy on a Hindoo child, in which the operation was followed by tetanus, and the patient ultimately recovered.

Dr. H. Mackenzie's case of inveterate ulcers, with diseased bone, in a native, quickly cured by the use of Madar, and Dr. Ward's account of an Epidemic Catarrh that had prevailed very generally in the Island of Penang, during the months of July and August, 1831. This Epidemic seems to have depended on some disordered condition of the atmosphere, and the pulmonary symptoms with fever were, in many instances, very severe. The author says "*no circumstance occurred during the progress of the malady to induce the belief of its being contagious.*" A similar disease appears to have prevailed extensively in the Island of Java, and in some districts to have been, in a considerable proportion of cases, fatal. The account of the disease at Java, transmitted by Dr. Ward, states that in the district of Soorabaya, where the population is 3,11,192 souls—48,217 persons were attacked with the Epidemic, of whom 103 died :—and in the department of Grissee, with a population of 2,23,626—52,528 persons suffered from the Epidemic, of whom 8 died. Here also the disease was ascribed to sudden alternations of temperature, with an unusual degree of humidity of the atmosphere.

Meteorological Register kept at the Surveyor General's Office, Calcutta, for the Month of December, 1831.

Day of the Month.	Minimum Temperature observed at Sun-rise.					Maximum Pressure observed at 9h. 50m.					Observations made at apparent Noon.					Max. Temp. and Dryness observed at 2h. 40m.					Minimum Pressure observed at 4h. 0m.					Observations made at Sunset.				
	Barometer reduced to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.	Barom. red. to 32°.	Temper. of the air.	Depres. of M.B.Ther.	Wind.	Aspect of the sky.
1	29,999	68,7	2,7	cm.	cl.	,042	75,	6,5	cm.	cu.	,014	78,7	8,	n. e.	cu.	,930	81,3	10,3	n. e.	cu.	,929	80,5	9,8	n. e.	cu.	,934	78,5	8,6	n. e.	cu.
2	30,035	68,3	2,1	n. e.	cis.	,080	73,	4,1	do.	cl.	,028	81,3	8,8	do.	do.	,963	82,3	9,6	do.	do.	,960	81,7	9,5	cm.	cl.	,970	79,	6,8	cm.	cl.
3	,025	68,7	2,6	cm.	cl.	,054	74,	4,3	do.	cu.	,019	75,	5,3	do.	do.	,964	76,5	5,3	n.w.	do.	,965	75,	4,8	n.w.	cu.	,976	70,5	3,3	do.	do.
4	,015	66,5	2,	n.	do.	,073	72,7	5,8	w.	cl.	,044	73,	4,3	w.	cl.	,982	76,	8,3	do.	do.	,975	74,7	6,8	do.	do.	,978	72,8	6,1	do.	do.
5	,032	64,	1,3	cm.	do.	,046	72,	6,3	do.	cu.	,028	76,6	8,9	do.	cu.	,962	78,3	5,6	w.	cl.	,955	77,3	8,4	w.	cl.	,956	75,6	7,4	w.	do.
6	,041	64,5	4,	n.	cu.	,079	68,7	7,2	cm.	cis.	,032	72,	10,8	n.	do.	,958	75,3	12,1	n.	do.	,947	73,6	10,9	n.	do.	,954	72,3	9,1	n.	do.
7	,004	60,8	3,2	cm.	cis.	,028	68,	8,8	do.	cl.	,982	73,	11,3	do.	cl.	,934	75,5	9,8	do.	do.	,920	73,3	12,1	cm.	do.	,937	72,	9,8	cm.	do.
8	,008	57,3	2,4	n.	cm.	,051	67,7	8,5	do.	do	,015	72,7	10,2	cm.	do.	,959	74,5	12,	cm.	do.	,958	73,5	9,6	n.	do.	,974	69,3	6,4	do.	do.
9	,067	57,7	2,7	cm.	cl.	,099	68,	4,3	do.	do	,053	73,7	10,5	n.	do.	,000	74,5	9,6	n.	do.	,997	73,5	9,7	do.	do.	,008	68,	3,3	do.	do.
10	,046	56,	1,1	do.	do.	,081	70,3	8,6	do.	do	,031	74,7	10,9	cm.	do.	,961	76,	11,3	cm.	do.	,959	75,	10,8	cm.	do.	,972	70,3	4,8	do.	do.
11	,035	63.4	2,2	do.	do.	,065	74,	9,8	do.	do	,028	75,	11,2	do.	do.	,967	77,9	14,	do.	do.	,952	75,7	11,8	do.	do.	,964	73,	9,3	do.	do.
12	,032	59,5	1,8	n. e.	do.	,068	70,3	6,8	do.	do	,003	76,3	10,1	do.	do.	,956	77,7	9,	n. e.	ci.	,957	76,5	8,5	n. e.	do.	,973	74,7	6,5	n. e.	do.
13	,025	62,8	1,9	cm.	do.	,072	73,	4,5	do.	do	,029	77,3	7,1	n. e.	cu.	,974	76,7	6,8	do.	cu.	,974	76,	8,5	cm.	do.	,974	74,3	6,4	cm.	do.
14	,001	65,5	2,	n.	cis.	,159	69,3	3,8	do.	cis.	,029	72,	6,5	cm.	cis.	,958	73,3	5,4	n.	cis.	,966	72,5	5,8	do.	cis.	,978	69,7	2,5	do.	do.
15	,025	62,	1,1	cm.	cl.	,072	72,	4,8	do.	cl,	,026	73,5	5,6	do.	cl.	,960	76,	6,1	cm.	cl.	,961	76,3	7,3	do.	cl.	,968	70,5	3,	do.	do.
16	,081	64,9	2,9	do.	do.	,098	72,7	5,3	do.	d o.	,017	75,3	5,4	n.	cu-	,003	75,3	6,4	n.	cis.	,999	74,3	7,4	n.	cis.	,004	71,5	5,3	n.	cis.
17	,098	63,	1,3	do.	do.	,128	69,5	6,3	do.	cis.	,048	76,3	9,8	do.	do.	,010	76,7	8,5	do.	cu.	,012	75,	6,5	cm.	ci.	,023	70,4	2,2	cm.	ci.
18	,095	62,3	2,4	do.	do.																									
19	,062	60,5	1,8	n.	cu.	,085	66,	3,8	do.	cis.	,043	69,5	4,8	do.	cis.	,984	72,3	7,6	do.	cu.	,964	68,7	4,2	do.	cl.	,991	68,	4,3	do.	cl.
20	,094	61,7	1,2	cm.	cl	,112	68,3	6,8	do.	do.	,052	73,5	9,6	do.	cu.	,998	75,	10,2	do.	do.	,994	73,5	8,6	n.	ci.	,015	70,7	5,8	do.	ci.
21	,047	58,8	1,	do.	ci.	,060	66,6	6,4	do.	ci.	,042	72,3	8,8	do.	cl.	,994	73,5	10,3	do.	cm.	,997	73,3	9,8	do.	cl.	,021	68,9	4,7	do.	do.
22	,084	60,5	2,6	do.	do.	,105	69,5	7,6	do.	cl.	,076	73,7	9,3	do.	do.	,031	75,5	10,8	do.	ci.	,030	74,5	10,6	do.	cu.	,007	68,3	5,1	do.	cl.
23	,117	60,5	1,6	do.	cl.	,132	69,	7,3	do.	do.	,074	73,3	9,8	do.	ci.	,017	75,3	9,8	do.	do.	,017	73,5	7,3	do.	ci.	,030	68,5	4,3	do.	do.
24	,104	59,5	1,8	do.	do.	,121	67,5	5,8	do.	do.	,068	72,3	9,4	cm.	cl.	,012	73,7	11,2	do.	cl.	,000	72,5	9,8	do.	cl.	,014	69,5	7,3	do.	ci.
25	,047	59,7	3,1	n.	cis.	,086	67,7	6,2	ne.	cis.	,028	71,8	10,6	n. e.	cis											,933	68,3	3,6	do.	do.
26											,993	74,	9,8	cm.	ci.	,964	75,3	10,1	cm.	do.										
27	,069	60,5	2,3	do.	ci.	,087	70,7	6,8	n.	cl.	,057	75,5	9,	n.	cl.	,992	77,3	10,1	n.	cu.	,992	76,3	8,8	n.	cl.	,996	75,3	8,8	n.	cis.
28	29,932	64,	2,5	cm.	cl.	,072	70,5	6,6	cm.	do.	,996	75,5	9,	c.m.	do.	,936	76,5	8,	n.w.	do.	,934	76,	7,8	n.w.	cu.	,945	74,7	6,2	cm.	cl.
29	30,028	64,5	2,5	do.	do.	,066	70,	5,3	do.	do.	,006	77,5	8,	n.w.	do.	,942	77,3	8,1	do.	do.	,941	77,	8,8	cm.	cl.	,955	74,5	5,8	n.w.	cu.
30	29,995	64,	1,6	do.	cus.	,044	72,	6,8	do.	do.	,988	76,5	8,	n. e.	ci.	,954	77,7	9,2	n.	cus.	,945	75,3	7,4	n.	do.	,954	72,5	5,	cm.	cl.
31	30,003	61,6	1,4	do.	cl.	,060	71,3	5,8			,990	75,5	8,3			,935	77,5	9,3	n. e.	cu.	,934	76,3	9,1	n. e.	cu.	,945	74,5	6,3	do.	cu.
Mean	30,043	62,3	2,1			,077	70,3	6,2			,028	74,6	8,6			,973	76,3	9,1			,969	75,	8,6			,978	71,9	5,8		

Abbreviations. In the column "wind," small letters have been used instead of capitals; *cm:* means *calm.* In the column "aspect of the sky," *cy.* is *cloudy*; *cl.* *clear*; *rn.* *rain.* *ci.* *cirrus*; *cu.* *cumulus*; *cs.* *cirro-stratus*; *cus.* *cumulo-stratus*; *cc.* *cirro-cumulus*; *n.* *nimbus.*

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