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THE

# JOURNAL

OF

# THE ASIATIC SOCIETY

OF

# BENGAL.

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VOL. II.

# THE JOURNAL OF THE ASIATIC SOCIETY OF BENGAL.

EDITED BY

JAMES PRINSEP, F. R. S.

SECRETARY OF THE ASIATIC SOCIETY.

VOL. II.

JANUARY TO DECEMBER,

1833.

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

SIR WM. JONES.

Calcutta:

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1833.

# PREFACE.

On completion of this second volume of the Journal of the Asiatic Society, the Editor feels it to be due to his subscribers, as well as to himself, to lay before them as briefly as possible, the results of the arrangements which he contemplated carrying into effect at the conclusion of the last volume;—more especially as a somewhat erroneous estimate of the cost and circulation of the Journal found admission into a late notice of the Indian Periodical Press, drawn up by the Editor of one of the morning papers. The Journal is not published, as there stated, by the Asiatic Society, but solely at the cost and responsibility of the Secretary, who was Editor of it before he enjoyed the honour of an election to that office. Since there never has been the least view to profit, either in the Gleanings or in the present work, there can be no object whatever in concealing any information respecting its publication; and it may be useful hereafter to find on record a note of the expences of printing, and the difficulties against which a Journal exclusively scientific has had to contend, as well as the advantages which it has enjoyed, in India at the present time. The following particulars have therefore been extracted from the accounts of the two years now terminated.

| | | | |
|---|---|---|---|
| The amount of subscriptions to the Journal at one rupee per number, including two extra numbers, in 1832, was ........ | | Rs. | 5148 8 |
| From this, deducting 20 per cent. commission paid to Messrs. Thacker and Co. for circulating it, .......... | | | 1028 11 |
| There remained net subscriptions available, | | Rs. | 4114 13 |
| The Baptist Mission Press charged for printing and stitching 500 copies, | Rs. 3742 10 | | |
| And the 15 plates cost with printing, | 416 5 | | |
| | Total | | 4178 5 |

The result of the first year exhibits a sufficient accordance between outlay and return. Of the amount subscribed however, only Rs. 3786 13 have been collected up to the present time, so that in fact there was a deficit of Rs. 392 2.

The alterations which the Editor proposed and completed for the second year were:—

1. The saving of nearly half of the commission paid for the mere circulation of the work (without responsibility), by undertaking that duty with the aid of his establishment as Secretary of the Asiatic Society;

2. As a return for this favor, he proposed circulating the Journal gratis to such of the paying members as should express a desire to take it in.

The effect of this scheme has been as follows:

Fifty members of the Society have availed themselves of the privilege, which has made a deduction to the same amount from the monthly receipts. The number of copies circulated, including those sent to subscribers and societies in Europe, is about 450.

The number of paying subscribers on the list, is 320, which at 1 R. per month, (including one extra number of Buchanan,) would give Rs. 4480.

The expenses of printing 500 copies, of 670 pages,

| | | |
|---|---|---|
| at 4-5 per page, may be stated at ........ | Rs. 2,890 | |
| 144 pages of Buchanan, at 4-8 per page,........ | 648 | |
| Covers, table work, &c. charged extra, ........ | 250 | |
| 40 pages of Appendix, at 5 Rs................. | 200 | |
| 28 plates (18 lithographs, 10 engravings*),.... | 480 | |
| Establishment for circulation,................ | 600 | |
| | —— | 5,068 |

Leaving a loss on the year of Rs. 588, or nearly as much as the subscriptions of the members exempted from paying.

But it must be mentioned, and mentioned with a degree of disappointment which is almost disheartening, that of the flattering list of sub-

* For these the cost of printing and paper only is charged.

scribers above given, 70 have not paid any part of the year's subscription, and as many more are still in arrears; so that a balance of Rs. 1321-8 still remains to be collected. The actual state of the concern is therefore by no means so favorable as could be wished, for it leaves the Editor out of pocket upwards of 2000 Rs. as the reward of his labour for two years! B əq ʇnwill not for a moment suppose that the balances outstanding are not recoverable: on the contrary the principal difficulty lies in the distance, and the supposed want of a mode of remittance.—Many subscribers are not aware, that letters containing hoondees for the amount may be transmitted *post free* to the Editor.

It will be remembered, that the Bengal Government were pleased to bestow the privilege of free postage on the GLEANINGS and on the JOURNAL, on condition of the publication of the late Dr. Buchanan's Statistical Reports. Under the impression (justly formed) of a corresponding increase of circulation, consequent upon this liberal boon, it was resolved not to incorporate these records in detached notices in the JOURNAL, nor to diminish from its original matter*, but to publish them as a separate work; and one volume has accordingly been completed,

| | |
|---|---|
| containing 356 pages, which at 4-8 per page have cost Rs. | 1,602 |
| And a reprint of the first 108 pages, which became necessary on the subsequent extension of the edition from 300 to 500 copies, | 216 |
| Total, Rs. | 1818 |

This expence has been incurred therefore on account of Government, in return for the postage saved, not to the work, but to the subscribers of the JOURNAL. On the completion of the first volume of BUCHANAN, a second extra volume of an official nature on the Monetary System was commenced, of which 50 pages have been printed with 3 plates, being in fact an expence of more than 300 rupees not included in the above estimate. The Government meantime placed the remaining volumes of Buchanan in the Editor's hands, with an intimation of its "desire that the printing of these records should be continued." It was therefore with no small feeling of mortification that

* Originally 32 pages only were given in each number, latterly 64.

the EDITOR perused the following letter, announcing that the privilege of free postage should cease from June next, especially after having been honored, on an explanation of the nature of the work, with an extension of the same privilege to the Madras presidency, in addition to that formerly bestowed by the Governors of Bombay and Ceylon.

To JAMES PRINSEP, Esq.

Genl. Dept. Editor of the Journal of the Asiatic Society,

Sir,

I am directed to inform you, that the Governor General in Council has resolved, that after six months the exemption from postage, which is now enjoyed by the Journal of the Asiatic Society, shall be discontinued.

I have the honor to be,
Sir,
Your most obedient servant,

Council Chamber,
2nd Dec. 1833.

G. A. BUSHBY,
Offg. Sec. to Govt.

It may reasonably be feared that many subscribers at distant stations may be unable to continue their support to the work, when its cost shall be enhanced by postage; but (should it be impossible, on a proper and respectful representation of the circumstances, to avert the imposition of postage) every means will be taken of lessening the burthen by sending the monthly numbers by the bangy instead of the regular dâk.

On the contents of a volume which has already been perused by nearly all to whom it circulates, it would have been obviously needless to make any remark, were it not desirable to prove that the favors hitherto conferred upon the work by the Government of the country had not been altogether misapplied.

Independently of the volume of Dinajpur Statistics, which forms a model for the use of public officers engaged in collecting similar information, the GLEANINGS and the JOURNAL have been the means of bringing to notice many of the mineral resources of our vast Indian Empire, and of leading to fresh discoveries by the announcement of what had already been found: coal may be adduced as an example,—of which twenty or more different localities have been brought to our knowledge through its pages, where only two were before known. Of the native mineral productions, iron, copper, gold, &c.:—Of the native arts and manufactures, salt, nitre, turpentine, dyes, mills, &c. numerous original ac-

counts have been inserted : catalogues of woods, medicinal plants and drugs : experiments on materials, wood, iron, cement ;—Statistical reports;—descriptions of newly explored countries and people :—in fact, it would be difficult to open a number of the JOURNAL without finding some information which must possess value in the eyes of a government. Contributions of a more exclusively scientific nature have, in the mean time, continued to multiply, and the objects pointed out as desiderata at home in the geography, meteorology, geology, and natural history of this country, are in the course of rapid and systematic elucidation. So numerous for instance have been the registers of the weather offered for publication, that space could only be found for abstracts of many. There has hardly been time for the collection of materials regarding the tides of the Indian coasts, suggested in the Rev. Professor WHEWELL's circular, (inserted in page 151,) but the attention of those who have opportunities of eliciting the information required, is again solicited to this object.

As aproof of the benefit conferred on science by the free and extensive circulation of a periodical devoted to such objects, the Editor feels pride in alluding to the ardour which his plates of ancient coins have inspired in many active collectors, and above all to the reward bestowed ou himself by the munificence of General VENTURA, the most successful pursuer of antiquarian research in the Panjáb, who has presented to him all the coins and relics discovered on opening the celebrated Tope of Manikyala. They are now on their way to Calcutta.

That extracts and analyses of European science have not been more frequent must be attributed once more to want of space and want of leisure. The Editor would recommend all who seek for knowledge of the progress of science in Europe to procure a copy of the Reports of the British Association for 1832, in which they will find every branch discussed by the philosopher best able to give it illustration. To attempt to shorten those admirable essays would be mutilation rather than abridgment ; yet unfortunately most of them are too long for the pages of a monthly journal.

On the subject of orthography of native words, the Editor is driven to make one concession, for which he fears the learned Societies at home

will denounce him as an apostate to the system of their leader. Every communication, with hardly any exception, which comes for publication, adopts the Gilchristian mode of spelling, or that modification of it which has been *ordered* to be used in all Government records, surveys, &c. An attempt has been made hitherto to conform the whole to Sir William Jones' method, but necessarily there have been continual omissions, and the contributors in most cases express themselves but ill pleased to see their words transformed into shapes but ill accordant with ordinary *English* pronunciation. The Editor has therefore resolved to adopt the middle course followed in Hamilton's Hindustan, namely, to print all Indian names and words in the ordinary roman type as they are usually written and pronounced, and to place in italics all such native terms and proper names, as are corrected, and spelt according to the classical standard of Sir William Jones: in many cases the latter may be inserted in brackets after the ordinary word.

Where contributors have occasion to illustrate their papers by plates, it will be a great convenience to the Editor to have the original drawings prepared of the same dimensions as the printed page of letter press, to save the trouble and expence of reducing them.

The Editor will not allude in this place to the severe loss he has sustained in the death of some of the most able and constant supporters of his work, and the departure to Europe of others in the course of the past year; since he hopes that a more worthy channel will be found for the record of their meritorious labours for the cause of Science in India, in the Proceedings of the Asiatic Society, to which their names belong, and in which their reputation must ever be cherished with fond remembrance.

1*st January*, 1834.

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# JOURNAL

OF

# THE ASIATIC SOCIETY.

*No.* 14.—*February*, 1833.


## I.—*Note on the Origin of the Kála-Chakra and Adi-Buddha Systems. By Mr.* Alex. Csoma de Körös.

The peculiar religious system entitled the *Kála-Chakra* is stated, generally, to have been derived from *Shambhala,* as it is called in Sanscrit, (in Tibetan "*b*dé-*h*byung," vulgò "dè-jung," signifying "origin or source of happiness,") a fabulous country in the north, the capital of which was *Cálapa,* a very splendid city, the residence of many illustrious kings of *Shambhala,* situated between about 45° and 50° north latitude, beyond the *Sita* or Jaxartes, where the increase of the days from the vernal equinox till the summer solstice amounted to 12 Indian hours, or 4 hours, 48 minutes, European reckoning.

The *Kála-Chakra* was introduced into Central India in the last half of the tenth century after Christ, and afterwards, viâ Cashmír, it found its way into Tibet; where, in the fourteenth, fifteenth, and sixteenth centuries, several learned men, whose works are still extant in that country, published researches and commentaries on the *Kála-Chakra* system; among these authors the most celebrated are Puton, or Bu-stom, Khetup, or *m*Khas-grub and Padma Carpo, who lived respectively in the three centuries above-mentioned.

Padma Carpo (on the 68th leaf of his "Origin of (the Buddhistic) religion" *h*Chhos-*h*byung (vulgò "Ch'os-jung," consisting of 189 leaves,) thus describes the introduction of the *Kála-Chakra* into, or at, *Nalanda* (or *Nalendra,* a large religious establishment in Central India), and the doctrine which it contained:

"He (a certain pandit called Tsilu or Chilu) then came to *Nalanda* in Central India, (S. *Madhyam,* Tib. *d*vus, or vulgò U.) Having designed

over the door of the *Bihar* the ten guardians (of the world), he wrote below them thus:

"He, that does not know the chief first Buddha, *(Adi-Buddha)*, knows not the *circle of time. (Kála-Chakra*, dus-kyi *h*khor-lo, in Tibetan*.)

He, that does not know the circle of time, knows not the exact enumeration of the divine attributes.

He, that does not know the exact enumeration of the divine attributes, knows not the supreme intelligence (S. *Vajra dhara jnyána*, Tib. *r*do-*r*jé *h*dsin-pahi yé-shes.)

He, that does not know the supreme intelligence, knows not the Tantrica principles *(Tantra Yánam.)*

He, that does not know the Tantrika principles, and all such, are wanderers in the orb of transmigrations, and are out of the way (or path) of the supreme triumphator (S. *Bhagaván Vajra dhara*, Tib. *b*,chom-*l*dan-*h*das *r*do-*r*je *h*dsin-pa.)

"Therefore, *Adi-Buddha* (Tib. mchhog-gi dang-pohi Sangs-*r*gyas) must be taught by every true *b*Láma (S. *Guru*, a superior teacher, religious guide), and every true disciple who aspires to liberation (or emancipation) must hear them." Thus wrote he:

"The venerable (the lord) Nárotapa (Narottama?) being at that time the principal (S. *Upádhyaya*, Tib. *m*khan-po) of the *Bihar;* he, together with five hundred pandits, disputed with him, but when they saw that he excelled them all in disputing, they fell down at his feet, and heard of him *Adi-Buddha;* then this doctrine was much propagated."—See leaf 68, by Pádma Cárpo.

Here follows the text of the above quoted passage by Pa'dma Ca'rpo, both in the Tibetan and Roman characters.

* The *Kála-Chakra* and *Adi-Buddha* systems are probably the same with that of the Samanians in the north, in Transoxana, and beyond the Jaxartes, as it has been described by M. Deguignes, in his "Histoire Générale des Huns," Livre III. p. 223, &c., recently criticised by M. Remusat; since the doctrine of the Samanians is exactly the same, as I have found in the Tibetan volumes.—Besides the mystical theology and philosophy, there are in the *Kála-Chakra* system several works on astronomy, astrology, and prophetical stories on the rise, progress, and decline of the Muhammedan faith.—In the *b*stan-*h*gyur collection (of 225 volumes) the five first volumes contain fifty-two tracts or treatises on the *Kála-Chakra*, all translated from the Sanscrit; but, besides these, there are many other volumes written by Tibetan authors on the same subject. In the Asiatic Society's library, there are also some printed volumes, containing commentaries on the *Kála-Chakra*, by Khétup or more properly *m*Khas-grub, mentioned in this paper as a very celebrated writer in the fifteenth century. Should I find any interesting article in it, I shall take occasion to notice it hereafter.

‘ དེ་ནས་དཔུས་ནས་པ་རྡུར་སྟོན། གཙུག་ལག་ཁང་གི་སྒོ
གེད་དུ་རྣམ་བཅུ་དབང་ལྡན་བྲིས། དེའི་གཞམ་དུ།
“ གང་གིས་མཆོག་གི་དང་པོའི་སངས་རྒྱས་མི་ཤེས་པ་
དེས་ནི་དུས་ཀྱི་འཁོར་ལོ་མི་ཤེས་སོ།། གང་གིས་
དུས་ཀྱི་འཁོར་ལོ་མི་ཤེས་པ་དེས་ནི་མཚན་ཡང་དག
པར་བརྗོད་པ་མི་ཤེས་སོ།། གང་གིས་མཚན་ཡང་
དག་པར་བརྗོད་པ་མི་ཤེས་པ་དེས་རྡོ་རྗེ་འཛིན་པའི་
ཡེ་ཤེས་ཀྱི་སྐུ་མི་ཤེས་སོ།། གང་གིས་རྡོ་རྗེ
འཛིན་པའི་ཡེ་ཤེས་ཀྱི་སྐུ་མི་ཤེས་པ་དེས་སྔགས་ཀྱི
ཐེག་པ་མི་ཤེས་སོ།། གང་གིས་སྔགས་ཀྱི་ཐེག་པ
མི་ཤེས་པ་དེ་ཐམས་ཅད་ནི་འཁོར་བ་པ་སྟེ་བཅོམ
ལྡན་འདས་རྡོ་རྗེ་འཛིན་པའི་ལམ་དང་བྲལ་བའོ།།
དེ་ལྟ་བས་ན་མཆོག་གི་དང་པོའི་སངས་རྒྱས་ནི་བླ
མ་དམ་པ་རྣམས་ཀྱིས་བསྟན་པར་བྱ་ཞིང་། ཐར་པ
དོན་དུ་གཉེར་བའི་སློབ་མ་དམ་པ་རྣམས་ཀྱིས
མཉན་པར་བྱའོ་ཞེས་བྲིས་པ།” ཇོ་བོ་ནཱ་རོ་ཏ་པ
དེ་ཉིས་དེའི་མཁན་པོ་ཡིན་པས། དེ་ལ་སོགས་པ་པཎྜི་ཏ་ལྔ
བརྒྱས་བཅད་པས་ཡུལ་དུ་སྦྱིན་པར་མཐོང་ནས་ཞབས་ལ
བཏུད་དེ་དང་པོའི་སངས་རྒྱས་ཉན་པས་ཆེར་དར་བར
གྱུར་པ་ཡིན་ནོ།། ’

Dé nas *d*us *Nalandar* byon, *g*tsug-lag khang-gi *s*go gong-du *r*nam-pa *b*chu *d*vang *l*dan bris, déhi *g*sham-du : " Gang-gis *m*chhog-gi dang-pohi Sangs-*r*gyas mi-shes-pa dés ni dus-kyi *h*khor-lo mi-shes-so; Gang-gis dus-kyi *h*khor-lo mi-shes-pa dés ni *m*tshan yang-dag-par *br*jod-pa mi-shes-so; Gang-gis *m*tshan yang-dag-par *br*jod-pa mi-shes-pa dés *r*do-*r*jé *h*dsin-pahi-yé-shes-kyi sku-mi-shesso; Gang-gis *r*do-rjé *h*dsin-pahi yé-shes-kyi *s*ku mi-shes-pa dés *s*nags-kyi thég-pa mi-shes-so; Gang-gis *s*nags-kyi thég-pa mishes-pa déthams-chad ni *h*khor-va-pa sté *b*chom-*l*dan-*h*das *r*do-*r*je *h*dsin-pahi, lam dang bral-vaho. Dé-lta-vas-na *m*chhog-gi dang-pohi Sangs-*r*gyas ni *b*Lámá dam-pa-*r*nams-kyis *bs*tan-par-bya-zhing, thar-pa don-du *g*nyér-vahi *s*lob-ma dam-pa-*r*nams-kyis *m*nyan-par-byaho," zhes bris-pa.

Jovo Nárotapa dé dus déhi *m*khan-po yin-pas, dé la sogs-pa Pandita *l*na *br*gyas *br*tsad-pas phul-du phyin-par *m*thong-nas zhabs-la *b*tud-dé dang-pohi Sangs *r*gyas nyan-pas chhér dar-var gyur-pa yin-no.

No mention is made of the *Kála-Chakra,* nor of *Adi-Buddha,* by ancient writers in India, till the 10th century, except in the first volume of the *r*Gyut class in the Kah-gyur, where it is evidently an interpolation from true historical works of later ages.

Since the passage above exhibited is an authentic text for the name of *Adi-Buddha,* while it furnishes a general idea of the *Kála-Chakra* system, I have thought proper to bring it to the notice of the Society, and hope it will be of some interest.

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II.—*Journal of a March from Ava to Kendat, on the Khyendwen River, performed in* 1831, *by* D. Richardson, *Esq. Assistant Surgeon of the Madras Establishment, under the orders of Major H. Burney, the Resident at Ava.*

20th January, time 5 h. 20 m. distance 10 miles; direction N. 40° W.; at noon, started from Ava; 12 h. 25 m. crossed the river, which, with waiting on the northern bank for two horses and some coolies from the *Myo Woon* of *Tsa-gain,* detained us till 2 h. 45 m. when we again proceeded, and at 3 h. 25 m. passed *Pa-be-dan,* or Blacksmith's Village, of from seventy to one hundred houses, all inhabited by blacksmiths from *Tsa-gain,* (the city on the northern bank of the river opposite to Ava:) to this place the houses are nearly continuous. At 3 h. 35 m. pass *Kyouk-tsheet,* nearly the same number of houses; the inhabitants employed in making marble images for the pagodas, and other religious edifices. At 4 h. pass *Magee-tzen,* a village nearly the

same size as the others : about 4 h. 30 m. pass within a furlong east of the *Koung-mhoo-dau-gyee* pagoda, to the S. W. of which, about half a mile, is a swamp of some extent, and to the east of it, and of the road, another, called *Yc-k,ha,* the waters of which are extremely bitter. 5 h. 20 m. halt at *Tsa-ye,* a large village; the road throughout the day has been level and good : about two and a quarter miles west from the foot of the *Tsa-gain* hills ;—the soil light and sandy : nearly the whole country, on both sides of the road, has been under cultivation, and the *cholum** and paddy stubble is now covered with many hundred black cattle, in high condition. No *Tès* had been built for us here, though orders to that effect had been issued by the *Lhwot-tau* many days.

21st. Time 3 h. 5 m., distance nine miles ; direction N. 20° W. ; 9 A. M. leave *Tsa-ye;* 9 h. 30 m. pass through *Padoo,* a large village, perhaps 160 houses. 12 h. 5 m. halt at *Kek-ka,* about 90 houses (in the *Zarat) ;* appearance of the country much the same as the latter part of yesterday's march. Cattle numerous, water sufficient, and cultivation extensive, but slovenly in most places, with the exception of the spots where grain is sown, which is about a foot high, green and vigorous, and the fields well cleared: the jungle has been only partially grubbed out, and the paddy, sesamum, and *cholum* sown amongst the remainder. The road to-day level, and still light and sandy, has run along a plain, between the *Tsa-gain* hills to the eastward, running about N. 20° W. distant three miles, and a ridge of elevated ground to the westward, running nearly in the same direction, distant about eight miles. Great part of this plain is, and the whole might be, brought under cultivation.

22nd. Time 7 h. distance 21 miles, direction N. 20° W. ; 8 A. M. leave *Kek-ka ;*—8 h. 50 m. pass *Thughe,* a small village, perhaps 20 houses :—9 h. 20 m. pass *Pay Thughe,* about 60 houses :—9 h. 45 m. pass *Oun-ngay-bouk,* about 70 houses :—10 h. 20 m. *Kamday,* small village ; in the palmyra tope, preparing to make sugar :—11 h. 10 m. *En-bay taung-cong ;*—11 h. 40 m. *En-bay,* rather a large village :—1 h. 20 m. *They-yoin,* small village, some remarkable pagodas :—3 h. 8 m. halt at *He-len,* large village, about 150 houses. The road light sandy, as before, as far as *They-yoin,* from which commences a rich loamy clay, and the crops of grain seem from the stubble to have been heavier. The range of hills, to the westward of which we have been marching, terminated at *Kek-ka,* and exposed to view a second range somewhat higher than the first ; the highest called *Seew-koo-taung,* perhaps 1500 or 2000 feet, bounding the Shan country, running nearly in the same direction

* Burmese, *Pyoung ;* I am told the whole country from this to Mouxobo is under water in July, August, and September.

(N. 20° W.) and distant from the road perhaps 15 or 20 miles. After leaving *En-bay,* up to which place the cultivation of all the common grain of this country was almost uninterrupted, with large and numerous herds of cattle and villages at short distances,—the horizon to the westward was bounded by apparently a thin strip of palmyra trees, running some way north, then coming round to the eastward, increasing in numbers, crossing the road, and running on towards the hills; immediately within these, to the westward, is a grassy, apparently marshy, plain of some miles, and immediately on the borders of this, about quarter of a mile from the road, small clusters of huts called *Tsha-doun,* from the occupation of their inhabitants, who are salt-makers; and between these and the road, the paddy grounds, from which the salt is also obtained, continue to *He-len.*

23rd. Time 8 h. distance 22 miles; direction N. 40° W.; 8 A. M. leave *He-len,* immediately after which, cross for a few minutes some high broken ground, at the foot of which cross some marshy grounds in the salt fields; at 8 h. 30 m. the paddy fields and cattle of the village; —9 h. 30 m. grassy plain with open jungle; 9 h. 45 m. jungle closer: —10 h. pass a small village of 10 or 12 houses, called *Tha-men-khyet-tshain,* or cooked-rice shop, where three people may dine well for ¼ of a tikal; the inhabitants of this place belong to *Mout-tsho-bo,* and come out here, and to some other villages of the same name in this neighbourhood in the fine monsoon, to keep these shops;—10 h. 30 m. a small village or salt station with its paddy ground and cattle; 11 h. 50 m. arrive at *Mout-tsho-bo,* famous as the birth place of ALOMPRA, a walled city of two miles square: the walls principally of bricks, partly of a kind of slate, are still in pretty good repair, though the city was at one time, since ALOMPRA, entirely abandoned, and has only of late years been re-occupied; it is said to contain 1000 houses, which I should think rather under than over the true estimate, though there are extensive paddy fields, (amongst which many of the descendants of ALOMPRA are living by their labor) to the northward and westward, between the inner brick walls and the outer wall, or earthen mound, round which is the ditch. To the southward, there is no earthen wall, and the ditch is close to the brick walls. The inner small fort or rather palace enclosure (for it is without flanking defences of any sort, as indeed, is the large one to any extent), is entirely without inhabitants. The old palace nearly all down, and overgrown with long grass and creepers; it must have always been confined, as the *Lhwot-tau* and platform for the gong for striking the hours are divided from it, within the same enclosure, by a brick wall. The large pagoda called *Shwe-ta-za,* or *Nae wadi see*

*thoo Koung-mhoo-dau,* is of considerable size, but no gilding is now visible on it. 12 h. 20 m. start, and at 1 h. 25 m. pass out of the *Kathee* gate of the outer wall; the ditch, which on the south side is empty, and might be crossed without notice, is here in tolerable repair, and between the gateways to the right, full of water*. 2 h. 35 m. a small village *(Thamen-khyet-tshain)*. 3 h. pass *Ka-daun,* a village of 50 or 60 houses : at four, halt at *Kya-yowa,* a village of about 200 houses. The first part of to-day's march has been less under cultivation than the same distance during any former part of the route from *Mout-tsho-bo ;* hitherto it has been almost continued : cattle and water abundant, the road good throughout : the eastward hills have been visible all day, but extremely distant in the afternoon : no high land visible to the westward, many of the villages surrounded with cocoanut trees, and the palmyra numerous throughout, notwithstanding the extensive production of salt. For the last two days, I have not tasted any water at all brackish. Of the salt, three different kinds are obtained—the red, the bitter (probably containing a portion of sulphate of magnesia), and the white; the two former are entirely used in making *Gna-pee* or *Balachong ;* the latter only is good and fit for culinary purposes.

24th. Time 7 h. 10 m. distance 19 miles,—direction N. 65° W. 8 A. M. leave *Kya-yowa ;* 9 h. 15 m. pass the second *Kya-yowa,* of which there are three established by Bundoola when he was Myo Woon of *Debay-en,* and governor of the northern provinces : to pass a small grassy lake, and the third *Kya-yowa ;*—10 h. 30 m. pass *Men-daun.* In the jungle to the north of this, which is scantily inhabited, there is a herd of 50 or 60 elephants, which are exceedingly destructive to the crops in this neighbourhood. 12 h. 45 m. came on the banks of the *Moo* river now easily fordable on horseback, but of much greater extent and depth in the rains. There are now two streams of nearly equal size, with an extent of perhaps 100 yards of land between; the whole from bank to bank cannot be less than 400 yards. Crossing which river and waiting at *Ye-oo,* a large village on the western bank, for some fresh horses, detained us till 2 h. 5 m. and at 3 h. 15 m. halt at *Pha-lan-goun.* Paid my respects in the evening to the *Debay-en* Myo Woon, (a relation of the Queen's,) who is a *Men-gyee,* and in addition to his Myo Woonship, also governs the northern provinces: he is a man of about 45 years of age, of intelligent and rather prepossessing appearance; he was engaged in the usual important duty of witnessing a *pwè* (or natch) on the occasion of calling *Thadoo*

* I was told that the ditch could at any time be filled from the *Kan-dau-gyee,* or great royal lake, which lies about two or three miles to the N. E.

to a new pagoda, many of which edifices and some magnificently gilded, with *Phoun-gyee* houses and tanks attached, have been constructed by him, and his predecessor, proclaiming the richness of his government.

The hills to the northward were visible till noon, since which I had not seen them: inhabitants, cattle, cultivation, and water, plentiful; and the roads good for any description of carriage at this season.

25th. Halt at *Pha-lan-goun*, which is a large scattered village of probably 150* houses; the governor of the northern provinces has now his residence here. The city of *Debay-en*, from which he takes his title, is situated about six miles to the south-westward; it is nearly depopulated, and the walls entirely out of repair. He (Myo Woon) furnishes from his government (which extends now, since the removal of the Myo Woon of *Mout-tsho-bo* from the *Tsa-gain* territory, to the *Khyendwen)*, 3600 soldiers and six *bós* or officers. 300 of them have been exercising with muskets last evening and to-day, assisted by some natives of British India, six of whom left Ava three months ago, receiving 25 tikals each; they say, they have been drilling recruits to the northward, and are now about to return to Ava.

Grain is here plentiful, and tolerably cheap; paddy sells at from 15 to 20 tikals per 100 baskets; *cholum*, 10 tikals per 100 baskets, and the sesamum oil $\frac{1}{4}$ tikal the *vis*, and palm sugar (a large quantity of which is made here, and sent to the other parts of the country, even exported at Rangoon; the season for entering on the manufactory commences the end of next month), I understand it sells for 15 tikals the 100 *vis*. Though cattle are so plentiful here, I am told that as much as 80 tikals is sometimes given for a good caste bullock, with the proper marks; but cows and the common bullocks sell from 5 to 8, or 10 tikals; and for common draught cattle, from 10 to 15. Got some coolies and horses here.

26th. Time 4 h. distance 12 miles; direction N. 60° W. left *Pha-lan-goun* at 8 h. 55 m. P. M. Pass *Sedi Mee*, a village of 30 houses;—9 h. 25 m. *Way They*, of the same size;—10 h. 10. m. *Yowatheet*, about 100 houses, which is called *Yowama*, or chief village, from which many little nameless villages in this neighbourhood are offsets.—11 h. 25 m. cross a small nala, and 8 h. 12 m. halt at *Myago*. The whole march to-day has been one uninterrupted sheet of cultivation; the soil, rich clayey loam, the crops heavy and close, and the whole country studded with palm trees, round which the paddy is sown with no more loss of room than the size of their trunks. The trees most numerous in the jungle are the *Theet-tse*, which were in full flower on my return on the 19th February.

* I discovered on my return that I had considerably underrated the population of this part of the country.

27th. Time 9 h. 15 m. distance 25 miles,—direction N. 80° W.; 7 h. 35 m. leave *Myagoo;* at 8 h. pass a small village, where sugar is made; 9 h. 30 m. another small village, of 5 or 6 houses,—small stream. 12 h. cross the wide bed of a nameless mountain stream, in which the stream of water at this season is not ankle-deep; from this there is a slight gradual ascent;—at 4 h. pass the village *Yowa-ngay*, 20 houses; 4 h. 50 m. halt at *Benthee* in the jungle. No village, and very little water; the road has been as good as usual, but entirely in the jungle. Since 9 h. 30 m. with the exception of the little village of *Yowa-ngay**, we have seen neither inhabitants, cultivation, nor cattle, and the palmyra has entirely disappeared; the jungle has been open, principally composed of *En*† trees; some teaks of fair size, and a great number of *Theet-tse* trees.

28th. Time 6 h. 30 m. distance 19 miles; direction S. 60° W. 7 h. 30 m. leave *Benthee;* 8 h. 15 m. pass the end of a deep ravine, running N. from the road. Since noon, yesterday, have been ascending;—now (8 h. 45 m.) descend‡ into the broad bed of a river (without a name), along which in deep sand, the road runs all the way to *Thoun-bouk*, when it falls into the *Khyendwen*, and along which a small stream of water finds its way, occasionally on the surface, occasionally lost in the sand; the banks, which are of soft sandstone, vary from 20 to 100 feet, often perpendicular; sometimes on both, sometimes only on one side of the river, the other being low, covered with jungle, as the high banks are to their edges. In width the river varies from 40 to 120 yards, or more; and in the sand are many larger rolled masses of granite and sienite; but I saw no other rock in situ but the argillaceous sandstone, of which the whole of the bank is composed, and which is in a state of decomposition wherever it is exposed to the action of the atmosphere. 11 h. *Kimdogue*, a small village, with 10 or 12 houses, some cattle, baffaloes, and cultivation about it; there is a ravine, running away to the N. W. and a small stream comes down from the westward, running apparently in much the same description of bed as that down which we have come, which joins here; and the ground is more

* This is the only village left of several very large ones, which were situated here, and were destroyed by robbers before Bundoola, who immediately preceded the present governor, was appointed to this province; they came from Lado, about 11 miles S. E. of *Moutshobo*. Their chiefs, wearing gold chattahs, ransacked the country sometimes with 2000 followers. Bundoola however cleared the country, which has remained quiet since, and travelling now is perfectly safe.

† A large forest tree; the timber of which is used in boat-building, and the leaves in the thatching of houses where grass is scarce.

‡ All the streams to the eastward fall into the *Moo*, those to the westward into the *Khyendwen*.

swampy (with long grass) than any part of the country since leaving Ava; the road is however still very passable for any common carriage: 1 P. M. low range of hills, S. 70° W. distant six miles, running S. 20° bed of the river, which is now a continued stream, and march along its banks till two :—halt at *Thoun-bouk*, a village of about 20 or 30 houses on the E.; leave the banks of the *Khyen-dwen*. The road we have come to-day is the only one by which communication is held with the capital, even in the rains, though the torrent is so impetuous during and immediately after heavy rain as not to be fordable, yet it soon runs off and never sends a continued body of water into the *Khyen-dwen* for any length of time.

29th. Time 4 h. 15 m. distance 12 miles, direction about N. 75° W. 8 h. 30 m. send the baggage by the river, by which greater part of the communication to the N. W. is carried on; we leave *Thoun-bouk;* for a few minutes we travel through a thick jungle, then ascend a low but steep hill, down the descent of which we are obliged to dismount and lead the horses. At 9 h. 10 m. in sight of the *Khyen-dwen*, and proceed along the broad bed of a mountain torrent in deep white sand, with high perpendicular banks running off in ridges from the stream :— 9 h. 35 m. enter the jungle, and immediately ascend another hill; pass along a narrow ridge, and descent very steep; continue crossing steep ridges of low sandy hills, covered with jungle, and winding amongst them in the dry beds of torrents, till 12 h. 15 m. when we pass a small village in a cultivated plain :—12 h. 30 m. cross a small stream about knee-deep, in which the horses suddenly sink up to their girths in the sand, and we are obliged to dismount, to allow them to extricate themselves; they crossed with some difficulty. 12 h. 45 m. at *Mouk-ka-dau*, a village of perhaps 80 or 100 houses, close to the banks of the *Khyen-dwen*. About one day to the north of our march to-day, are a considerable number of cassia trees. In the bed of most of the streams and on many of the hills also, saw numerous (calcareous) woody petrifactions, but could hear of no fossil organic remains in this neighbourhood; there are two pretty large boats on the stocks here, and teak timber of good size cut in the neighbourhood, ready for the construction of others.

30th. Time 6 h. 20 m. distance 17 miles; direction N. 30° W.; 7 h. 30 m. leave *Mouk-ka-dau*, and in a few minutes descend slightly into the valley of the stream in which the horses swamped yesterday :—pass along a bad and swampy road through paddy fields, into which the water has been turned for cultivation; cross and recross the stream till 9 h. 45 m. when we proceed up a small branch more to the westward, with high sandstone banks on the west-

ward and jungle on the eastward side, along which we proceed till 11 h. 25 m. when the water is lost in the sand; halt till 12; then to *Pa-doo-yee*, where we halt at 3 h. 15 m. in a small bamboo *Za-yat* in the jungle: the road has much the same character as yesterday, with the addition that some of the ravines close to the road have a considerable appearance of danger; both sides of the first stream, along which we passed till 9 h. 45 m., are well cultivated and inhabited, with many buffaloes and some black cattle. We followed the cart road of the valley till 11 h. 25 m. when we left it to the eastward; the jungle principally composed of *En* trees, with a considerable number of teak and *Theet-tse* trees: we have seen numerous marks of deer, wild hogs, and cows throughout the march; passed some small pieces of petrified wood, but not nearly so abundant as yesterday.

31st. Time 7 h. 45 m. distance 20 miles—direction N. 35° W. at 7 h. 45 m. A. M. leave *Pa-doo-ye*, and proceed along a jungle path in all respects the same as that we have followed for the last two days; till 4 P. M., when we pass some paddy fields with a few buffaloes belonging to the small village of *Balet*, which consists only of 4 or 5 houses, at which we halted at 4 h. 25 m. Some high hills to the westward of the *Khyen-dwen*, within a few miles of which this village is situated. One visible from this, bearing N. 80° W. distant 15 miles—direction of the range is about N. 10 W.

1st February. Time nine hours; distance 25 miles; direction N. 20° W.; were nearly losing some of the horses in the night by a tiger, which has done a good deal of mischief between this and the next stage; 5 h. 50 m. leave *Balet* by a sandy road, on the side of a small stream, with paddy fields along its banks, till 8 h. 30 m. when we halted at *Ma-tsen* to breakfast; had cold dew or fog all the morning, so heavy as to fall from the trees, as after a shower. We have had during the night ever since entering the jungle, and it will continue it is said till the beginning of the rains, which set in here about the middle or end of this month. 10 h. 25 m. leave *Ma-tsen*, by a pretty good buggy road along the edge of the stream we have followed from *Balet*, and which here runs in a valley of about a mile in width. This valley is nearly all under cultivation, with a good many black cattle and buffaloes; it is bounded on the west by a low range of hills, and to the east by high hills running off in ridges to the northward; the little villages in this valley go by the general name of *Ma-tsen*, and are said to amount in all to about 400 houses. 12 h. 30 m. leave the valley, and cross some steep, but low hills, by a rugged path, in rather thick jungle, till 1 h. 20 m.; pass a small village. From this to *Nanthee* the

course of the river is exceedingly circuitous amongst low rugged hills, across which our path has lain : after passing three small villages, each in its little valley by the stream, which is here perhaps two and half feet deep, at 4 h. 45 m. halted at *Nanthee,* a village, 40 or 50 houses, with extensive paddy fields, many black cattle, and a few horses.

2nd. Time 5 h. 40 m.; distance 16 miles; direction N. 20° E. 7 h. 50 m., leave *Nanthee,* and proceed along the banks of the stream in a little valley, two or three miles in width, in which the *Nanthee* villages are scattered in the same way as were those of *Ma-tsen* yesterday; road partly good, till 9 h. 30 m. when we entered the jungle, and the path assumes the same character as the jungle of the last few days, from 1 h. 30 m. till 2 h. 30 m. when we halted at *Kendat:* the road is level, and the country open and cultivated to the N. W. as far as the *Khyen-dwen* river; immediately on the western side of which, distant about six miles, the rugged hills of the *Manipúr* territory rise to some height, and run away in confused and broken ranges to the N. E. close to the edge of the river. *Kendat,* the present residence of the Khambat or Kendat Woon, (for the former title is still given him by the Burmans, though the town from which he takes it, is at present subject to *Manipúr ;)* is a long, narrow jungle-wood stockade close to the east bank of the river, containing perhaps 12 or 1400 inhabitants, situated in a long narrow swampy valley, lying along the river, about 15 or 20 miles in length and averaging one-half or two miles in width, with a strip of swampy ground, which appears at one time to have formed the bed of the river running to the eastward of it. The number of cattle is smaller in proportion to the number of inhabitants than in the villages nearer the capital. Bad as the road is from *Thoun-bouk* to this, I am assured, that ALOMPRA once travelled it in a carriage ! and that it is the best, perhaps the only one by which any number of people ever come in this direction, I have little doubt. It is called by all the poor people in the villages, who cannot be suspected of any motive to deceive, and who could not have been warned to do so, *Lan-ma-dau-gyee,* or great royal road (king's high way), and is I dare say very passable to a Burmese army, who have no commissariat, and whose artillery is not the most extensive, and is often moved by manual labor, assisted by elephants.

10th. Waiting to this date for the arrival of Captain Grant from *Manipúr,* who joined me this evening; have seen a good deal of the Kambat Woon, since my arrival here; he tells me the *Payen-dwen* or amber mine, so called, is in the bed of this river, about 40 days from this place ; but that the amber is found most abundant, about four miles inland, on the eastern side of the river, where it is obtained in pieces sometimes

one and a half foot or more in length, and images of Godama are formed of it; its price increases with its size and transparency, but good amber may be bought on the spot for one tikal and a half a viss, and I am assured that the best would not cost five tikals.

The principal deposit of coal, which is found here in large quantities, in the bed of the river, is about 12 or 14 miles above this, in the small valleys, on both sides of the river. It is of that species denominated lignite, and some of it is so highly bituminized as to be converted into jet. In some specimens, whilst the outside contains this large proportion of bitumen, internally there is very little; the longitudinal fracture is dull, the woody structure perfect, and some of the fibres retain slight elasticity; the transverse fracture has in all instances some degree of lustre in situ; it is formed in sand, and soft sandstone rock, in large pieces, retaining the form of the trees, from which it was originally formed: the Burmans say it is useless as fuel, going out unless used with a large quantity of wood.*

17th. Having been provided by the Khambat Woon with three boats, we started this day at noon, on our return to Ava. The river which runs here to the southward and westward is wide, probably 600 yards; but the water is at this season confined to a narrow channel on the western side. In 1829, the river rose higher than has been remembered here, and the same was the case with the *Me-ping*, and rivers in north *Laos*, where a good deal of damage was done, and the crops, in many places, totally destroyed. Six p. m. halt at *Matsein*, the largest of the villages of that name; the river has been very circuitous throughout the day; the banks generally high sandstone hills, covered with jungle to the water, which is so shallow, where it extends nearly across the bed of the river, that the boat has grounded once or twice; the villages four in number, generally small; no cultivation visible on the immediate banks of the river.

18th. Seven h. 20 m. a. m. leave *Mat-sein*, and at 6 h. 30 m. p. m. halt at *Oo-yowa;* passed eight villages on our route to-day, some of them (as *Kea-dzet*, which we passed at nine o'clock,) larger than any of those we passed yesterday; at 11 h. 40 m. a small river falls into this from the north-eastward, which the people in my boat say is the *Myeet-tha.* The nature of the country has been nearly the same as yesterday, viz. high hills, often nearly perpendicular towards the river; covered with jungle, till 3 p. m.; since which the hills have retired from the river, and the country has been more level, but covered with jungle; we have passed a good many fishing stakes, and several parties of fishermen hutted on the sands.

* Vide Gleanings in Science, III. 125.

19th. Seven h. 15 m. leave *Oo*;—10 h. 30 m. the river gives off a branch nearly as wide as the main stream. 10 h. 45 m. pass the city of *Men-gen,* about 150 houses with gardens, tastefully dispersed along the banks of the river: where also are the boats of the village, (for a village it is now,) amounting to about 100 or upwards, many of them good sized. 12 h. 20 m. the branch mentioned at 10 h. 30 m. here rejoined the main stream. 3 h. 35 m. *Mouk-ka-dau,* and at 5 h. halt at *Thoun-bouk,* where the horses had arrived about a quarter of an hour before us; we passed six villages to-day, including *Men-gen* and *Mouk-ka-dau;* all small, but the two named; the course of the river was very circuitous, and the hills (which are of sandstone, soft and friable at the upper part and more compact near the bottom) again close to it, but to-day frequently only on one side, the other being level.

20th. From this we returned by the same route we travelled in the way up, making longer marches, and reached Ava in six days. We had heavy rain the first three marches, from which the people look on the rains as set in, and are in many places preparing the ground for the paddy. The last three days, however, it cleared up again, and the sun was exceedingly powerful till our arrival at Ava, where we halted on the 25th, at noon.

Should it ever be necessary to move a force across this part of the country, the way in which I have returned is the only practicable one. From *Ken-dat* to *Thoun-bouk,* the road is impassable for all sorts of carriage, but boats may be had on the river: from *Thoun-bouk* to Ava the road is good; water, cattle, grain, every necessary in greatest abundance.

It may be worthy of remark here, as a little clue to the feelings of the people towards us, that I was very well received by the Debayen and Kambat Woons; that after the third day's march, *tès* or little temporary houses were invariably erected for us as had been ordered by the Woon-gyees, and the people voluntarily appeared to pay us more attention in proportion as we receded from the capital. On my return, the lower orders were universally anxious to learn the result of my Mission, with the object of which they all appeared acquainted; and on being told that every thing was quiet and right, I was always greeted by the exclamation of "*thadoo,*" "*thadoo**," (counting beads at the same time)—an expression which entitles the person making it to a portion of the merit arising from a good work, whilst it increases, or at all events does not diminish that accruing to the performer of it.

* A term of approbation in Burmese, "well done—that is right."

*Remarks on the Route Protraction, Pl.* V.

The *Irrawaddy* and *Moo* rivers, in this sketch, have been copied from the Map of Ava in Mr. Crawford's Mission, and the *Khyen-dwen* river from Lieutenant Montmorency's Survey, as given in Lieutenant Wilcox's Map of the countries to the E. and N. E. of Bengal. The position of *Kendat* and *Mouk-ka-dau,* as well as of Ava, being fixed according to the above authorities, an attempt has been made to lay down Mr. Richardson's route, so as to correspond with those points. The following table will show the direction and distance travelled on each day, as computed by Dr. Richardson, and the corrections, on account of the windings of the road, and alterations made in order to reconcile his route with the situation of *Mouk-ka-dau* and *Kendat.*

| | | Dr. Richardson's Computation. | | | Correction and Alteration. |
|---|---|---|---|---|---|
| 1st day, | 20th Jan. | From Ava to Tsa-ye, | N. 40 W. 10 miles, | | N. 40 W. 8 miles |
| 2nd do. | 21st do... | To Kek-ka, ....... | N. 20 W. 9 do.... | | N. 20 W. 7 do. |
| 3rd do. | 22nd do.. | To He-len,........ | N. 20 W. 21 do.... | | N. 20 W. 16 do. |
| 4th do. | 23rd do... | To Kya-yowa,..... | N. 40 W. 22 do.... | | N. 40 W. 17 do. |
| 5th do. | 24th do... | To Pha-lan-goun,.. | N. 70 W. 19 do.... | | N. 70 W. 16 do. |
| 6th do. | 25th do... | To Mya-goo, ...... | N. 60 W. 12 do.... | | N. 60 W. 10½ do. |
| 7th do. | 26th do... | To Ben-thee,...... | S. 80 W. 25 do.... | | S. 80 W. 20 do. |
| 8th do. | 27th do... | To Thoun-bouk,.... | S. 60 W. 19 do.... | | N. 10 W. 17 do. |
| 9th do. | 28th do. . | To Mouk-ka-da, .. | N. 80 W. 12 do. | over hills. | N. 40 W. 9 do. |
| 10th do. | 29th do... | To Padoo-ye, ..... | N. 30 W. 17 do. | over hills. | N. 30 W. 14½ do. |
| 11th do. | 30th do... | To Balet,......... | N. 35 W. 20 do. | over hills. | N. 0 W. 15 do. |
| 12th do. | 31st do... | To Nan-thee,...... | N. 20 E. 25 do. | over hills. | N. 15 E. 17 do. |
| 13th do. | 1st Feb. | To Ken-dat,....... | N. 10 W. 10 do.... | | N. 15 W. 9 do. |
| | | | Total, 221 miles. | | Total, 176 miles. |

The most important deviation from Dr. Richardson's computation was found necessary to be made, in the direction of the route from *Ben-thee* to *Thoun-bouk.* Captain Baker, who visited *Mont-tsho-bo* in 17 hours, 55 minutes, estimates Ava to be 45 miles distant, and states that he stopped and landed at *Khoun-meon, (Kyouk-myoung,)* on the Irrawaddy, and that this place is 12 miles due east from *Mout-tsho-bo.*—(Dalrymple's Oriental Repertory, vol. i. 147, 169, and 176.) *Kioum-young,* in Mr. Crawfurd's Map, is due east from the position given to *Mont-tsho-bo* in Dr. Richardson's route, which makes this city 40 miles from Ava. But it would appear, that the Irrawaddy, in this part of its course, must have a direction 14 miles more to the westward, than what is marked in former maps. *Dibayen,* Dr. R. learnt, is only six miles to the S. W. of *Pha-lan-goun,* and not so near to the Irrawaddy as before supposed. The situation of the great lake, or *Kan-dau-gyee,* also must be different. Dr. R. understood, that water can be let into the ditch of *Mout-tsho-bo* fort from that lake.

Dr. R. on his return from *Kendat,* came down the *Khyen-dwen* in a boat in three days to *Thoun-bouk,* and thence to Ava he travelled by the same route as before.

PROTRACTION
of
Dr. Richardson's route
from
AVA to KENDAT
10 5 0 10 20
Scale of Miles.
Gendu or Kendat
Nat-kywon Oung Mye
Nun-thee
Matsen
Balet
Jungle
Pudooye
Moukhadau
23°
Thounbouk
Kain-dau gwe
Theetsee trees
Mya-goo
Yowangay
Yowa-theet
Benthee
We-the
Sada-mee
Phu-lap-goun
Ye-oo
Kya-yowa
Ky-yowa
Kya-yowa
Kadoung
Mout-tshobo
He-len
En-bay
Oun-ngay-bouk
Kek-kai
Padoo
Tsaye
Tsa-gain
Khyen-dwen River from Lt. Montmorency's Survey
Moo Khyoung or River
22° North
Irawady River from Crawfurd's Map.
AVA
Amarapura
95°
96° East

## III.—*Trisection of an Angle.* *By* Col. Nasmyth Morrieson.

### *Proposition 1st, Theorem.*

If, from the vertical angle of a triangle, having one of the angles at its base double of the other one, and the vertical angle greater than half a right angle, a straight line be drawn to cut the base, making an angle with the greater side of the triangle adjacent to the vertical angle, equal to the lesser angle at the base; and if from the vertical angle as a centre, at the distance of the lesser side of the triangle adjacent to the vertical angle, a circle be described; the circle, and the line drawn from the vertical angle to cut the base, and the base of the triangle, have one common intersection.

Let ABC (fig. 1) be a triangle, having the angle BAC, one of the angles at its base double of the angle BCA, the other angle at its base, and its vertical angle ABC greater than half a right angle; and let the straight line BD be drawn from the vertical angle ABC, to cut the base AC in D, making with CB, the greater side of the triangle adjacent to the vertical angle, the angle CBD equal to BCA, the lesser angle at the base (23.1); also from B as a centre at the distance BA, the lesser side of the triangle adjacent to the vertical angle, let the circle ADE be described; the circle ADE, the line BD, and the base AC intersect one another in one common point D.

Because, by construction, the angle DBC is equal to the angle DCB, the side BD is equal to the side CD (5.1), and D is the point of intersection of BD and AC. Again, because BDA, the exterior angle of the triangle BDC, is equal to the two interior and opposite (32.1) and also equal angles DBC, DCB, therefore, BDA is double of DCB, that is ACB; but, by construction, the angle BAC is double of ACB, therefore BAC is equal to BDA (6 ax); and because the angle BAC is equal to the angle BDA, the side BD is equal to the side BA (5.1); wherefore the circle ADE described from the centre B, at the distance BA passes through D, the extremity of BD, or D is the point of intersection of the circle ADE and the line BD; but it bas been already shewn that D is the point of intersection of BD and AC, consequently the circle ADE intersects, in the point D, the line AC; therefore the circle ADE, and the straight lines AC and BD intersect in one common point D. Q. E. D.

### *Proposition 2nd, Problem.*

To draw the base of a triangle, so that, of the interior angles at the base, one shall be double of the other, the vertical angle of the triangle being a given rectilineal angle greater than half a right angle.

Let ABC (fig. 2) be any given rectilineal angle greater than half a right angle. Having placed it for the vertical angle of the triangle ABG, it is required to draw the base AG, so that of the interior angles it shall make with BA and BC, at the base of the triangle ABG, the one shall be double of the other.

From the centre B at any distance BA describe the circle ADE; again, from the centre B at twice the distance BA describe the arch of a circle FH, cutting BC, in F; also from the centre A at three times the distance BA, mark the point C in the line BC; divide the segment FC into three equal parts (9.6); make FG equal to one-third part of FC (3.1); through G draw GH at right angles to BC (11.1), meeting the arch FH in the point H; join BH and GA; the line GA is so drawn that BAG, one of the angles at the base of the triangle ABG, is double of BGA, the other angle at the base.

Because the two straight lines BH and AG and the circle ADE intersect in D, the two sides BD, BA of the triangle ABD, being radii of the circle ADE, are equal to one another (11.def.); also BH, which is equal to BF (11.def.) and double of BA or BD, is bisected in D; again, because BGH is a right angle subtended by BH, it is an angle in half the circle, having BH for its diameter and DB for its radius (31.3); and because GD joins the vertex of the right angle BGH and D, the point of bisection of the diameter, it is equal to DB (11.def.). Now because DG is equal to DB, the angle DBG is equal to the angle DGB (5.1); and they are the two interior and opposite angles to BDA, the exterior angle of the triangle BDG, therefore BDA is equal to them both (32.1), and double of either of them, that is, it is double of DGB; but the angle BAD is equal to the angle BDA, because BD is equal to BA (5.1), therefore BAD, that is BAG, is double of DGB, that is, AGB. Wherefore the base AG is drawn so that the angle BAG, one of the angles at the base of the triangle ABG, is double of BGA, the other angle at the base. Which was required to be done.

*Note.*—The truth of the above demonstration rests upon the straight lines BH and AG and the circle ADE having one common intersection; but as the circle and any two right lines have not of necessity one common intersection, it may *perhaps* be objected to, on the ground, that though it states the fact, it does not prove the intersection of the circle ADE and the right lines BH and AG in the common point D. To remove that objection, the following demonstration is given.

The construction being the same as above, instead of joining GA, proceed thus:—join BH, and let BH cut the circle ADE in the point D; join GD and DA; AD, DG are in the same straight line, and AG, the

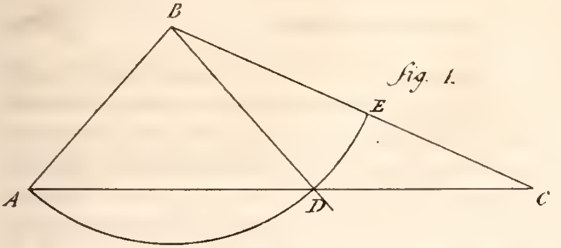


fig. 1.

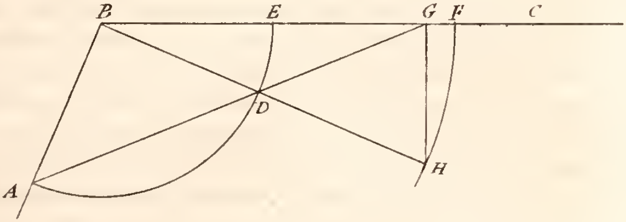


fig. 2

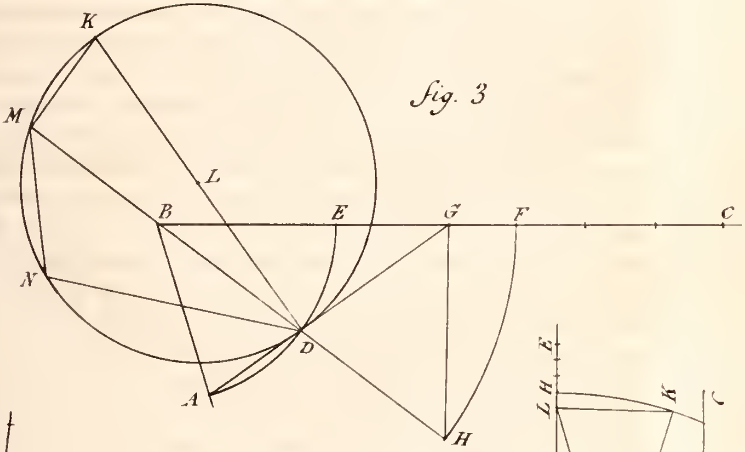


fig. 3

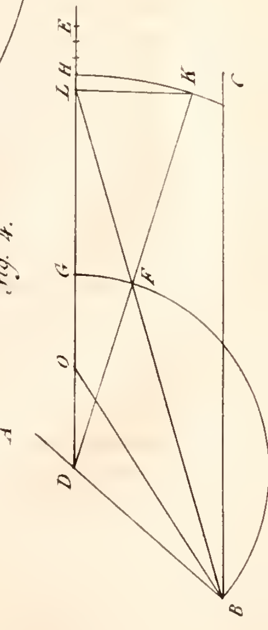


fig. 4.

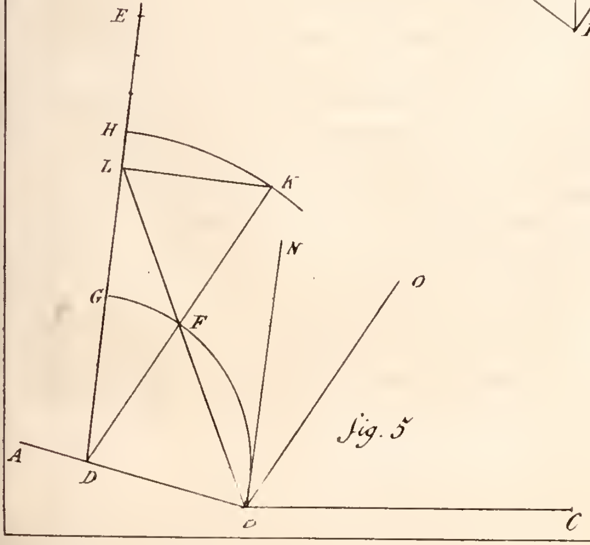


fig. 5

[illegible]

base of the triangle ABG, is so drawn that BAG one of the angles at the base is double of BGA the other angle at the base.

AD and DG are in the same straight line; for through D draw DK, making the angles KDA, KDG equal to one another (9.1); take any point L in the line KD, and from the centre L at the distance LD describe the circle DNMK; if necessary, produce DB to meet the circle DNMK in M; join MK; and make the angle MND in the segment DNM of the circle DNMK. Now the angles KDG, KDA are either together, equal to, or greater, or less than two right angles; if greater, then KDG is greater than a right angle, and GD being produced in the direction of D, will fall within the circle DNMK on the opposite side of KD from DG (Cor. 16.3), which it does not, therefore KDG is not greater than a right angle: neither is it less than a right angle, for then DG would fall within the circle DNMK (16.3), which it does not; therefore KDG must be a right angle: and because at the point D the extremity of the diameter DK, DG makes a right angle with DK, therefore GD touches the circle DNMK (Cor. 16.3), and because DM, drawn from the point of contact D, cuts the circle DNMK, the angle MDG is equal to the angle DNM in the alternate segment MND (32.3). Again, because the angle KDA is equal to the angle KDG, it is a right angle, and also touches the circle KMND (Cor. 16.3); and because DM, drawn from the point of contact D, cuts the circle DNMK, the angle MDA is equal to the angle MKD (32.3); and because KDNM is a quadrilateral figure, described in a circle, the opposite angles MKD, DNM are equal to two right angles (22.3), therefore the angles MDG, MDA, being equal to the angles DNM, MKD are also equal to two right angles; and since at the point D, in the straight line MD or BD, the two straight lines DA, DG, upon the opposite sides of MD, make the adjacent angles MDA, MDG, equal to two right angles, AD is in the same straight line with DG (14.1): and the figure AGB being contained by three straight lines, is therefore a rectilineal triangle (16 def.) Now BD is equal to BA, being radii of the same circle ADE (11 def.), and because BH is a radius of the circle of which FH is an arch, it is equal to BF and double of BA or BD, and bisected in D by the circle ADE; also because BGH is a right angle, subtended by BH, it is an angle in half the circle, having BH for its diameter and DB for its radius (31.3); and because GD joins the vertex of the right angle BGH and D, the point of bisection of the diameter, it is equal to DB (11 def.) Now, because DG is equal to DB, the angle DBG is equal to the angle DGB (5.1), and they are the two interior and opposite angles to BDA, the exterior angle of the triangle BDG, therefore BDA is equal to them both (32.1), and double of either of

them, that is, is double of DGB; but the angle BAD is equal to the angle BDA, because BD is equal to BA (5.1), therefore BAD, that is BAG, is double of DGB, that is, AGB. Wherefore the base AG is drawn so that the angle BAG, one of the angles at the base of the triangle ABG, is double of BGA, the other angle at the base. Which was required to be done.

*Proposition 3rd, Problem.*

To divide any given rectilineal angle into three equal angles.

Let ABC be any given rectilineal angle, it is required to divide it into three equal angles.

Consider whether the given angle is greater or less than three half right angles. First, let the angle ABC be less than three half right angles. Take any point D in AB, and through D draw DE, parallel to BC (31.1); then the angle BDE is the angle to be placed as the vertical angle of the triangle BDL; which having obtained, draw the line BL in the same manner as was done in the diagram for the foregoing proposition No. 2; and bisect the angle ABL by the straight line BO (9.1). The straight lines BL and BO divide the angle ABC into three equal angles.

Because DE is parallel to BC, and LB falls upon them, the angle DLB is equal to the angle LBC (29.1); and because the angle DBL is double of the angle DLB, as demonstrated in the 2nd proposition above written; therefore the angle DBL is double of the angle LBC; also because the angle DBL is bisected by the straight line BO, the three angles DBO, OBL, LBC are equal to one another.

Secondly. But if the given angle ABC be greater than three half right angles, bisect it by the straight line BN (9.1); and take any point D in AB, and through D draw DE, parallel to BN (31.1). Having thus got the vertical angle for the triangle BDL, viz. BDE, draw the line BL, as was done in the diagram for the foregoing proposition No. 2; and bisect the angle LBC by the straight line BO (9.1); the straight lines BL and BO divide the given angle ABC into three equal angles.

As before, because the angle DBL is double of the angle LBN, it is two thirds of the angle DBN; but because the angle DBN is one-half of the angle ABC, and that two-thirds of the half is one-third of any given whole, therefore DBL is one-third, and the remaining angle LBC is two-thirds of the whole angle ABC; and because the angle LBC is bisected by the straight line BO, the three angles ABL, LBO, OBC are equal to one another. Wherefore the given angle ABC is divided into three equal angles by the straight lines BL and BO. Which was required to be done.

## IV.—*Short Description of the Mines of Precious Stones, in the District of Kyat-pyen, in the Kingdom of Ava.*

[Translated from the original of PE'RE GIUSEPPE D'AMATO.]

The territory of *Kyat-pyen** (written *Chia-ppièn* by d'Amato) is situated to the east, and a little to the south of the town of *Mon-lhá,* (which latter place is by observation in latitude 22° 16′ North,) distant 30 or 40 Burman leagues, each league being 1000 *taa,* of seven cubits the *taa*†; say 70 miles. It is surrounded by nine mountains. The soil is uneven and full of marshes, which form seventeen small lakes, each having a particular name. It is this soil which is so rich in mineral treasures. It should be noticed, however, that the ground which remains dry is that alone which is mined, or perforated with the wells whence the precious stones are extracted. The mineral district is divided into 50 or 60 parts, which, beside the general name of "mine," have each a distinct appellation.

The miners, who work at the spot, dig square wells, to the depth of 15 or 20 cubits, and to prevent the wells from falling in, they prop them with perpendicular piles, four or three on each side of the square, according to the dimensions of the shaft, supported by cross pieces between the opposite piles.

When the whole is secure, the miner descends, and with his hands extracts the loose soil, digging in a horizontal direction. The gravelly ore is brought to the surface in a ratan basket raised by a cord, as water from a well. From this mass all the precious stones and any other minerals possessing value are picked out, and washed in the brooks descending from the neighbouring hills.

Besides the regular duty which the miners pay to the Prince, in kind, they are obliged to give up to him gratuitously all jewels of more than a certain size or of extraordinary value. Of this sort was the *tornallina* (tourmaline ?) presented by the Burman monarch to Colonel Symes. It was originally purchased clandestinely by the Chinese on the spot; the Burmese court, being apprized of the circumstance, instituted a strict search for the jewel, and the sellers, to hush up the affair, were obliged to buy it back at double price, and present it to the king.

* The *Kyat-pyen* mountains are doubtless the *Capelan* mountains mentioned as the locality of the ruby, in Phillip's Mineralogy—"60 miles from *Pegue, a city in Ceylon.*" Though it might well have puzzled a geographer to identify them without the clue of their mineral riches.

† Estimating the cubit at $1\frac{1}{2}$ feet, the league will be 10,500 feet, or nearly two miles;—about an Indian *kos.*

You* may ask me, to what distance the miners carry their excavations? I reply, that ordinarily they continue perforating laterally, until the workmen from different mines meet one another. I asked the man who gave me this information, whether this did not endanger the falling in of the vaults, and consequent destruction of the workmen? but he replied, that there were very few instances of such accidents. Sometimes the miners are forced to abandon a level before working to day-light, by the oozing in of water, which floods the lower parts of the works.

The precious stones found in the mines of *Kyat-pyen*, generally speaking, are rubies, sapphires, topazes, and other crystals of the same family, (the *precious corundum.)* Emeralds are very rare, and of an inferior sort and value. They sometimes find, I am told, a species of diamond, but of bad quality†.

The Chinese and Tartar merchants come yearly to *Kyat-pyen*, to purchase precious stones and other minerals. They generally barter for them carpets, coloured cloths, cloves, nutmegs and other drugs. The natives of the country also pay yearly visits to the royal city of Ava, to sell the rough stones. I have avoided repeating any of the fabulous stories told by the Bnrmans of the origin of the jewels at *Kyat-pyen*.

There is another locality, a little to the north of this place, called *Mookop*, in which also abundant mines of the same precious gems occur.

*Note.*—While I am writing this brief notice, an anecdote is related to me by a person of the highest credit, regarding the discovery of two stones, or, to express myself better, of two masses (*amas*) of rubies of an extraordinary size, at *Kyat-pyen*. One weighed 80 *biches*‡, Burmese weight, equivalent to more than 80 lbs.! the second was of the same size as that given to Colonel Symes. When the people were about to convey them to the capital to present them to the king, a party of bandits attacked *Kyat-pycn* for the second time, and set the whole town on fire. Of the two jewels, the brigands only succeeded in carrying off the smaller one; but the larger one was injured by the flames: the centre of the stone, still in good order, was brought to the king. I learned this from a Christian soldier of my village of *Mon-lhá*, who was on guard at the palace when the bearer of the gem arrived there.

* The letter seems to have been intended for some scientific friend in Italy.

† Probably the *turmali* or transparent zircon, which is sold as an inferior diamond in Ceylon. [Vide vol. i. page 357.]

‡ The Père d'Amato's *biche* is the *bisse* of Mendez Pinto, and the old travellers, and the *biswa* or *vis* of Natives of India. The Burmese word is *Peik-tha*, which is equivalent to 3½ lbs., and to a weight on the Coast of Coromandel called *vis*. B.

## V.—*Note on Saline Deposits in Hydrabad. By Assistant Surgeon* J. Malcolmson, *Madras European Regiment.*

From the interest which these possess, and the discussions they have excited, without any precise information as to their geological position, I believe the following notice will be interesting.

The summits of most of the detached hills and minor ranges north of *Cuddapah* are composed of a sand-stone, stratified in a perfectly horizontal manner. It is often white, and the grains are large; but towards *Tripetty*, where it meets the granite, it is very compact and white, and it is a good deal inclined to the east. The red soil of the district is loaded with salt, which is manufactured by the natives, principally for their cattle; but as it is prohibited by the Government on account of the revenue from the salt monopoly, it is seldom extensively worked in the districts I visited. The range of hills through which the *Benar* river passes at the ancient fortress of *Gundicottah* is formed of this sandstone; but inclined towards the east at a slight angle, and by no means regularly. This is separated by a narrow valley from hills exhibiting the horizontal strata on their caps, and the remains of these could be clearly traced on insulated conical hillocks, and had all belonged to one vast sheet. Below the sandstone caps, a clay slate, easily broken down, is found, and the lower strata over the country is a stratified blue limestone. In the slope of the hill of *Gundicottah* are springs of very pure water, very profuse, and forming small rivulets, tumbling over the rocks in fine cascades, but evidently deriving their source from no great distance, as in a day or two after the rain we had, the streams were much diminished where they emerged from between the strata. The *Benar* and these streams have formed cliffs round the fortress of 200 or 300 feet, all of sandstone, but at the very bottom, a deep ravine. I found one or two clay slate strata of about an inch thick interposed; and a few miles below, the blue limestone appeared in the bed of the river. At a place eight or ten miles lower, the same rock abounds over the plains, and in the town is a salt well celebrated from its use in washing cloths of fine colors manufactured there, and to the fixing of which it is essential. I descended the well, and with some difficulty broke off specimens of the rock, which was deep blue slate-like stone, as if the clay were passing into the limestone, and between the thin slabs were layers of salt. The specimens were lost, but I hope to procure others. The salt was in great part composed of muriates of soda and carbonate of soda, but they were not examined. Carbonate of soda effloresces on the surface not far off, and this on being melted with

powdered quartz in the manufacture of bangles affords, attached to the glass, a hard solid *pure* white coat of muriate of soda, $\frac{3}{4}$ of an inch thick. Copious springs abound in the blue limestone, and those I saw were sweet, and probably flowed from the neighbouring sandstone. In a cavern in the lime opening above by a great longitudinal fissure, like that of Duncombe park, after a rapid descent of perhaps 30 or 40 yards, I found further progress stopt by a stream of water running over a quartz sand. When the water was low, the natives told me they could go further, but at that time it reached within half a foot of the roof of the contracted extremity. The sand was probably derived from the cap of the adjoining hill. The sides were rough, with stalagnite exceedingly like the *kankar* found in great beds lying on the limestone. It is probable that the stream is not long subterraneous, as numbers of small fish approached the torches. The natives gave them a name, but I regretted I could not catch one for examination. Superstitious stories led me to examine this, and other likely places for organic remains, and I think it probable, such may yet be found. In the sandstone are the celebrated diamond mines of *Banganopilly*. Shafts being sunk through the rock, till they reach the conglomerate containing the numerous species of minerals which experience has shewn to be associated with the gem, this is excavated and sent out of the mine to be broken up in search of the diamond. This conglomerate does not occupy a complete stratum, but generally varies in thickness. The sandstone in many places has been subjected to violent forces injecting, between its layers, a reddish iron-looking sandy rock, which has bent the thin strata above and below out of its place, and at others forced a way through the numerous vertical divisions of the stone, and appears to have flowed in a semifluid state over the surface, and to have carried along with it angular fragments of the rock, which are fixed in it like plums in a cake. In one or two instances, the fragments seemed to have been broken, but not removed from their original situation; the lines of separation being filled with the same matter that flowed out. The end of a neighbouring hill is covered with round stones, several feet in diameter, hard, black, and apparently composed of trap, and called in the language of the country "black balls." The trap rocks are not known to exist within 50 miles. Amongst the "diamond stones," as they are called, there is one of a jet black, and very hard, suggesting that it might be of a carbonaceous nature; and the appearances of the action of fire would favour an hypothesis of the carbon of this mineral being changed by that action into the diamond. This is a mere fancy, but it seems sufficient to direct

inquiry. The *Chinúr* mines are in general formed by the destruction, by water, of hills, such as *Banganopilly*. The blue limestone has also experienced violent changes, forcing the strata into vertical and curiously contorted shapes, but in general it is little disturbed. I did not find nor hear of the remains of shells, although I looked anxiously for them; but there were, in many situations, numerous tubular perforations usually full of a *kankar* like matter mixed with iron, and very subject to decay. They were often arranged in rows, and sometimes lost in the stone gradually. If these are justly regarded as peculiar to lacustrine deposits, the absence of shells is singular; but at Ellore, I have seen the trap perforated by similar shaped calcedonies, most properly compared to tobacco-pipe stalks. These rocks abound with curious minerals and phenomena, but these are the principal facts I observed connected with the question of the relations of the sandstone. I met with a blue limestone perforated as above, in the *Guntoor Circar*, running into the white lithographic marble of *Manopilly*, on the *Kistnah*, and probably in some way connected with the diamond deposits of the district. The identity with the Hindústan sandstone appears from the number of variegated marks and of grits in the beds; from its use for architectural purposes, in being horizontally stratified; in the strata being sometimes unconformable;—in its being in the neighbourhood of saline deposits of the same kind, and in both containing diamond mines and various iron ores;—in its passing into quartz rock, and being interstratified with clay slate, though rarely. If there is no misprint, it differs in lying *on* instead of being *covered by* a blue limestone, without fossils: vide Gleanings, vol. iii. p. 213.

P. S. The clay slate is sometimes wanting, and the sandstone then lies on the blue limestone as at *Pushpagarry*, immediately above the *Chinúr* diamond mines; and here there are larger grits than in most other places, and small veins of quartz. Below the mines, the limestone is much contorted and dislocated. The limestone is not one of the diamond stones of the miners, although it abounds with the gem in the beds of Chinúr. Nor is there any trap rock amongst them, although Werner asserts they are found in Orissa at the foot of trap mountains. The subject of the origin of the "*terreins de transport*," in which they are found, is demonstrated by the associated stones in my possession; but it appears very doubtful, whether they are of diluvial origin, as asserted by Buckland, using the word as opposed to alluvial. See *Reliquiæ*, page 220, and *Brongniart's Traité*.

## VI.—*An Experimental Inquiry into the Means employed by the Natives of Bengal for making Ice.* *By* T. A. Wise, *Esq. M. D.*

(Read 3rd October, 1832.)

A large quantity of ice is used during the cold season in Bengal, for purposes of luxury, which is supplied by natives at a comparatively cheap rate, from their employing a process by which they can make a large supply at a moderate expence. As very imperfect accounts have hitherto been given of the means they employ, and as most erroneous opinions are generally received regarding the causes by which the required degree of cold is produced, I hope a short account of the principal ice-manufactory in Bengal will not be considered unworthy the notice of the Society.

A particular field in the neighbourhood of the town of Hooghly has been many years in requisition as the place for making ice, and is said by the natives to be the only one in this part of the country in which it can be produced in any considerable quantity: this seems the more reasonable, as the trials to make ice at Serampore, Calcutta, &c. may be considered to have failed when the quantity is compared with that obtained at Hooghly. This peculiarity may be owing to the elevation, exposure, and distance of the latter from the sea. The soil of the field in which the ice is made is a black loam upon a substratum of sand; it is more elevated than the surrounding country, is liable to partial inundations in heavy rains, and is skirted on the south, east, and north by trees, and on the western and northern directions has an open plain for some extent.

The manufacturing commences towards the end of November, and generally continues until some time in February. These periods vary in different years, owing to such circumstances as the quantity of water upon the ground at the close of the rains, the early or late cold season, its length, &c.

The best months for making ice are the latter part of December and the whole of January; and during November and February, there are generally only a few nights in which ice is made in any quantity.

The natives commence their preparations for making ice by marking out a rectangular piece of ground, about 120 feet long, by 20 broad, in an easterly and westerly direction, from which the soil is removed to the depth of two feet. This hollow is smoothed and allowed to remain exposed to the sun for some time to dry, when rice-straw in small sheaves is laid in an oblique direction in the excavation, with loose straw upon the top, to the depth of a foot and a half, leaving its surface half a foot

under the level of the ground. Numerous beds of this kind are formed, with a narrow path between them, in which large earthen water-jars are sunk into the ground for the purpose of having water near, to fill the shallow unglazed earthen vessels in which it is to be frozen. These dishes are nine inches in diameter at the top, diminishing to $4\frac{3}{10}$ inches at the bottom, $1\frac{3}{10}$ deep, and $\frac{3}{10}$ of an inch in thickness; and are so porous as to become moist throughout when water is put into them.

During the day, the loose straw in the beds above the sheaves is occasionally turned up, so that the whole may be kept dry, and the water-jars between the beds are filled with soft pure water from the neighbouring pools. Towards evening, the shallow earthen dishes are arranged in rows upon the straw, and, by means of small earthen pots tied to the extremities of long rods of bamboo, each is filled about a third with water. The quantity, however, varies according to the ice expected; which is known by the clearness of the sky and steadiness with which the wind blows from the N. N. W. When favourable, about eight ounces of water is put into each dish, and when less is expected, from two to four ounces is the usual quantity; but, in all cases, more water is put into the dishes nearest the western end of the beds, as the sun first falls on that part, and the ice is easier removed from its solution being quicker. There are about 4590 plates in each of the beds lately made, and if we allow five ounces for each dish, which presents a surface of about four inches square, there will be an aggregate of 239 gallons, and a surface of 1530 square feet of water in each bed.

In the cold season, when the temperature of the air at the ice-fields is under 50°*, and there are gentle airs from the northern and western direction, ice forms in the course of the night in each of the shallow dishes. Persons are stationed to observe when a small film appears upon the water in the dishes, when the contents of several are mixed together and thrown over the other dishes. This operation increases the congealing process. A state of calmness has been discovered by the natives to diminish the quantity of ice produced; and this is confirmed by the fact well known in our laboratories, that water may be gradually cooled down many degrees below the freezing point without congealing, provided it be kept perfectly still. When the sky is quite clear, with gentle steady airs from the N. N. W. the freezing commences before or about midnight, and continues to advance until morning, when the thickest ice is formed. I have seen it $\frac{7}{10}$th of an inch in thickness, and in a few very favourable nights, the whole of the water is sometimes frozen;

* Fahrenheit's thermometer is used in the following essay: a minute having been allowed for each experiment.

when it is called by the natives solid ice *(pakka baraf)*; when it commences to congeal between two or three o'clock in the morning, thinner ice is expected, called *paperí*; and when about four or five o'clock in the morning, the thinnest is obtained, called *phúl baraf*. The freezing is frequently retarded in its formation during the night by the wind rising to a breeze about 11 or 12 P. M.,—by clouds, &c. and the ice in consequence does not begin to form until towards morning.

In the most favourable nights, the dishes are generally found encrusted with ice, both on their inner and outer sides, which adheres to the rough surface of the plate with such a degree of firmness as to require it to be partially dissolved before it can be separated from the dish. I have often seen the natives wait until the sun was two hours and a half above the horizon, before they could remove it.

Seven or eight persons, generally women, are allowed for each bed, who with semicircular blunt knives remove the ice and water into earthen vessels placed near them, which are moved along as they proceed in their work. When these vessels are full, they are emptied by men employed for that purpose, into conical-shaped baskets placed upon the jars between the ice-beds which retain the ice, and allow the water to flow into the water-jars. When the baskets are filled, their contents are conveyed to temporary ice pits, which are about six feet deep, by four in diameter, and are lined with mats. The ice is covered with straw, and allowed to remain until evening, when it is again taken out and placed in large pits. These consist of circular holes in dry situations from 10 to 12 feet deep, by 8 or 10 feet in diameter. These pits are well lined with mats, and when nearly filled, some more straw and a shed of the same material is placed over the ice. These non-conductors of caloric are not sufficient to prevent the influence of the neighbouring media, and a slow solution of the ice is the consequence, the water of which is conveyed by a small hole, below the level of the pits, to a well near it, from thence it is occasionally removed.

During the colder months, the ice is conveyed in the evening, in bags of coarse country cloth, to boats in which it is put in bulk, and defended from damp and heat, and is sent to Calcutta during the night, the distance being about 40 miles; but, as the wastage is very considerable at the beginning and towards the end of the season, when it is most required and bears the highest price, it is then conveyed thither in baskets lined with straw and mats, and arrives before sun-rise.

The ice which is not immediately required remains in the pits while the ground is dry, where it slowly dissolves, especially along its sides; but as soon as rain falls in any considerable quantit its high temperature quickly dissolves what remains.

Repeated trials have been made at different times to accomplish the desirable object of keeping the ice during the hot season; but so great is the first expense, and so small a quantity of that produced yields any return, that hitherto every trial has proved unsuccessful, and has entailed a heavy loss on the speculator. For the two last seasons, another attempt has been made to keep ice, but although every precaution was employed to guard against the influence of the surrounding media, so powerful was it found during the last season, when the trial was for the first time properly made, that the experiment proved unfavourable, or only partially succeeded. The ultimate succcss of the measure must now however depend in a great measure on the encouragement it receives in Calcutta, through which the best hopes may be held out of introducing one of the greatest luxuries in a tropical climate during the hot-season.

When the ice bed is examined after a favourable night, the straw exposed between the plates and their sides is found covered with hoar-frost, and near the water on the inner side small irregular nodules of ice appear.

When the night has been very favourable, so as to freeze a considerable portion of the water, numerous small globules of air, naturally combined with water, are disengaged during the freezing process, and are found swimming upon the surface of the water, while others remain attached to the bottom of the plate.

The separation of air from the water increases as the congelation advances, and retards its progress more and more, as the proportion of ice is greater, until nearly all the water is congealed, when a large globule of air is left at the lower and central part of the ice.

By expelling the air naturally contained in the water, by boiling, an increased quantity of ice is produced, but the expence of doing so is too great to admit of its being generally employed. On an evening in the cold season, I boiled some water for a short time, and found next morning more ice, but apparently as much air as in the neighbouring dishes.

When the wind attains a southerly or easterly direction, no ice is formed, from its not being sufficiently dry, not even, though the temperature of the air be lower than when it is made with the wind from a northern or western point. The most favourable direction of wind for making ice is the N. N. W. diminishing in power as it approaches the north and west: in the latter case, more latitude is allowed than from the N. N. W. to the north. So great is the influence of the direction of the wind on the ice, that when it sometimes changes in the course of a night from the N. N. W. to a less favourable direction, the change not

only prevents the formation of more ice, but dissolves what may have been formed. On such occasions a mist is seen hovering over the ice-beds, from the moisture upon them, and the quantity of humidity contained in the wind. A mist in like manner forms over deep tanks during favourable nights for making ice.

Another important circumstance in the production of ice is the degree of wind. When it approaches a breeze, no ice is formed. This is explained by such rapid currents of air indicating a considerable difference of temperature between the situation from whence it passes, thus removing the cold air before any accumulation has taken place in the ice-beds. It is for these reasons that the thickest ice is expected when during the day a breeze has blown from the N. N. W. which thoroughly dries the ground, and towards evening and during the night diminishes to gentle airs, which steadily proceed from the same quarter, so as to allow the full influence of radiation and the impressions from the clear sky.

The ice dishes present a large moist external surface to the dry northerly evening air, which cools the water on them, so that, when at 61°, it will in a few minutes fall to 56°, or even lower. But the moisture which exudes through the dish is quickly frozen, when the evaporation from the external surface no longer continues to produce much effect.

To detect the influence of evaporation in producing ice, one of the dishes was placed in the evening upon a patch of grass, five feet above the level of the ice-beds, so as to be exposed to the full influence of the sky and the cold northerly wind. This was the most favourable situation for promoting evaporation. The night proved a favourable one for the formation of ice, and in the morning the dishes in the beds were covered with it, but the dish upon the elevation had lost weight during the night, and had no ice upon its surface; the water soon after sun-rise was at 46°, on another morning the water stood at 50°. This experiment was varied by placing a brass vessel of the same size and form as the common plates upon a sprinkling of straw on an elevated piece of ground near the ice-beds. In the morning it was found about the same weight, without any ice, although the plates on the beds were covered with thick ice. On the same morning one of the porous earthen vessels similarly situated, and covered on its under side with tinfoil, presented the same result.

As a further proof of the cold not being produced by evaporation, I next carefully weighed a number of the unglazed dishes in the evening and again in the morning, when I found that they had gained con-

siderable weight, which was owing to the absorption of moisture on the surface of the water exceeding the loss by evaporation from the external surface. The quantity of cold water which is sprinkled over the dishes is not sufficiently large to explain the great increase in the weight of the dishes, which I found was about the same when no water had been thrown over the bed. Glazed vessels of different colours were placed amongst the unglazed, which in the morning were found to have thicker ice, and to have gained more weight than the common dishes.

In eight experiments with the common unglazed ice-dishes, the average gain in weight, was 68.5 grains; and of five experiments with smaller black-glazed slightly porous dishes, this average was 110 grains. As the surrounding media must have a great influence on the formation of ice, I noted their different temperatures. The air at the ice-fields was always found warmer in the evening, and much colder in the morning, than at the neighbouring village of Bandel, where the ground is more sheltered by trees, from the direct influence of the sun's rays. The average of a number of experiments in favourable weather for making ice, gives, at Bandel, 70 degrees in the evening, and 56 in the morning; and at the ice-fields 72° in the evening, and 46° in the morning.

The temperature of the different substances in the neighbourhood, or forming part of the ice-beds, was examined a little before sun-set and soon after sun-rise: on a clear evening and favourable morning, they were found to be as follows:—

| | *Morning.* | *Evening.* |
|---|---|---|
| The air 5 feet above the ice-beds, .... ........ | 42° to 46° | 72° |
| Water in the large jars between the ice-beds,...... | 44 to 60 | 68 |
| Water in a deep tank in ice-fields,................ | 57 | 77 |
| Ground in the neighbourhood, immediately under the surface,.................................. | 54 | 57 |
| Straw in the ice-beds, 3 or 4 inches under the surface, | 42 to 46 | 48 |
| Ditto, of a thatched hut in the ice-fields, obliquely exposed to the sky,.......................... | 44 | 61 |

The temperature that generally prevails on nights fitted for the manufacture may be learned from the following table, for which I am chiefly indebted to Mr. Herklots, Fiscal of Chinsurah.

*Abstract of a Table of* 11 *years' Observations on the Temperature of the Air at Chinsurah between the dawn of day and sun-rise, during the season of Ice manufacture, by Mr. Herklots, Fiscal of Chinsurah. The thermometer at the Ice-fields generally stood* 6 *or* 7 *degrees lower; but this is not shewn, except in the last year from Dr. Wise's Observations.*

| Mean temperature of the air at Chinsurah. | | ° |
|---|---|---|
| 1819-20. | Dec. ...... | 54.6 |
| | Jan........ | 49.9 |
| | Feb. ..... | 55.0 |
| 1820-21. | Dec ....... | 52.5 |
| | Jan........ | 51.4 |
| | To Feb. 7. .... | 53.1 |
| 1822-23. | Nov. 25 to 29, | 57.0 |
| | Dec. ...... | 55.4 |
| | Jan. 1 to 21, | 55.0 |
| 1824-25. | Dec. 7 to 28, | 54.6 |
| | Jan. 2 to 19, | 54.0 |
| 1825-26. | Dec. 16 to 28, | 54.2 |
| | Jan........ | 53.0 |
| | Feb. 1 to 10, | 55.0 |
| 1826-27. | Dec. ...... | 54.5 |
| | Jan........ | 52.3 |
| 1827-28. | Dec. ...... | 55.4 |
| | Jan........ | 52.2 |
| | Feb. 1 to 19, | 55.0 |
| 1828-29. | Dec. 18 to 31, | 56.1 |
| | Jan........ | 54.4 |
| | Feb. 1 to 17, | 54.8 |
| 1829-30. | Dec. 5 to 31, | 54.8 |
| | Jan........ | 52.5 |
| | Feb. no ice. | |
| 1830-31. | Jan. 1, ..... | 30.0 |
| | 2 to 30, .... | 53.2 |
| | Feb. ...... | 55.2 |
| | Mar. to 6th, . | 54.4 |

| 1831-32. | Chinsurah. ° | Ice-fields. ° | Quantity. | Wind. |
|---|---|---|---|---|
| Nov. 6 to 20, | 59.0 | | | |
| December 8, | 56.0 | .. | *a* | NE. |
| 9 to 23, | 56.7 | .. | .. | NW. |
| January 3, | 51. | 29 | *b* | NNW. |
| 4, | 49. | 44 | *a* | NW. |
| 5, | ? | 45 | *b* | NW. |
| 6, | 48.8 | 45 | *b* | NW. |
| 7, | 49. | 46 | *a* | NW. |
| 8, | 52. | 46 | *a* | W. |
| 9, | 53. | 50 | .. | NNW. |
| 11, | 58. | 55 | *a* | SW. |
| 12, | 58. | 50 | .. | NNW. |
| 13, | 56. | 54 | .. | NW. |
| 14, | 53. | 47 | *a* | NNW. |
| 15, | 52. | 46 | *b* | NNW. |
| 16, | 49. | 44 | *c* | NW. |
| 17, | 48. | 42 | *c* | NW. |
| 18, | 47. | 41 | *c* | NW. |
| 19, | 49. | 45 | *b* | NW. |
| 20, | 48. | .. | *b* | NW. |
| 21, | 50. | 31 | *b* | NW. |
| 22, | 48. | 45 | *a* | NW. |
| 23, | 52. | 47 | *b* | NW. |
| 24, | 50. | 48 | *a* | NW. |
| 25, | 51. | | *a* | SW. |

| 1831-32. | Chinsurah. ° | Ice-fields. ° | Quantity. | Wind. |
|---|---|---|---|---|
| January 26, | 52 | .. | *a* | SW. |
| 27, | 52 | 45 | *a* | SW. |
| 28, | 54 | 49 | .. | W. |
| 29, | 56 | 47 | .. | SW. |
| 30, | 60 | 59 | .. | SW. |
| 31, | 56 | 46 | .. | SW. |
| February 1, | 54 | 44 | *a* | W. |
| 2, | 53 | 44 | *a* | NW. |
| 3, | 52 | 43 | *a* | NW. |
| 4, | 52 | 43 | *a* | NW. |
| 7, | 57 | 52 | .. | N. |
| 18, | 60 | | .. | SE. |
| 20, | 58 | | | |
| 28, | 60 | | | |
| 29, | 56 | | | |
| March 1, | 56 | | | |
| 3, | 56 | | | |
| 9, | 59 | | | |
| 11, | 56 | | | |
| 12, | 58 | | | |
| 14, | 56 | | | |
| 15, | 60 | | | |

| | |
|---|---|
| Number of days on which ice was formed in small quantity (*a*), .................................. | 17 |
| Ditto ditto of an average amount, (*b*), .............. | 7 |
| Ditto ditto very abundantly, (*c*), .................. | 3 |
| Total Ice-days in 1831-32. . | 27 |

*Note.* In lieu of the more copious table given by Dr. Wise, we have condensed his own and Mr. Herklot's Observations into one table, which in fact shews all that bears upon the question of Ice-making, namely, the general temperature under which it can be formed, and the prevailing wind.—ED.

The result of the observations of last season, as shewn in the above table, proves that it is not by the temperature alone we are to judge of the number of nights in which ice is produced, for, owing to the frequent and heavy falls of rain and the number of cloudy days last season, there were very few nights in which ice was formed, although the temperature was for an unusual number of mornings at the degree required for producing it. The average number of nights in one season in which ice forms is from 25 to 30; of these there are about 18 favourable, in which the air is cold, the thermometer at Bandel under 54°, or, at the

ice-fields, 48°. The very cold nights are from six to eight in one season, or in which the thermometer is below 48° at Bandel, or in the ice-fields, 42°. The careful record of last season shews there were 27 nights on which ice was formed, of which only three nights were very favourable, seven favourable, and 17 less so.

As the influence of straw in producing the necessary degree of cold must be considerable, the following experiments were tried. One of the common unglazed dishes was placed at the bottom of one of the ice-beds, with a very small quantity of straw between it and the earth, and another dish of the same kind was placed in the same way without any straw under it. Next morning I found ice had formed upon the water in the dish which was put upon the straw in the ordinary way, but there was none on the dish which had been placed without, nor on another at the bottom of the ice-beds ; the water in the dish upon the sprinkling of straw being at 50°, and the other upon the earth at 52°. Soon after sun-rise on the same morning, the water in an ice plate, put upon the walk between the ice beds, stood at 46°, and in the large water jar between the beds at 60.5°.

As a further proof of the influence of straw in producing the degree of cold necessary for forming ice, a register thermometer was placed upon the straw with its bulb exposed to the sky near the side of one of the beds, after several of the plates had been removed, when it was found to indicate as follows :—

| Date. | Time. | | Temperature. | | Covered with hoar-frost. | Minimum. | Maximum. | Straw between the plates. | Temperature of the air 4 feet above the beds. | | Difference between the air at the surface of the straw & 4 feet above it. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Morning. | Evening. | Morning. | Evening. | | | | | Mor. | Evg. | Mor. | Evg. |
| 1832. | | | ° | ° | | ° | ° | ° | ° | ° | ° | ° |
| Jan. 20. | 7 A. M. | .. | 28 | .. | covered | 26 | .. | .. | 47 | 65 | 21 | .. |
| 22. | 7 A. M. | 5 P. M. | 47 | 70 | . | .. | 121 | 42.5 | 48 | 61 | .. | 60 |
| 23. | 7 A. M. | .. | 34 | .. | covered | 29.5 | 114 | 34 | 47 | .. | 17.5 | .. |
| 24. | .. | 5½ P. M. | .. | 59 | .. | .. | 114 | .. | 48 | .. | .. | .. |
| 25. | .. | .. | .. | .. | covered | 29 | 124 | .. | .. | .. | .. | .. |

This table presents a high maximum and very low minimum temperature, which is to be explained by the non-conducting and powerful radiating property of the straw, &c. and, in the morning, in part to the production of hoar-frost.

As the kind of dishes employed must have a considerable influence on the temperature of the water they contain, I employed the following means to detect the influence of the material of which the dishes were formed. A morning was selected when the wind had suddenly changed

towards daybreak to the S. W. direction, when the air was mild and moist, and ice had formed on very few of the dishes placed upon the straw. Soon after sun-rise a mist appeared over the ice-beds. The air was at 53.5°, and the temperature of the straw 42°. The temperature of the water, which in one of the common unglazed dishes in the evening was 56°; in a black glazed one was 58°; in a white glazed one, 59°; in the morning the temperature of the water in one of the common unglazed dishes, with a film of ice on its surface, was at 34°, in the dish next it without ice 35°. The water in a white saucer had a thin sheet of ice upon its surface and was 35°, and in a deep white cup, without ice 39.5°, in a black glazed cup 36°, in a deep one of the same material 38°, and in a flat glazed plate 36°. On another morning of the same kind, a black coloured copper vessel had no ice, while a white painted brass vessel was covered with it.

The influence of brass dishes in conveying away the heat was made evident by the ice being thicker than on the other dishes, and extending from the under edge of the plate of ice upon the surface of the water for some distance along the inner surface of the brass dish. (February 2.) The ice was thick, and numerous small triangles were found a little to one side of its centre, which were not completely closed at their apices, and around this central point the ice was bulged out and thin, and, on examining its under surface, numerous crystals were found to have formed at the raised part where the ice was thinner; from whence they shot obliquely towards the centre of the water, underneath the upper plate of ice, where a small aperture was situated.

On the 2nd and 3rd of January, (1832,) there was only a thin film of slightly irregular ice on the surface of the brass dishes without any appearance of ice upon the water, in most of the plates, which with the exposed portions of straw, grass, &c. were moist. The water in the dishes which had not frozen near the sides of the beds, stood at from 32° to 33°. In a dish put upon another with water in it the upper stood at 32°, and the under at 33°. From these experiments the water appears to be influenced by its depth, exposure, and the materials and colour of the dishes employed for making ice.

In Bengal the day is always hot, and the tendency of caloric to arrive at a state of equilibrium would soon render bodies on the surface of the earth of the same temperature, were it not that each has an aptitude to receive and a power to discharge caloric, which is influenced principally by the nature of the surface of the body and its temperature. The degree of heat will vary with the power of the body, which may, however, be influenced by the evaporation from it by winds and air

heated by contact with the earth becoming specifically lighter and rising on the atmosphere. By the continual operation of these causes an accumulation of caloric in the earth is prevented during the day, and as soon as the sun sets, the increase of heat is checked and the night is generally cool under a clear and sparkling firmament even during the hottest season. This is in consequence of the generality of bodies on the face of the earth radiating caloric in large quantities, especially when exposed to the clear sky, as they receive few rays from the neighbouring bodies in return for what they radiate into space. So powerful are these causes in producing a great degree of cold, that in very favourable mornings drops of dew may sometimes be found congealed in Bengal upon thatched roofs, and upon the leaves of some plants during the cold weather. The cooling process advances more rapidly than could be supposed by one who has not experienced it himself, and proved the justness of his feelings by the aid of the thermometer. In the open plain in which the ice is made, I have seen the temperature of the air four feet above the ground fall in the time the sun took to descend the two last degrees before its setting from 70. 5° to 57°.

Pieces of glass and tin were placed under the common dishes in the ice-beds: in the morning they were carefully examined, and their under surfaces were covered with large drops of moisture. A piece of glass eight inches long and seven broad was placed on the evening of the 24th January, 1832, under an ice plate among the other dishes upon the straw in the beds, after it had been weighed; next morning, the dish was found to have gained 120 grains in weight, and, as there was no ice, the water was found to stand at 34°. A dish placed upon a plate of tin similarly situated with the last, gained 60 grains, and the water stood at 38°. On the 26th January, there was very little ice upon the plates, and a piece of glass and another of tin of the same size as the last were placed under two dishes which had been accurately weighed. In the morning the dish upon the tin had very little ice upon its surface, and had gained 70 grains; the dish upon the glass had no ice and had gained 160 grains.

(17th January, 1832.) This evening the following varieties of dishes were placed among the common dishes. A brass dish of the same shape and size as the common unglazed dishes weighed the same evening and morning. On another morning the experiment was repeated with the same result. The ice however was thicker and more equal throughout on the brass dishes than on any of the others; as water boils more readily in metal, so it freezes more readily—hence little

appearance of crystallization was observed, and near the centre of one of the plates of ice a small triangular opening was left. The ice was sooner detached from the dish by the heat of the sun, and a thin rim of ice several lines in breadth was found descending along the metal beyond the under surface of the ice.

One of the common dishes, lined with a coating of gum-lac on the inside, weighed the same evening and morning:—another coated on the outside had less ice, and more crystals, and lost a quarter of an ounce by weight; and one lined with tinfoil on the inside was of the same weight evening and morning.

The ice on these dishes was thicker, presented fewer crystals, and had less air in the interior; more especially on the one lined with lac on its inside. The brass vessels had less bubbles than the common dishes, probably from the air flying off as it was detached from the water, as it had less hold on the smooth surface; and on the two lined on the inside the ice was easily detached from the plates.

The application of these results to the explanation of the manner in which ice is formed in Bengal becomes sufficiently evident. The influence of the soil and the elevation of the dry ground, its inland situation and free exposure to the sky, and the quantity of dry straw presenting a large mass of a bad conductor of heat, which penetrates but a short way into it during the day*;—and as soon as the sun descends below the horizon this large and powerfully radiating surface is brought into action upon the thin porous vessels,—themselves powerful radiators.

The night air descends to the earth's surface by the removal of the heating cause, and deposits a portion of its moisture upon the powerfully radiating and therefore cold surface of the straw and the large moist surface of the dishes. The cold dry north-west breeze of the day dries the ground, and declines towards the night into moderate airs, which pass slowly over the dishes and prevent the accumulation of caloric on their surface from the deposition of moisture.

The combined influence of the above agents seem sufficiently powerful to account for the degree of cold required for forming ice, as the above experiments appear to me to prove.

* I have strong reasons for believing that electricity has a considerable influence on the formation of ice, but I have not had sufficient opportunities of investigating this important point, which I must leave to form the subject of another communication.

## VII.—*Proceedings of the Asiatic Society.*

*Wednesday Evening, 20th February,* 1833.

George Swinton, Esq. in the Chair.

After the Minutes of the last meeting had been read, the Society proceeded to ballot for Colonel John Briggs, Dr. J. N. Casanova, and Rev. John Macqueen proposed on that occasion, who were unanimously elected Members.

Sir Benjamin Malkin, Recorder of Penang, proposed by Sir E. Ryan, seconded by Mr. J. Prinsep, was upon the favorable report of the Committee of Papers, elected an Honorary Member.

The Secretary announced, that the Committee of Papers had, upon the authority of the resolution at the last meeting, disposed of two notes, value Rupees 5,500, for the liquidation of the debts standing against the Society.

The Secretary also reported, that in consequence of new arrangements made by him as Editor of the JOURNAL of the ASIATIC SOCIETY, he trusted that he should in future be able to supply that work gratis to the members of the Society. Mr. W. H. Macnaghten remarked that no notification had been circulated to the members acquainting them with the resolution of the 7th March, and giving them the opportunity of possessing the Journal then allowed to be published under its auspices; he thought that such notice should be issued both with reference to the former volume, and to the future numbers; and it was ordered accordingly.

The Secretary explained to the meeting, that Mr. Wilson, previous to his departure, had reported to Government the completion of Mr. Csoma de Körös' Tibetan Grammar and Dictionary, and had offered to take the manuscripts to England for publication; but that the Honorable the Vice-President in Council, being of opinion that the works might more appropriately be published in this country, under Mr. Csoma's own eye, Mr. Wilson had made them over to the Society. He had therefore followed up the subject by a second application to Government on the 30th January, to which the following reply had just been received:

To JAMES PRINSEP, ESQ. *Secretary to the Asiatic Society.*

SIR,

I am directed to acknowledge the receipt of your letter, dated the 30th ultimo, reporting the inability of the Society to defray any part of the expense which will attend the publication of Mr. Csoma de Körös' works.

2nd. In reply, I am directed to acquaint you, with reference to the concluding paragraph of your letter, that it was intended by Mr. Swinton's letter to Mr. Wilson under date the 27th ultimo, to intimate that Government would take upon itself the expense of the publication of Mr. Csoma de Körös' works, and I am now directed to acquaint you, that the Right Honorable the Governor General in Council will be happy to sanction the estimate furnished in your letter.

3rd. It is obviously desirable that the work should have the benefit of the learned author's superintendence during its progress through the press, and His Lordship in Council trusts, that it may be entered upon immediately. I am further directed to tender to yourself the acknowledgments of Government for the valuable assistance you have offered on your own part.

I have, &c. &c.

(Signed) W. H. MACNAGHTEN,

*Offg. Chief Secy. to Government.*

*Council Chamber*, 12*th February*, 1833.

The Secretary stated that arrangements had accordingly been made with the Baptist Mission Press, to commence upon the Tibetan Grammar and Dictionary immediately.

Read, a letter from Mr. W. Twining, Secretary to the Medical Society, acknowledging the receipt of the 1st volume of the Journal of the Asiatic Society, and vol. xvii. of the Researches.

*Library.*

The following books were presented:

3rd vol. of *Flora Indica*, or Description of Indian Plants, by the late Wm. Roxburgh, M. D. F. R. S. &c. &c.—*by Capt. James Roxburgh, on the part of himself and brother, Editors of the work.*

Proceedings of the Zoological Society for 1830, 31, and 32—*by the Society.*

The following works,—*by their author Sir J. F. W. Herschel.*

On the Separation of Iron from other Metals.

On a New Method of Computing Occultations of the Fixed Stars.

An account of Observations made with a twenty-feet Reflecting Telescope in the years 1826-27-28-30, on the Parallax of the Fixed Stars.

An account of Determining the Difference of Meridians.

Herschel's Micrometrical Measures.

Ditto's Account of the Repetition of M. Arago's Experiments.

Humboldt's Fragmens de Geologie.—*By the author.*

Vaillant's Numismata Imperatorum Romanorum, 3 vols. and

Agostini on Medals, 1 vol.—*by C. R. Prinsep, Esq.*

Nos. 54, 55, 56 of the Jour. of the Asiatic Society of Paris.—*By the Society.*

Meninski, Thesaurus Linguarum Orientalium, 3 vols. and

Federici Borromæi Thesaurus, 1632, vols. 4.—*by Baboo Ramcomal Sen.*

A complete copy of the Calcutta Journal, bound in quarto,—*by the Secretary.*

Essai sur le Madar (Calotropus Madarii),—*by J. N. Casanova, Esq.*

A copy of "Vidvunmoda Tarunginee," *by Maha Raja Kalikissen Bahadur.*

A copy of the New Testament and the Psalms of David, translated into the Malagasy language, at the Missionary establishment of Tananarivo,—*by C. Telfair, Esq. President of the Nat. Hist. Soc. Mauritius.*

Meteorological Registers for December, 1832, and January, 1833.—*by the urveyor General.*

Lardner's Cabinet Cyclopedia—Chemistry 1 vol.—*received from the Booksellers.*

*Physical.*

Read a letter from Mr. G. Swinton, communicating correspondence between Mr. Robison, Sec. Ed. Roy. Society, and several paper manufacturers, on the subject of the Nipal Paper Stuff.

The experiments tried by the paper manufacturers at home upon the dried pulp of the Nipal paper stuff made up into bricks (as described in the Journal, 1st vol. page 10,) and sent home by Mr. G. Swinton in 1831, do not seem to have been at all successful. The specimens furnished by Mr. C. Cowan to Mr. Robison possess neither the softness nor toughness of the paper manufactured in the valley itself, according to the methods detailed by Mr. Hodgson. They are brittle and stiff; transparent, as if impregnated with varnish, and full of gritty brown spots. The colour of the specimen marked "strongly bleached" is still far from being of a good white. It took about 10 lbs. of strong dry chloride of lime, and two lbs. of sulphuric acid, to bleach 90 lbs. of the material, being four or five times as much as is necessary with ordinary stuff, and the texture was doubtless injured thereby. It retained the water very obstinately on the sieve, and shrank remarkably on drying. The thin sheets made in Nipal and sent home in 1829, by Mr. Swinton, were on the contrary exceedingly tough, flexible, though not quite white; they more resembled what is called "India paper," and took the minute impression of a bank note plate with perfect fidelity.

Mr. Charles Cowan mentions in his notes on working-up the stuff, that it was found to be as tough as any material with which he was acquainted, which proves that it must have deteriorated since. The value of the cakes was estimated by this manufacturer at £6 to 8 per ton, or if fit for cartridge paper, at nearly double. No hopes were entertained of turning it to any more refined purpose.

Read a letter from the same Member on the subject of the *Garjan* or wood-oil procured in the forests of the Tenasserim provinces, a large quantity of which he had also transmitted to the Sec. of the Ed. Roy. Society, to ascertain its value in the English market.

This oil is in general use among the natives here for mixing with colors, and is chiefly imported from Chittagong, but it would appear on Major Burney's authority to be still more abundantly produced in the Tavoy district, and at much less cost; the bazar price in Calcutta averaging about 9 or 10 rupees per maund, whereas at Tavoy it may be procured at about one-fourth that price. Both in India and in England it has been found to be a good substitute for linseed oil, for outside work, especially in light colors, being worth for this purpose about £12 to 15 per ton.

Mr. Dowie, a currier of Edinburgh, read a paper before the Ed. Society of Arts, on the mode of applying this vegetable oil alone or mixed with tallow to the preparation of leather for shoes, and he considers it as far preferable to fish oil: this application is quite new, and at Mr. Swinton's suggestions some similar trials have since been made in Calcutta, by Mackenzie and Macfarlan, with success. The leather absorbs a great deal of the oil, and the specimens presented to the Society appear to be very soft and tough.

Major Burney describes the tree whence the *Garjan* oil is extracted, as forming large forests in Tavoy, growing to a great height and size; its native name is *Ka-*

*niyen;* the flag-staff at Moulmein, 92 feet high, is formed of a single *Kaniyen* tree. Mr. Maingy says, that the oil is much improved by boiling, which gives it drying properties; he has often used it for boats, and has found it excellent in preparing tarpauling. The inhabitants of Tavoy and Mergui do not burn earth-oil like other Burmese, but torches made of this wood-oil and touch wood. The imports into Calcutta for the last three years were as follows:

| | | | | | |
|---|---|---|---|---|---|
| In 1829 30, | Bazar maunds | 759, | Average price | 7 | 8 |
| 1830-31, | | 914, | | 6 | 4 |
| 1831-32, | | 1708, | | 7 | 2 |

Read a letter from Dr. F. W. Malcolmson, Mad. Euro. Reg. Hyderabad, announcing that he had fallen in with a box of Dr. Voysey's Geological specimens, which he should forward to Calcutta by the first opportunity.

" Among them are two fossil bones (of which he sends drawings)—descriptions and localities may be found in Dr. V.'s. papers. Fig. 1 is part of one of the long bones of a mammiferous animal (probably a goat or deer); its fibrous structure is very distinct, and presents fine yellow veins when cut and polished: internally the remains of the ridges to which the concellated structure was attached are visible. Fig. 2 is one end view of the same filled with a reddish earth, common near some of the granite rocks in the neighbourhood, and it is filled with small pieces of felspar. It is mineralized with the carbonate and a little phosphate of lime. All the other stones appear to have been collected in this district, and there can be no doubt of the locality from which this was obtained."

Dr. Malcolmson also sends the drawing of a chambered univalve fossil shell, in a white limestone, found among Dr. Voysey's collections.

Read a letter from William Onslow, Esq. C. S. dated Futtehpoor, 6th December, begging the Society's acceptance of some old Roman coins dug up upon his father's estate in England.

The sixty-one coins transmitted consist chiefly of the *small brass* of Constantine, among which are some of URBS ROMA and URBS CONSTANTINOPOLIS: also two of the Antonines, two of Domitian, one of Tetricus; the rest are in so decayed a state as not to be decypherable.

Read a letter from Lieut. A. Burnes, dated Bombay 26th Jan. announcing that he had dispatched for the Society some Bactrian coins, collected in his recent journey to the Oxus: also some belemnites and other fossil shells from the deserts.

Specimens of copper ore from Nellore were presented on the part of Mr. Kerr.

The mines appear to lie to the northward of the Pennar river, 36° N. N. W. of Nellore and 37° W. from the sea, near a village called *Ganypenta* in Arrowsmith's Map.

The copper ore prevails over a considerable tract of country—it consists of malachite, and of black anhydrous oxide of copper with red and yellow ochre imbedded in micaceous schist. Mr. Kerr points out that the ore differs from the English coppers essentially, in being free from iron pyrites and other deteriorating ingredients, as lead, antimony, sulphur, &c. which make that ore difficult to purify, whereas the Nellore ore becomes quite pure by simple smelting. The specimen of

reduced metal sent with the ores is of a very fine color and highly malleable. Doctor Thompson, 20 years ago, analyzed the ore and found it to contain,

| | |
|---|---|
| carbonic acid, | 16.7 |
| black oxide copper, | 60.75 |
| red oxide iron, | 19.5 |
| silica and loss, | 3.05 |
| | 100 |

Four different varieties examined by the Secretary contained from 13 to 47 per cent. of red oxide of iron and silex. The appearance of the ore seems to promise ample success to those who have engaged in the working of these mines.

Specimens of the copper ore of Nipal were presented by the Resident Mr. B. H. Hodgson.

This ore is a sulphuret of copper, mixed with a large proportion of ferruginous sulphuret.

A stuffed albatross, presented by Mr. J. Kyd on the part of Captain Henry Hutchinson of the Ship Lord Wm. Bentinck.

Some fossil bones supposed to belong to the Drenti or the Dodo, from the Isle of France, presented by C. Telfair, Esq.

Also a specimen of the silk produced from the Madagascar worm, by the same gentleman.

This silk is reported by competent judges in Calcutta to be " well reeled in the Italian method—the thread is harsh, uneven, and gouty, of 14 or 16 cocoons. The specimen appears old and damaged."

Specimens of the *Scincus Bojerii* and the *S. Boutonii* (J. Desj.), and the *squille* de l'I. Maurice, preserved in spirits ; also some fossil bones of the turtle discovered in an estate at Flacq, in the Mauritius. *By* Mons. J. Desjardins.

A letter was read from Monsieur Desjardins, Secretary to the Mauritius Society, presenting to the Asiatic Society, manuscript copies of 24 notes, memoirs, descriptions, &c. composed by himself, on various subjects of natural history. Several of them have been published in the scientific journals of Europe.

The first two papers relate to the organization of the Society for the study of natural history in the island, to which allusion was made in the JOURNAL, vol. i. 157. There are also the rules and the report of the third anniversary meeting, (we have already received the two former reports.) Of Monsieur Desjardins' contributions to natural history, the following list will give the most flattering proof.

Sur une couleuvre prise vivante a l'Ile Maurice, 1829.
Description physique de l'Ile d'Ambre, 1829.
Ditto de la Becasse de Maurice.
Ditto d'une caverne située à la riviere du rempart, 1829.
Ditto des mammiféres de l'Ile Maurice.
Ditto des 20 oiseaux de Madagascar.
Sur une annelide du genre Erpobdelle, (*Lam.*)

Sur trois espèces de lêzard du genre scinque.
Sur un tandree de Madagascar.
Sur trois espèces d'echassiers *(grallæ)* de do.
Sur une coucou pris à l'Ile de France.
Sur quelques poissons de la cote N. O. de Sumatra 1831.
Description d'un oiseau *(scolopax totanus glottis)*, 1829, &c. &c.

*Literary.*

Mr. Telfair also transmitted by the same opportunity a variety of manuscript essays by Mr. Baker and others, connected with the literature of Madagascar, besides the Missionary publications already noticed.

1. Translation of the fable of the alligator and hedge-hog.
2. Ditto of a song concerning the dead.
3. On the ordeal of the Tangéna.
4. Sur les maladies epidemiques de Madagascar.

Portions of some of these papers were read.

*Resolved,* that the last paper be made over to the Medical Society, and that the best thanks of the Society be given to the President and Secretary of the Mauritius Natural History Society.

Thanks were also voted for the other contributions of the evening.

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After the business of the evening was concluded, Mr. W. Macnaghten begged to remind the meeting that this might be the last occasion in which they would enjoy the society of the gentleman who now occupied the chair, in this country—nay perhaps for ever! He had seen his friend in the morning overwhelmed with the fatigues of preparation for embarkation on the morrow, and little thought it possible for him to attend to other engagements; but his ardent zeal for the cause of literature and science had urged him to devote the very last moment of his residence in this land to the Institution with which he had been connected so long. For the affection and interest thus manifested to the last, the gratitude of himself and of his brother members was most due,—and for the modesty which had marked his services to the Society, and which alone had prevented his rising long since to the highest dignity it could bestow. From the time of his quitting college, Mr. Swinton had been distinguished as an Orientalist, and his unimpeachable conduct had marked him as one of the brightest ornaments of the Civil Service. Mr. Swinton, he knew, would wish him to spare such eulogium in his presence, but it would be unjust in him and in the Society to allow their associate to quit them without testifying their anxious solicitude for his safe and happy return to his native land.

Mr. Swinton returned thanks for this expression of feeling on the part of his associates, which he attributed rather to their partiality than to his merits. He had always felt the warmest interest in the Society, and had endeavoured to contribute to its success, whenever an opportunity occurred. He could but now for the last time tender his sincerest wish for its lasting fame and prosperity, and once more returning his best thanks, he bade them farewell.

## VIII.—*Systematically arranged Catalogue of the Mammalia and Birds belonging to the Museum of the Asiatic Society, Calcutta. By Dr.* W. Warlow.

### MAMMALIA.

*Ord.* Carnassiers.

*Fam.* Cheiroptera. *Gen.* Galeopithecus.

*Galeopithecus vulgaris.* The Colugo.

*Fam.* Insectivora. *Gen.* Sorex.

*Sorex giganteus,* Geoff. Indian Shrew.

*Fam.* Carnivora. Tribe Plantigrada. *Gen.* Ictides.

*Ictides ater.* This specimen was presented to the Society by Col. Farquhar under the title of long-tailed Bear of Malacca, and has been described by Sir S. Raffles as the "Benturong" in the 13th vol. of the Transactions of the Linnæan Society. Sir Stamford is incorrect in his enumeration of the molar teeth, which are not six on each side in both jaws; there being six in the upper and only five in the lower. In every other particular his description corresponds. The exact number of teeth in *Ictides* I am unacquainted with. Baron Cuvier's account would lead me to the supposition that there are six in each jaw, as in Procyon, whilst I find in the Bulletin Universel, that the teeth are 18 in number in each jaw, namely six incisors, two canines, and 10 molars. There can be no doubt of the identity of the specimen with the Ictides ater of Frederick Cuvier, though it may be necessary to separate the latter from the species with which it has been generically connected.

*Tribe* Digitigrada. *Gen.* Lutra.

*Lutra nair,* F. Cuvier, Indian Otter.

*Gen.* Viverra.

*Viverra Bengalensis,* Hardw.

*Gen.* Felis.

*Felis kutas,* Pearson.

*Felis catus,* a variety of the common cat?

*Ord.* Marsupialia.

*Fam.* Dasyuridæ. *Gen.* Thylacinus.

*Thylacinus striatus.* Zebra Thylacine. Didelphis cynocephalus, Harris.

*Ord.* Rodentia.

*Gen.* Rhizomys, Gray.

*Rhizomys Sumatrensis.* Bambu Rat, Raffles. This specimen has also been described by Sir S. Raffles, and from his description, Mr. Gray has referred it to his new genus Khizomys, adding however a note of interrogation as to the correctness of the location. It certainly does belong to the genus, but it would be very desirable that a specimen should be sent to Mr. Gray, especially as it is by no means clear that it may not be identical with his *R. Chinensis.*

*Gen.* Hystrix, *Subg.* Atherina.

*Atherina fasciculata.* Brush-tailed Porcupine.

*Ord.* Edentata.

*Gen.* Manis.

*Manis pentadactyla.* The short-tailed Pangolin.

*Ord.* Monotrema.

*Gen.* Echidna.

*Echidna Hystrix.* Porcupine Echidna.

*Ord.* Ruminantia.

*Gen.* Moschus.

*Moschus Javanicus.* The Kautchil.

*Gen.* Bos.

*Bos Bufalus.* }
—- *Taurus.* } Monstrous specimens of the Ox and Buffalo.

*Ord.* Cetacea.

*Gen.* Delphinorhychus.

*Delphinorhychus Gangeticus.* Indian Dolphin.

BIRDS.

*Ord.* II. Insessores.

*Tribus* 1. Fissirostres.

I. *Fam.* Meropidæ. *Gen.* Merops.

*Merops viridis.* Indian Bee-Eater.

*Gen.* Alcedo.

*Alcedo Bengalensis.* Indian Kingfisher.

*Gen.* Halcyon.

*Halcyon Smyrnensis.* Smyrna Kingfisher.

*Gen.* Dacelo.

*Dacelo gigantea.* Great Brown Kingfisher.

*Tribus* 2. Dentirostres.

I. *Fam.* Muscicapidæ. *Gen.* Muscipeta.

*Muscipeta cœrulea.* Azure Fly-catcher.

II. *Fam.* Laniadæ *Subf.* Dicrurina. *Gen.* Dicrurus.

*Dicrurus macrocercus.*

III. *Fam.* Merulidæ *Subf.* Oriolina. *Gen.* Oriolus.

*Oriolus Melanocephalus.*

IV. *Fam.* Sylviadæ. *Gen.* Jora.

*Jora Scapularis.*

*Gen.* Accentor.

*Accentor modularis?*

V. *Fam.* Pipridæ. *Gen.* Parus.

*Parus cristatus.* Crested Titmouse.

*Tribus* 3. *Subf.* Alaudina. *Gen.* Alauda.

*Alauda cristata.* Crested Lark.

*Gen.* Emberiza.

*Emberiza Bengalensis.*

III. *Fam.* Covidæ. *Subf. Gen.* Barita.

*Barita Destructor.*
——— *Tibicen.*

*Subf.* Corvina. *Gen.* Pica.

*Pica vagabunda.* The Rufous Crow.

*Subf.* Coraciana. *Gen.* Coracias.

*Coracias Bengalensis.* Bengal Roller.

V. *Fam.* Loxiadæ. *Gen.* Cocothraustes.

*Cocothraustes vulgaris.* Common Grosbeak.

*Tribus* 5. Scansores.

II. *Fam.* Psittacidæ *Subf.* Psittacina. *Gen.* Psittacus.

*Psittacus erythrocephalus.* The grey Parrot or Jaco.

*Subf.* Palæornina. *Gen.* Nanodes.

*Nanodes pulchellus.* The Turcosine Parrakeet.

*Gen.* Platycercus.

*Platycercus eximius.* Nonpareil Parrakeet.

*Gen.* Palæornis.

*Palæornis flavirostris.* Yellow-colored Parrakeet.
—— *erythrocephalus.* Blossom-headed Parrakeet.

III. *Fam.* Picadæ. *Gen.* Bucco.

*Bucco Philippensis.* Yellow-throated Barbet.
—— *Gyanops,* Cuv.

*Gen.* Picus.

*Picus viridis.* Green Woodpecker.
—— *tiga.* Horsfield.

IV. *Fam.* Certhiadæ. *Gen.* Upupa.

*Upupa Epops.* The Hoopoe.

V. *Fam.* Cuculidæ. *Gen.* Cuculus.

*Cuculus Orientalis.*
*Coromandus.* Colored Cuckoo.

*Gen.* Centropus.

*Centropus Philippensis.* Philippine Cuckow.
—— *Gigas?*

*Tribus* 5. Tenuirostres.

V. *Fam.* Meliphagidæ. *Gen.* Melithreptus, (Vieill.)

*Melitreptus Nova Holandiæ.*

*Gen.* Orcadion, Vieill.

*Orcadion caruncululatus.* Wattled Bee-eater, Lath.

*Gen.* Prinia, Horsf.

*Prinia familiaris.*

*Ord.* III. Rasores.

I. *Fam.* Columbidæ. *Gen.* Treron, (Vinago, *Cuv.*)

*Treron militaris.* Saint Thomas' Pigeon. The Green Pigeon.

II. *Fam.* Phasianidæ. *Gen.* Tragopan, Cuv.

*Tragopan Satyrus.* The Nipal Pheasant.

III. *Fam.* Tetraonidæ. *Gen.* Perdix.

*Perdix Chukar,* Gray. Chukar Partridge.

*Gen.* Ortygis.

*Ortygis Pugnax.* The fighting Quail.

*Ord.* IV. Grallatores.

II. *Fam.* Ardeidæ. *Gen.* Platalea.

*Platalea lencorodia.* The Spoonbill.

*Gen.* Ciconia.

*Ciconia leucocephala.* The Violet Stork, or *Manikjore* of the Natives.

*Gen.* Ibis.

*Ibis falcinellus.* The Green Ibis.

IV. *Fam.* Rallidæ. *Gen.* Parra.

*Parra Melanochloris.* Indian Jacana.
—— *Chinensis.* Chinese Jacana.
—— *Africana ?*

*Gen.* Porphyrio.

*Porphyrio Indicus.* Indian Porphyris.

*Gen.* Crex.

*Crex porzana.* Spotted Gallinule.

III. *Fam.* Scolapacidæ. *Gen.* Totanus.

*Totanus Glottis.* Green-shank Snipe.

V. *Fam.* Charadriadæ. *Gen.* Vanellus.

*Vanellus macroptera,* Cuv. *V. Tricolor,* Horsf.

*Gen.* Charadrius.

*Charadrius morinellus.* The Dottrel.

*Gen.* Himantopus.

*Himantopus melanopterus,* Tem. Long-legged Plover.

*Ord.* V. Natatores.

I. *Fam.* Anatidæ. *Gen.* Clangula.

*Clangula Histrionica.* Harlequin Duck.

*Gen.* Fulgula.

*Fulgula rufina.* Red-crested Pochard.

*Gen.* Marcia.

*Marcia cana* (*et Casarca*), Brown. Grey-headed Goose. The Brahminee Duck.
—— *arcuata.* Anas Sili, Ham.

*Gen.* Querquedula.

*Querquedula Crecca.* Common Teal.

IV. *Fam.* Pelecanidæ. *Gen.* Phalacrocorax.

*Phalacrocorax vulgaris.* The Cormorant.

V. *Fam.* Laridæ. *Gen.* Sterna.

*Sterna Hirundo.* The Great Tern.

*Gen.* Diomedea.

*Diomedea exulans.* Wandering Albatross.

I am aware that in the preceding list there are a few omissions and there may be some errors, but I have not at present the opportunity of correcting the one or supplying the other. The list should also have comprised the reptiles, of which the Museum contains some very fine specimens.

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## IX.—European Notices of Indian Natural History.

### 1.—*The Dugong.*

The animal sent home preserved in spirits by Mr. G. Swinton, in 1830, to Mr. J. Robison, Secretary of the Edinburgh Royal Society, was delivered over to Dr. Knox, for dissection. That eminent anatomist writes to Mr. Robison in the following terms:

" This very splendid gift to science can be appreciated only by those who, having visited inter-tropical climates and warm countries, generally know well the extreme difficulty of procuring, preserving, and transmitting specimens such as the Dugong,

which you have now received from Mr. Swinton, and which you have done me the honor to place in my hands for examination and dissection.

It may not perhaps be altogether uninteresting to that gentleman to be informed, that two portions of the animal have arrived and have been examined, though in a very cursory way, by me ; the shortness of the day and darkness of our climate during the winter months forbidding all attempts at more minute inquiry for the present. These portions are, the head and upper or anterior part of the trunk, including the arms, and seemingly the pyoid bones with the connected soft parts. This portion seems in excellent condition, and will no doubt afford ample scope for dissection ; the details of which, together with illustrative sketches, I shall so soon as they are properly arranged and finished, put into your hands, in order to be transmitted to Mr. Swinton, this being the very smallest return we can make for his so great kindness in transmitting the specimen.

The other portion is the posterior part of the vertebral column and tail ; but the middle portion, containing all the viscera, I have not yet seen. It will be readily understood by every anatomist and naturalist, and I hope also by Mr. Swinton, that this division of the animal into three portions was the greatest misfortune which could have happened, since it involved the cutting across so many important parts, the division of all the great vessels and nerves, the displacement of almost all the organs, and the destruction of many ; so that it is not to be concealed, that the value of the specimen has been incalculably diminished. It would I fear be presuming too much to hope that the Dugong might one day reach us entire, *in a good state* and *untouched ;* inasmuch as the difficulty of procuring these animals is very great, and when taken would require to be immediately placed in a cask of ardent spirits, and carefully enclosed. But however this may be, I shall bestow every pains in my power to make the most of those portions which have already come to hand, and beg to return you and to the Royal Society my thanks for having placed at my disposal an anatomical specimen deemed by me of so great value."

### 2.—*Nepal Specimens.*

[*Extract from the Proceedings of the Zoological Society of London, Jan.* 24, 1832.]

William Yarrell, Esq. in the Chair.

" Specimens were exhibited of various *Mammalia* and *Birds*, collected in Nepâl by B. H. Hodgson, Esq. Corr. Memb. Z. S., British Resident at Katmandoo. For this exhibition, the Committee was indebted to the kindness of Dr. N. Wallich, to whom the skins had been transmitted by Mr. Hodgson.

The *Mammalia* included specimens of a new species of *Felis*, L. ; of two *Antelopes*, one the *Chiru* and the other new to science ; and of the wild *Dog* of Nepâl. They were accompanied by colored figures, and, except in the instance of the latter*, by accounts of the several animals from the pen of Mr. Hodgson. These accounts were read.

The new species of *Felis* is described as the *Moormi Cat*, a name derived from that of the tribe which inhabits the part of the hills in which the animal was taken. It was entirely unknown to the natives, and had consequently no local name. It may be thus characterized†.

* This account will be found to be supplied in the 2nd pt. Trans. Phys. Cl. As. Soc.

† Mr. Hodgson's description is given in the Gleanings, iii. p. 177.

The only specimen of this species which Mr. HODGSON has been able to procure was a fine mature male, sent to him alive, about two years hack, hy the Prime Minister of Nepâl; it was accompanied by an intimation that the animal presented to him was the first of the kind ever taken, the people of the country having heen by its capture first apprized of its existence in Nepâl. It was caught in a tree hy some hunters in the midst of an cxceedingly dense forest, situated in ahout the latitude of the great valley: the *habitat* of the species may therefore be presumed to he the central part of these mountains, or that portion which lies equidistant from the snows of the Himalaya and the hot plains of Hindústan. Though only just taken when it was brought to Mr. HODGSON, it hore confinement very tranquilly, and gave evident signs of a tractable disposition and cheerful unsuspicious temper; so much so as to convince that gentleman that a judicious attempt at taming it must succeed. None such, however, was made, and when the animal, after six months confinement, died of disease, it was still, of course, unreclaimed from its wild state of manners and temper; in which state it manifested considerahle ferocity and high courage, the approach to its cage of the huge *Bhoteah Dog* exciting in it symptoms of wrath only—none of fear.

In a note appended to his description of this second new species of *Felis* from Nepâl, Mr. HODGSON refers to that of the *Fel. Nepalensis*, puhlished hy Messrs. HORSFIELD and VIGORS, in the 'Zoological Journal,' vol. iv. p. 383. The ground-colour of this latter animal is there described as "grey, with a very slight admixture of tawny;" whereas in five specimens possessed by Mr. HODGSON, the tawny prevails over the grey to such an extent that the tawny should he regarded as the ground-colour in the mature animal of both sexes. One adult male is almost as hrightly tinted as a *Leopard:* the females are paler than the males. He adds that the common species of *wild Cat* is frequently met with in Nepâl of the fullest European size, and so like to the Occidental type as not even to constitute a variety."

The new species of *Antelope* distinguished hy Mr. HODGSON as the *Bubaline Antelope*, has been already made known to our readers*.

The skin of the *wild Dog* of Nepâl was compared hy Col. Sykes with a specimen of the *Kolsun* of the Mahrattas, recently described hy him in the 'Proceedings,' (Part 1. p. 100,) under the name of *Canis Dukhunensis.* He stated his impression to he, tbat the animals are identical, differing only hy the denser coat and more woolly feet of the Nepal race, a difference readily accounted for hy the greater cold of the elevated regions inhabited hy it. He declined, however, pronouncing a decided opinion, which, he thought, could only he arrived at by more extensive comparison, and hy a full acquaintance with the hahits of the *wild Dog* of Nepâl.

Among the *Birds* contained in Mr. HODGSON'S collection was exhibited a specimen of the *Hæmatornis undulatus*, a species described in the first part of the Proceedings of the Committee, p. 170, and figured in Mr. GOULD'S 'Century of Birds.' The specimen agreed accurately with that which had been previously exhihited to the Committee, except in size; the present specimen being about one-third larger. From this difference in size it was conjectured to be a female. Specimens were also in the collection of the *Myophonus Temminckii*, the difference between which species and the *Myophonus flavirostris* (*metallicus*, Temm.) had heen pointed out in

* Vide GLEANINGS, iii. 122.

the same part of the 'Proceedings,' p. 171. The separation of the two species was thus further justified by the accurate accordance of several specimens of the Nepâlese bird, in those characters which separated them from the Archipelagan species. A specimen of *Zoothera monticola* was also included in the exhibition, which deviated in no respect from that already described in the 'Proceedings,' p. 172, and figured by Mr. Gould.

An interesting species of *Hornbill*, which has been described by Mr. Hodgson in the 'Asiatic Researches,' vol. xvii. p. 178, but which had never before been seen in Europe, accompanied the former birds.

Among some drawings of this species which accompanied the collection, one was observed in which the tail was elevated in the same manner, although not to the same extent, as in the *Toucans* of South America when at rest. Mr. Vigors called the attention of the Committee to this peculiarity in the *Toucans*, which he had ascertained from a living bird in his own collection, and which he described in the 'Zoological Journal,' vol. ii. p. 480, pl. xv. And he dwelt on the additional proof thus afforded of affinity between these two families of the Old and New World, which are equally allied by the most important characters of their structure.

A male and female *Pheasant* were also exhibited from the collection, which appeared to be the species described by Dr. Latham under the name of *Phasianus leucomelanos*, (Ind. Orn. ii. 633.) Mr. Vigors pointed out the difference between this species and the *Phasianus albo-cristatus*, which he had described in the first part of the 'Proceedings,' p. 9. This difference consisted in the deep black colour of the crest in the *Phas. leucomelanos;* in the lanceolated feathers of the under part of the body extending no further than the breast; and in the plumes of the lower part of the back being doubly fasciated, by a slender violet-black band in the first instance near the *apex*, and secondly by a slender white apical band. In the *Phas. albo-cristatus*, on the contrary, the crest is white, with a somewhat dusky base; the lanceolated feathers on the under body extend over the abdomen; and the feathers on the lower part of the back are fasciated with one rather broad white apical band, without any vestige of the black violet markings observed in the other species. Mr. Vigors added, that these two species, together with the *Phas. lineatus* of Dr. Latham, exhibited to the Committee on the 11th Jan. of last year, and described in the 'Proceedings' of that date, p. 24, as well as the *fire-backed Pheasant*, *Phasianus ignitus*, Lath., formed a group among the *Pheasants*, which appeared intermediate between the typical birds of that family and the genus *Gallus*, or *Jungle Fowl*. This group, distinguished by their crests, and by the tail partaking equally of the elevated character of that of the *Jungle Fowl*, and the recumbent character of that of the *Pheasant*, had been set apart by MM. Temminck and Cuvier under the name of *Houppifères*, and by the former naturalist under the scientific name of *Euplocamus*.

The only species apparently undescribed in the collection was the following *Pigeon*, which Mr. Vigors expressed his pleasure in having it in his power to dedicate to the enterprising and scientific discoverer.

Columba Hodgsonii. *Col. capite colloque pallidè, dorso crissoque intensiùs vinacco-griseis; alis, regione interscapulari, abdomineque vinaceo-brunneis, hoc albo variegato; scapularibus albo guttatis; nuchâ vinaceo-brunneo notatâ; remigibus rectricibusque, his intensius, fuscis; gulâ albescenti-griseâ; pedibus saturatè cæruleis, unguibus flavis.*

Longitudo *corporis*, 15 unc.

## Meteorological Register kept at the Assay Office, Calcutta, for the month of February, 1833.

| Day of the month. | Barometer reduced to 32° Farh. | | | | Thermometer in the Air. | | | | | Depression of moist-bulb Thermometer. | | | | Hair Hygrometer. | | Rain. | Wind. | | | Weather. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | At 5 A. M. | At 10 A.M. | At 4 P. M. | At 10 P. M. | Minimum at 5 A. M. | At 10 A. M. | Max. by reg. Ther. | At 4 P. M. | At 10 P. M. | At 5 A. M. | At 10 A. M. | At 4 P. M. | At 10 P. M. | At 10 A. M. | At 4 P. M. | Inches. | Morning. | Noon. | Evening. | Morning. | Noon. | Evening. |
| 1 | 29,989 | ,056 | ,950 | ,040 | 64, | 71,6 | 83,6 | 76,0 | 69,8 | 3,0 | 5,9 | 10,5 | 5,8 | 92 | 81 | | o. | n. | o. | clear all day. | | |
| 2 | 30,008 | ,054 | ,940 | ,021 | 67, | 71,0 | 83, | 77,4 | 70,0 | 2,6 | 4,3 | 9,9 | 3,9 | 95,5 | 85 | | o. | w. | s. e. | fog. | clear. | clear. |
| 3 | 29,967 | ,030 | ,920 | ,006 | 67, | 71,5 | 83,8 | 77,8 | 71,5 | 2,4 | 5,5 | 10,1 | 5,6 | 92 | 83 | | o. | n. e. | e. | ditto. | cir. | cir. |
| 4 | ,977 | ,023 | ,900 | ,964 | 68,8 | 72,6 | 83,6 | 78,0 | 69,4 | 5,8 | 6,8 | 11,0 | 6,2 | 90 | 82 | | o. | n. | n. | clear. | ditto. | ditto. |
| 5 | ,920 | ,976 | ,810 | ,853 | 65,7 | 70,3 | 83,4 | 75,7 | 68,2 | 3,7 | 5,3 | 9,0 | 3,2 | 93 | 87 | | n. w. | n. e. | o. | cum. | cum. | cloudy. |
| 6 | ,822 | ,891 | ,812 | ,892 | 64,5 | 73,2 | 81,8 | 76,2 | 69,2 | 2,8 | 6,5 | 8,9 | 3,5 | 91 | 86 | | o. | o. | e. | ditto. | ditto. | clear. |
| 7 | ,917 | ,950 | ,850 | ,945 | 63,5 | 72,8 | 83,0 | 76,2 | 67,9 | 6,0 | 14,5 | 17,8 | 10,1 | 75 | 68 | 0,10 | w. | n. | w. | ditto. | clear. | clear. |
| 8 | ,942 | ,981 | ,870 | ,925 | 63,1 | 71,0 | 80,5 | 77,2 | 68,0 | 8,1 | 10,2 | 16,0 | 5,7 | 82 | 67 | | o. | n. | s. w. | ditto. | ditto. | ditto. |
| 9 | ,913 | ,976 | ,828 | ,884 | 60,3 | 72,0 | 82,6 | 78,2 | 67,3 | 5,0 | 8,0 | 14,8 | 5,3 | 84 | 70 | | o. | w. | w. | ditto. | ditto. | ditto. |
| 10 | ,846 | ,843 | ,732 | ,841 | 67,5 | 73,0 | 83,4 | 79,1 | 73,3 | 2,5 | 6,0 | 10,1 | 4,6 | 90 | 80 | | o. | n. w. | n. w. | cis. | ditto. | cir. |
| 11 | ,782 | ,845 | ,729 | ,878 | 70, | 75,2 | 82,3 | 80,2 | 71,2 | 2,8 | 4,3 | 8,2 | 3,9 | 95 | 90 | | e. | n. e. | s. e. | stratus. | cum. | nimbus. |
| 12 | ,851 | ,943 | ,835 | ,934 | 69, | 73,9 | 85,0 | 78,0 | 72,0 | 3,2 | 6,6 | 11,6 | 5,9 | 90 | 80 | | o. | n. e. | o. | clear. | ditto. | gathering. |
| 13 | ,936 | ,996 | ,886 | ,025 | 69,2 | 74,5 | 84,4 | 78,4 | 69,6 | 4,4 | 9,3 | 16,0 | 7,2 | 82 | 65 | 0,08 | o. | n. w. | n. w. | ditto. | ditto. | cl. [N. E. |
| 14 | 30,005 | ,009 | ,890 | ,025 | 68,2 | 74,2 | 82,3 | 78,8 | 71,0 | 8,1 | 12,5 | 16,5 | 6,8 | 75 | 71 | | o. | n. w. | e. | ditto. | clear. | ditto. |
| 15 | 29,983 | ,012 | ,865 | ,959 | 66,5 | 73,3 | 82,4 | 78,5 | 69,3 | 6,3 | 13,7 | 17,0 | 9,0 | 74 | 67 | | o. | w. | s. w. | ditto. | ditto. | ditto. |
| 16 | ,967 | ,988 | ,871 | ,978 | 62,8 | 72,8 | 81,3 | 78,8 | 66,7 | 4,6 | 15,5 | 18,3 | 8,1 | 69 | 64 | | o. | n. w. | o. | ditto. | ditto. | ditto. |
| 17 | ,955 | ,998 | ,830 | ,976 | 64,3 | 73,2 | 83,2 | 79,2 | 70,2 | 6,3 | 10,4 | 15,1 | 6,0 | 72 | 80 | | o. | o. | o. | ditto. | ditto. | ditto. |
| 18 | ,923 | ,975 | ,825 | ,971 | 66,6 | 73,8 | 81,0 | 79,6 | 69,6 | 2,7 | 8,4 | 7,9 | 3,5 | 83 | 90 | | s. w. | s. w. | s. | ditto. | cum. | cloudy. |
| 19 | ,974 | ,025 | ,920 | ,023 | 68,2 | 74,6 | 83,2 | 78,9 | 73,2 | 2,1 | 4,6 | 7,5 | 3,5 | 95 | 92 | 0,30 | o. | n. w. | n. | ditto. | cu. st. | n. wester. |
| 20 | ,980 | ,029 | ,897 | ,989 | 69,4 | 75,0 | 83,7 | 79,2 | 75,1 | 1,0 | 3,9 | 6,7 | 4,0 | 97 | 94 | | o. | o. | n. | fog. | cu. | cum. |
| 21 | ,925 | ,964 | ,827 | ,964 | 70,2 | 76,1 | 83,8 | 79,8 | 74,5 | 3,5 | 7,6 | 10,1 | 7,5 | 91 | 84 | | s. | n. w. | n. | ditto. | clear. | clear. |
| 22 | ,956 | ,920 | ,803 | ,934 | 71,2 | 75,2 | 83,1 | 80,2 | 74,7 | 5,9 | 7,2 | 12,0 | 9,3 | 91 | 81 | | o. | n. e. | o. | clear. | ditto. | ditto. |
| 23 | ,869 | ,933 | ,793 | ,886 | 68,4 | 76,2 | 83,0 | 80,0 | 75,0 | 4,0 | 7,7 | 10,9 | 4,2 | 89 | 84 | | s. | n. e. | s. w. | ditto. | cum. | cum. N. |
| 24 | ,874 | ,920 | ,800 | ,948 | 72,1 | 76,8 | 83,8 | 81,4 | 76,4 | 2,1 | 8,2 | 10,7 | 4,2 | 89 | 86 | | s. | n. e. | n. | ditto. | ditto. | cloudyS.E. |
| 25 | ,901 | ,940 | ,821 | ,943 | 72,5 | 77,1 | 84,8 | 82,8 | 75,5 | 1,7 | 8,9 | 10,2 | 4,2 | 89 | 87 | | o. | n. e. | o. | ditto. | clear. | clear. |
| 26 | ,903 | ,934 | ,784 | ,908 | 67,5 | 76,7 | 86,0 | 84,2 | 73,4 | 2,2 | 9,8 | 15,9 | 3,4 | 85 | 71 | | s. e. | n. | n. | ditto. | ditto. | ditto. |
| 27 | ,896 | ,928 | ,836 | ,960 | 72,1 | 77,9 | 87,0 | 85,7 | 74,8 | 3,7 | 8,2 | 23,3 | 11,3 | 87 | 55 | | s. | w. | o. | cum. | ditto. | ditto. |
| 28 | ,940 | ,997 | ,826 | ,938 | 71,4 | 77,9 | 86,9 | 83,7 | 74,7 | 2,8 | 9,5 | 18,9 | 6,7 | 85 | 59 | | s. w. | n. w. | o. | foggy mist | ditto. | ditto. |
| Means | ,925 | ,969 | ,844 | ,951 | 67,5 | 74,0 | 83,5 | 78,7 | 71,5 | 3,9 | 8,2 | 12,7 | 5,8 | 86 | 78 | 0,48 | light airs. | | | generally fine. | | |

The instruments for 10 A. M. and 4 P. M. are suspended in the free air of the laboratory. Those for 5 A. M. and 10 P. M. are placed in a south veranda near the Cathedral. The Barometers stand ,020 lower than the Surveyor General's instrument.

Sketch
OF THE CANALS
from the Jumna in the Dehli Territory
Reduced from Major Colvin's Map.
Scale: 26 Brit Miles = 1 Inch.
Chicherowle
Booreeah
Damla
Rudowr
Bhiran
Buersal
Solah
Sambee
Indree
Teraoree
Karnal
Cantonment
Chittung Nuddee
Dutchor
Rutluk
Bullah
Barse
Khanduh
Dhatrut
Suffeedon
Quvee
Mudlowda
Jheend
Ramrah
Feroze's Canal
Namound
Sisaee
Hansi
Cantonment
Dhana
Bass
Hissar
Shahpoor
Darbah
Nirana
Darbah Branch Canal
Bhikanir Boundary
Chanee
Neenan
Buha
Bed of the Chittang Nuddee
Moonuree
Kurotanughul
Raneah
Kaghar or Ghaghar Rr
Bara Nyedilla
Seersah
Aloopoor
Lalla
Badulghur
Moonuk
Munduwa
Phoolud
Kalwun
Jumalpoor
Eirwa
Fullehabad
Beegur
Buhoona
Bitmurra
Murwana
Oochana Kulan
Burwala
Kole Kulan
Agrowa
Kooranuh
Jagsee
Gohanna
Mudeena
Old Course of the Rajbuha
Bhaoo
Rohtuk
Rhotuk Branch
Original line of the Dehli Canal
Dehli Canal
Bullee
Bhanwur
Jooah
Soneput
Phulgong
Rohul
Hulalpoor
Teekree
Bowanna
Khara Kul
Badlee
Wuzeerpoor
Paneeput
Duhur
Nurayunuh
Se rah
Baolee
Gugseena
Oomcha
Doab Canal
Kandla
Nalla
Jakoulee
Gurhi
Khyl
Teelron
Shamli
Guw
Lissar
Bural
Barole
Burkeree
Deolah
Kutoul
Serowli
Hindun R.
Tilloh
Kirsuni R.
Julalabad
Gousgurh
Nanaula
Rampoor
Luck-nowla
Umbei-tta
Khera
Bee-danna
Zyne-poor
Gejellur
Koonjpoora
Dheeka
Tugra
Sirsawa
Chilkana
Behut
Suharunpoor
Rusoolpoor
Tanseepoor
Bugwunpoor
Sumloonee
Hindun R.
Morufferabad
Koynawur or Ooncha Gaon
Fizabad
Ripoor
Kyarala
Sombe R.