







# **ASIATIC RESEARCHES**





# ASIATIC RESEARCHES

Comprising

HISTORY AND ANTIQUITIES,  
THE ARTS, SCIENCES, AND  
LITERATURE OF ASIA

*Vol. The Twenty*

SET OF TWENTY TWO VOLUMES

*"The bounds of its investigations will be the geographical limits of Asia, and within these limits its enquiries will be extended to whatever is performed by Man or produced by Nature."*

*Sir William Jones*



**COSMO PUBLICATIONS**  
**NEW DELHI** **INDIA**

Accession No. 23926  
ST. L. LIBRARY  
Cal-60.  
86.  
Dated 28.2.82

**First Published 1836**

**Reprinted 1979**

*Published by :*

**Cosmo Publications**

**24-B, Ansari Road**

**New Delhi-110002**

*Printed by :*

**Mehra offset Press**

**New Delhi-110002**

## **PUBLISHER'S NOTE**

**Asia is a vast and magnificent land with a magnificent heritage of civilization and a diversity of cultural strands and traditions. Yet the Asiatic Society, since its inception in 1784 took up this broad canvas for its investigations under the scholarly leadership of its founder Sir William Jones. Dilating on this point in the first annual discourse, Sir Jones declared, "if it be asked what are the intended objects of our enquiries within these spacious limits, we answer MAN and NATURE, whatever is performed by the one or produced by the other." These memorable words have since been paraphrased in the aims and objects of the Society as "The bounds of its investigation will be the geographical limits of Asia, and within these limits its enquiries will be extended to whatever is performed by Man or produced by Nature."**

**Sir William Jones had for his colleagues a band of enthusiastic persons with scholarly bent of mind like Charles Wilkins, H. T. Colebrooke, William Chambers, H. H. Wilson, Sir John Shore, Jonathan Duncan and several others. In spite of being stationed in Civil, Military and Judicial branches of administration, they evinced keen and abiding interest in unfolding the hidden treasures of Oriental learning, and thus laid a solid foundation of the science of Indology or Orientalology, to be more precise. These illustrious scholars, undeterred by handicaps, faithfully and zealously translated the objectives outlined by the founder in their literary and scientific tracts and**

dissertations that they presented at the forum of the Society that provided an exciting new dimension to Asian studies. Sir Jones contemplated to publish these fruits of researches by the scholar-members in annual volumes for wider appreciation by the academic world, and the first volume of "ASIATIC RESEARCHES" came out under his own editorship in 1788, three years after the foundation of the Society. Sir Jones was the editor for the first six years i.e. upto 1794. Fourteen more volumes were published under the auspices of the Society upto 1839.

And now Cosmo Publications takes pride in bringing out this first authorised reprint of the "ASIATIC RESEARCHES" complete in 20 volumes. The wide range and variety of subjects dealt with in these volumes present a panoramic view of the civilization and culture of Asia in its different facets and in the different periods of history. There are no less than 367 essays, some amply illustrated in the series of 20 volumes. An analysis of subjects with a select list of names of the contributors, given below, will enlighten readers about their worth.

## **List of Subjects and Contributors :-**

### **HUMANITIES**

#### **1. *Antiquities*.....30 articles.**

Charles Wilkins, William Chambers, John Shore, William Jones, F. Wilford, H. T. Colebrooke, Jonathan Duncan, H.H. Wilson.

#### **2. *History* .....31 articles.**

F. Wilford, William Jones, A. Sterling, H.H. Wilson  
W. Hunter, J. Prinsep, John Crawford.

**3. *Language & Literature*.....37 articles.**

**W. Jones, W. Marsden, H.T. Colebrooke, F. Balfour,  
J. Leyden, B.H. Hodgson, A. Csoma de Koros.**

**4. *Religion, Manners,***

***Customs and Music*... . 47 articles.**

**W. Jones, H. Vansittart, H. Colebrooke, F. Buchanan,  
J. Duncan, J. D. Patterson, J. Leyden, W. Carey, John  
Crawford, H. H. Wilson, B. H. Hodgson, Capt. James  
Low.**

**5. *Coins Weights & Measures*...3 articles.**

**H. T. Colebrook, Jonathan Duncan, William Jones,  
F. Balfour.**

**SCIENTIFIC**

**1. *Mathematical & Physical***

***Sciences* ..... 67 articles.**

**T. D. Pearse, R. Burrow, W. Jones, F. Balfour, John  
Playfair, R.H. Colebrooke, W. Hunter, F. Wilford,  
W. Lambton, J. Bentley, H.T. Colebrooke, J.D. Herbert,  
J. Prinsep, G. Everest.**

**2. *Geology*..... 27 articles.**

**H.W. Voysey, J.D. Herbert, P.T. Cautley, H. Piddington,  
J.G. Gerard, James Prinsep.**

**3. *Zoology*.....34 articles.**

**W. Jones, H.T. Colebrooke, B.H. Hodgson, P.T. Cautley,  
H.W. Voysey, R. Everest.**

**4. *Botany*.....20 articles.**

**W. Jones, W. Roxburgh, W. Hunter, F. Buchanan,  
H.T. Colebrooke, N. Wallich.**

**5. Geography .....24 articles.**

**S. Turner, R. H. Colebrooke, W. Hunter, J. T. Blunt,  
W. Lambton, A. Sterling, J.D. Herbert, R. Wilcox,  
B.H. Hodgson.**

**6. Ethnography.....16 articles.**

**W. Jones, J. Rawlins, J. Eliot, J. Crisp, R. Wilcox,  
W. Hunter, J. Prinsep, William Chambers.**

**7. Chemistry.....2 articles.**

**J. Prinsep.**

**8. Economic & Statistics.....29 articles.**

**W. Hunter, Col. Polier, H. T. Prinsep, J. Prinsep,  
Dr. Voysey, J.F. Royale.**

# CONTENTS

I.	Page
<i>Sivatherium Giganteum</i> , a New Fossil Ruminant Genus from the Valley of the Markanda, in the Siválik Branch of the Sub-Himálayan Mountains. By Hugh Falconer, M. D., Superintendent Botanical Garden, Saháranpur, and Captain P. T. Cautley, Superintendent, Doáb Canal, .....	1
II.	
<i>Note on the Fossil Crocodile, of the Siválik Hills.</i> By Captain P. T. Cautley, Superintendent, Doáb Canal, .....	25
<i>The Fossil Ghariál of the Siválik Hills,</i> .....	32
III.	
<i>Note on the Fossil Hippopotamus of the Siválik Hills.</i> By Hugh Falconer, M. D., Superintendent Botanical Garden, Saháranpur, and Captain P. T. Cautley, Superintendent, Doáb Canal, .....	39
IV.	
<i>Specimens of the Hippopotamus and other Fossil Genera of the Sub-Himálayas in the Dádápur Collection.</i> By Lieutenant H. M. Durand, Engineers, .....	54
V.	
<i>Indication of a New Genus of the Carnivora, with Description of the Species on which it is founded.</i> By B. H. Hodgson, Esq., Resident in Népál, .....	60
VI.	
<i>Note of the Eurinorynchus Griseus.</i> By J. T. Pearson, Esquire, Assistant Surgeon, Curator Mus. As. Soc., .....	69



	Page
VII.	
<i>Description of three New Species of Paradoxurus, inhabiting the Southern, Central, and Northern Regions of Nèpál respectively, with Notices of the Habits and Structure of the Genus. By B. H. Hodgson, Esq., H. C. Resident in Nèpál,</i>	72
VIII.	
<i>Sketch of an undescribed Hooded Serpent, with Fangs and Maxillar Teeth. By Dr. Th. Cantor,</i>	87
IX.	
<i>Description of Two Genera of the Family of Hamamidae, Two Species of Podostemon and One Species of Kaulfussia. By William Griffith, Esq., Asst.-Surgeon, Madras Establishment,</i>	94
X.	
<i>Note on the Fossil Camel of the Siválik Hills. By Hugh Falconer, M. D., Superintendent, Botanical Garden, Sháranpur, and Captain P. T. Cautley, Superintendent, Doáb Canal,</i>	115
XI.	
<i>Note on the Felis Cristata, a New Fossil Tiger, from the Siválik Hills. By Hugh Falconer, M. D., Superintendent Botanical Garden, Sháranpur, and Captain P. T. Cautley, Superintendent, Doáb Canal,</i>	135
XII.	
<i>Notices of the Ornithology of Nèpál. By B. H. Hodgson, Esq., Resident at Katmandu,</i>	143
XIII.	
<i>Note on the Ursus Sivalensis, a New Fossil Species, from the Siválik Hills. By Captain P. T. Cautley, Superintendent, Doáb Canal, and Hugh Falconer, M. D., Superintendent, Botanical Garden, Sháranpur</i>	193
XIV.	
<i>Daily Register of the Tides at Singapore, from the 1st September 1834 to the 31st August 1835, inclusive. Observed by Mr. J. Dias,</i>	201

I.

---

**SIVATHERIUM GIGANTEUM,  
A NEW FOSSIL RUMINANT GENUS**

**FROM THE VALLEY OF THE MARKANDA, IN THE SIVA'LIK BRANCH  
OF THE SUB-HIMA'LAYAN MOUNTAINS.**

---

**BY HUGH FALCONER, M. D.**

*Superintendent Botanical Garden, Saháranpur,*

AND

**CAPTAIN P. T. CAUTLEY,**

*Superintendent, Doáb Canal.*

---

THE fossil which we are about to describe forms a new accession to extinct Zoology. This circumstance alone would give much interest to it. But in addition, the large size, surpassing the Rhinoceros; the family of Mammalia to which it belongs; and the forms of structure which it exhibits; render the *Sivatherium* one of the most remarkable of the past tenants of the globe, that have hitherto been detected in the more recent strata.

Of the numerous fossil mammiiferous genera discovered and established by CUVIER, all were confined to the Pachydermata. The species belonging to other families, have all their living representatives on the earth. Among the Ruminantia, no remarkable deviation from existing types has hitherto been discovered, the fossil being closely allied to living species. The isolated position, however, of the Giraffe and the Camelidæ, made it probable, that certain genera have become extinct, which formed the

connecting links between those and the other genera of the family, and further between the Ruminantia and the Pachydermata. In the Sivatherium\* we have a ruminant of this description connecting the family with the Pachydermata, and at the same time so marked by individual peculiarities as to be without an analogue in its order.

The fossil remain of the Sivatherium, from which our description is taken, is a remarkably perfect head. When discovered, it was fortunately so completely enveloped by a mass of stone, that although it had long been exposed to be acted upon as a boulder in a water course, all the more important parts of structure had been preserved. The block might have been passed over, but for an edging of the teeth in relief from it, which gave promise of something additional concealed. After much labour, the hard crystalline covering of stone was so successfully removed, that the huge head now stands out with a couple of horns between the orbits, broken only near their tips, and the nasal bones projected in a free arch, high above the chaffron. All the molars on both sides of the jaw are present and singularly perfect. The only mutilation is at the vertex of the

\* We have named the fossil, *Sivatherium*, from SIVA, the Hindú god, and *θηριον βελυκ*. The *Siválík* or Sub-Himálayan range of hills, is considered in the Hindu mythology, as the *Látík* or edge of the roof of SIVA's dwelling in the *Himálaya*, and hence they are called the *Siva-ala* or *Sib-ala*, which by an easy transition of sound became the *Sewálík* of the English. The fossil has been discovered in a tract which may be included in the *Sewálík* range, and we have given the name of *Sivatherium* to it, to commemorate this remarkable formation so rich in new animals. Another derivation of the name of the hills, as explained by the *Mahant* or High Priest at *Dekhra*, is as follows :

*Sewálík*, a corruption of *Siva-wála*, a name given to the tract of mountains between the Jumna and Ganges, from having been the residence of Iwara SIVA and his son GANE's, who under the form of an Elephant had charge of the Westerly portion from the village of *Dúdhlí* to the Jumna, which portion is also called *Gangaja*, *gaja* being in Hindí an Elephant. That portion Eastward from *Dúdhlí* or between that village and *Haridwár* is called *Deodhar*, from its being the especial residence of *Deota* or Iwara SIVA : the whole tract however between the Jumna and Ganges is called *Siva-ala*, or the habitation of SIVA : unde der. *Sewálík*.

cranium where the plane of the occipital meets that of the brow : and at the muzzle which is truncated a little way in front of the first molar. The only parts which are still concealed, are a portion of the occipital, the zygomatic fossæ on both sides, and the base of the cranium over the sphenoid bone.

The form of the head is so singular and grotesque that the first glance at it strikes one with surprise. The prominent features are—1st, the great size approaching that of the Elephant : 2d, the immense developement and width of the cranium behind the orbits : 3d, the two divergent osseous cores for horns starting out from the brow between the orbits : 4th, the form and direction of the nasal bones, rising with great prominence out of the chaffron, and overhanging the external nostrils in a pointed arch : 5th, the great massiveness, width and shortness of the face forward from the orbits : 6th, the great angle at which the grinding plane of the molars deviates upwards from that of the base of the skull.

Viewed in lateral profile, the form and direction of the horns, and the rise and sweep in the bones of the nose, give a character to the head widely differing from that of any other animal. The nose looks something like that of the Rhinoceros : but the resemblance is deceptive, and only owing to the muzzle being truncated. Seen from in front, the head is somewhat wedge-shaped, the greatest width being at the vertex and thence gradually compressed towards the muzzle ; with contraction only at two points behind the orbits and under the malars. The zygomatic arches are almost concealed and nowise prominent : the brow is broad, and flat, and swelling laterally into two convexities ; the orbits are wide apart, and have the appearance of being thrown far forward, from the great production of the frontal upwards. There are no crests or ridges : the surface of the cranium is smooth, the lines are in curves, with no angularity. From the vertex to the root of the nose, the plane of the brow is in a straight line, with a slight rise between the horns. The accompanying drawings will at once give a better idea of the form than any description.

Now in detail of individual parts; and to commence with the most important and characteristic, the teeth:

There are six molars on either side of the upper jaw. The third of the series, or last milk molar, has given place to the corresponding permanent tooth, the detrition of which and of the last molar is well advanced and indicates the animal to have been more than adult.

The teeth are in every respect those of a ruminant with some slight individual peculiarities.

The three posterior or double molars are composed of two portions or semi-cylinders, each of which incloses, when partially worn down, a double crescent of enamel the convexity of which is turned inwards. The last molar, as is normal in ruminants, has no additional complication, like that in the corresponding tooth of the lower jaw. The plane of grinding slopes from the outer margin inwards. The general form is exactly that of an ox or camel, on a large scale. The ridges of enamel are unequally in relief, and the hollows between them unequally scooped. Each semi-cylinder has its outer surface, in horizontal section, formed of three salient knuckles, with two intermediate sinuses; and its inner surface, of a simple arch or curve. But there are certain peculiarities by which the teeth differ from those of other ruminants.

In correspondence with the shortness of jaw, the width of the teeth is much greater in proportion to the length than is usual in the family: the width of the third and fourth molars being to the length as 2.24 and 2.2 to 1.55 and 1.68 inches, respectively; and the average width of the whole series being to the length as 2.13 to 1.76 inches. Their form is less prismatic: the base of the shaft swelling out into a bulge or collar, from which the inner surface slopes outward as it rises; so that the coronal becomes somewhat contracted: in the third molar, the width at the coronal is 1.93, at the bulge of the shaft 2.24. The ridges and hollows on the outer surface descend less upon the shaft, and disappear upon the bulge. There are no accessory pillars on the furrow of junction at the inner side. The crescentic

plates of enamel have a character which distinguishes them from all known ruminants: the inner crescent, instead of sweeping in a nearly simple curve, runs zig-zag-wise in large sinuous flexures, somewhat resembling the form in the *Elasmotherium*.

The three double molars differ from each other only in their relative states of wearing. The antepenultimate, being most worn, has the crescentic plates less curved, more approximate and less distinct: the penultimate and last molars are less worn, and have the markings more distinct.

The three anterior or simple molars have the usual form, which holds in *Ruminantia*, a single semi-cylinder, with but one pair of crescents. The first one is much worn and partly mutilated: the second is more entire, having been a shorter time in use, and finely exhibits the flexuous curves in the sweep of the enamel of the inner crescent: the last one has the simple form of the permanent tooth which replaces the last milk molar: it also shews the wavy form of the enamel.

Regarding the position of the teeth in the jaw; the last four molars, viz. the three permanent and the last of replacement, run in a straight line, and on the opposite sides are parallel and equi-distant: the two anterior ones are suddenly directed inwards, so as to be a good deal approximated. If the two first molars were not thus inflected, the opposite lines of teeth would form exactly two sides of a square: the length of the line of teeth, and the intervals between the outer surfaces of the four last molars, being almost equal, viz. 9.8 and 9.9 inches respectively.

The plane of detrition of the whole series of molars from rear to front is not horizontal, but in a slight curve, and directed upwards at a considerable angle with the base of the skull: so that when the head is placed, so as to rest upon the occipital condyles and the last molar, a plane through these points is cut by a chord along the curve of detrition of the whole

series of molars at an angle of about 45°. This is one of the marked characters about the head :

***DIMENSIONS OF THE TEETH.***

	<i>Length.</i> <i>Inches.</i>	<i>Breadth.</i> <i>Inches.</i>
Last molar right side, .....	—	2.35
Penultimate do. ....	2.20	2.38
Antepenultimate do. ....	1.08	2.20
Last simple molar, .....	1.55	2.24
Second do. do. ....	1.70	1.95
First do. do. ....	1.70	1.90
	<i>Outer</i> <i>Surfaces.</i>	<i>Inner</i> <i>Surfaces.</i>
Interval between the surfaces of last molar, .....	9.9	5.5
Do. do. do. third molar, .....	9.8	5.5
Do. do. do. second do. ....	8.4	4.5
Do. do. do. first do. ....	6.4	3.2

Space occupied by the line of molars 9.8 inches.

*Bones of the Head and Face.*—From the age of the animal to which the head had belonged, the bones had become anchylosed at their commissures, so that every trace of suture has disappeared, and their limits and connections are not distinguishable.

The frontal is broad and flat, and slightly concave at its upper half. It expands laterally into two considerable swellings at the vertex, and sweeps down to join the temporals in an ample curve; and with no angularity. It becomes narrower forwards, to behind the orbits; and then expands again in sending off an apophysis to join with the malar bone, and complete the posterior circuit of the orbit. The width of the bone where narrowest, behind the orbit, is very great, being 16.2 inches. Partly between and partly to the rear of the orbits, there arise by a broad base passing insensibly into the frontal two short thick conical processes. They taper rapidly to a point, a little way below which they are mutilated in

# SIVATHERIUM

from a skull of the same animal

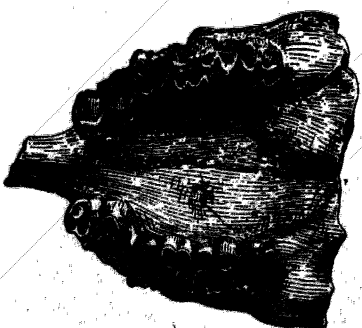


# GIGANTHEUM

of the megatherium



PLATE I



Illustrated by J. J. Hensley, from drawings by J. J. Hensley





the fossil. They start so erect from the brow that their axis is perpendicular to their basement: and they diverge at a considerable angle. From their base upwards they are free from any rugosities, their surface being smooth and even. They are evidently the osseous cores of two intra-orbital horns. From their position and size they form one of the most remarkable features in the head. The connections of the frontal are nowhere distinguishable, no mark of a suture remaining. At the upper end of the bone the skull is fractured and the structure of the bone is exposed. The internal and outer plates are seen to be widely separated, and the interval to be occupied by large cells, formed by an expansion of the diploe into plates as in the Elephant. The interval exceeds  $2\frac{1}{2}$  inches in the occipital. On the left side of the frontal, the swelling at the vertex, has its upper lamina of bone removed, and the cast of the cells exhibits a surface of almond-shaped or oblong eminences with smooth hollows between.

The temporal is greatly concealed by a quantity of the stony matrix, which has not been removed from the temporal fossa. No trace of the squamous suture remains to mark its limits and connection with the frontal. The inferior processes of the bone about the auditory foramen have been destroyed or are concealed by stone. The zygomatic process is long and runs forward to join the corresponding apophysis of the jugal bone, with little prominence or convexity. A line produced along it would pass in front, through the tuberosities of the maxillaries, and to the rear along the upper margin of the occipital condyles. The process is stout and thick. The temporal fossa is very long and rather shallow. It does not rise up high on the side of the cranium; it is overarched by the cylinder-like sides of the frontal bone. The position and form of the articulating surface with the lower jaw are concealed by stone which has not been removed.

There is nothing in the fossil to enable us to determine the form and limits of the parietal bones: the cranium being chiefly mutilated in the region which they occupy. But they appear to have had the

same form and character as in the ox : to have been intimately united with the occipitals, and to have joined with the frontal at the upper angle of the skull.

The form and characters of the occipital are very marked. It occupies a large space, having width proportioned to that of the frontal, and considerable height. It is expanded laterally into two alæ, which commence at the upper margin of the foramen magnum and proceed upwards and outwards. These alæ are smooth, and are hollowed out downwards and outwards from near the condyles towards the mastoid region of the temporal. Their inner or axine margins proceed in a ridge arising from the border of the occipital foramen, diverging from each other nearly at right angles, and enclose a large triangular fossa into which they descend abruptly. This fossa, is chiefly occupied by stone in the fossil, but it does not appear shallow, and seems a modification of the same structure as in the Elephant. There is no appearance of an occipital crest or protuberance. The bone is mutilated at the sides towards the junction with the temporals. Both here and at its upper fractured margin its structure is seen to be formed of large cells with the diploe expanded into plates, and the outer and inner laminæ wide apart. This character is very marked at its upper margin, where its cells appear to join on with those of the frontal. The condyles are very large and fortunately very perfect in the fossil, the longest diameter of each is 4.4 inches, and the distance measured, across the foramen magnum, from their outer angles, is 7.4 inches : dimensions exceeding those of the Elephant. Their form is exactly as in the Ruminantia, viz. their outer surface composed of two convexities meeting at a rounded angle : one in the line of the long axis stretching obliquely backwards from the anterior border of the foramen magnum ; on the other forwards and upwards from the posterior margin, their line of commissure being in the direction of the transverse diameter of the foramen. The latter is also of large size, its antero-posterior diameter being 2.3 inches, and the transverse diameter 2.6 inches. The large dimensions of the foramen

and condyles must entail a corresponding developement in the vertebræ, and modify the form of the neck and anterior extremities.

The sphenoidal bone, and all the parts along the base of the skull from the occipital foramen to the palate are either removed or so concealed by stone as to give no characters for description.

The part of the brow from which the nasal bones commence is not distinguishable. The suture connecting them with the frontal is completely obliterated : and it is not seen whether they run up into a sinus in that bone, or how they join on with it. Between the horns there is a rise in the brow, which sinks again a little forward. A short way in advance of a line connecting the anterior angles of the orbits, there is another rise in the brow. From this point, which may be considered their base, the nasal bones commence ascending from the plane of the brow, at a considerable angle. They are broad and well arched at their base, and proceed forward with a convex outline, getting rapidly narrower, to terminate in a point curved downwards, which overhangs the external nostrils. For a considerable part of their length they are joined to the maxillaries : but forwards from the point where they commence narrowing, their lower edge is free and separated from the maxillaries by a wide sinus : so that viewed in lateral profile their form very much resembles the upper mandible of a hawk, detached from the lower. Unluckily in the fossil, the anterior margins of the maxillaries are mutilated, so that the exact length of the nasal bone that was free from connection with them cannot be determined. As the fossil stands, about four inches of the lower edge of the nasals, measured along the curve, are free. The same mutilation prevents its being seen how near the incisives approached the nasals, with which they do not appear to have been joined. This point is one of great importance, from the structure it implies in the soft parts about the nose. The height and form of the nasal bones, are the most remarkable feature in the head : viewed from above they are seen to taper rapidly from

a broad base to a sharp point ; and the vertical height of their most convex part above the brow at their base, is  $3\frac{1}{2}$  inches.

The form of the maxillaries is strongly marked in two respects : 1st, their shortness compared with their great width and depth : 2d, in the upward direction of the line of alveoli from the last molar forwards, giving the appearance (with the licence of language intended to convey an idea of resemblance without implying more) as if the face had been pushed upwards to correspond with the rise in the nasals ; or fixed on at an angle with the base of the cranium. The tendency to shortness of the jaw was observed in the dimensions of the teeth, the molars being compressed, and their width exceeding their length to an extent not usual in the Ruminantia. The width apart, between the maxillaries, was noticed before ; the interval, between the outer surfaces of the alveoli, equalling the space in length occupied by the line of molars. The cheek tuberosities are very large and prominent, their diameter at the base being 2 inches and the width of the jaw over them being 12.2 inches, whereas at the alveoli it is but 9.8 inches. They are situated over the third and fourth molars ; and proceeding up from them towards the malar, there is an indistinct ridge on the bone. The infra-orbitary foramen is of large size, its vertical diameter being 1.9 inch ; it is placed over the first molar as in the ox and deer tribe. The muzzle portion of the bone is broken off at about 2.8 inches from the 1st molar, from the alveolar margin of which, to the surface of the diastema, there is an abrupt sink of 1.7 inch. The muzzle is here contracted to 5.8 inches, and forwards at the truncated part to about 4.1. The palatine arch is convex from rear to front, and concave across. No trace of the palatine foramina remains, nor of the suture with the proper palatine bones. The spheno-palatine apophyses and all back to the foramen magnum\* are

---

\* With the exception of a portion of the basilar region, which resembles that of the Ruminants.

either removed or concealed in stone. In front, the mutilation of the bone, at the muzzle, does not allow it to be seen, how the incisive bones were connected with the maxillaries : but it appears that they did not reach so high on the maxillaries as the union of the latter with the nasals. The same cause has rendered obscure the connections of the maxillaries with the nasals, and the depth and size of the nasal echancrure or sinus.

The jugal bone is deep, massive and rather prominent. Its lower border falls off abruptly in a hollow descending on the maxillaries : the upper enters largely into the formation of the orbit. The posterior orbital process unites with a corresponding apophysis of the frontal to complete the circuit of the orbit behind. The zygomatic apophysis is stout and thick, and rather flat. No part of the arch, either in the temporal or jugal portions is prominent : the interval between the most salient points being greatly less than the hind part of the cranium, and slightly less than the width between the bodies of the jugals.

The extent and form of the lachrymals, cannot be made out, as there is no trace of a suture remaining. Upon the fossil, the surface of the lachrymary region passes smoothly into that of the adjoining bones. There is no perforation of the lower and anterior margin of the orbit by lachrymary foramina, nor any hollow below it indicating an infra-orbital or lachrymary sinus. It may be also added, what was omitted before, that there is no trace of a superciliary foramen upon the frontal.

The orbits are placed far forwards, in consequence of the great production of the cranium upwards, and the shortness of the bones of the face. Their position is also rather low, their centre being about 3.6 inches below the plane of the brow. From a little injury done in chisseling off the stone, the form or circle of the different orbits does not exactly correspond. In the one of the left side, which is the more perfect, the long axis makes a small angle with that of the plane of the brow : the antero-posterior diameter is 3.3 inches, and the vertical 2.7 inches. There is no prominence or inequality in the rim of the orbits, as in the Ruminantia. The plane

of the rim is very oblique: the interval between the upper or frontal margins of the two orbits being 12.2 inches, and that of the lower or molar margin 16.2 inches.

**\*DIMENSIONS OF THE SKULL OF THE SIVATHERIUM GIGANTEUM.**

*Eng. Inches. Mètres.*

From the anterior margin of the foramen magnum to the alveolus of 1st molar, ..	18.85	.478
From do. to the truncated extremity of the muzzle, .....	20.6	.5268
From do. to the posterior margin of the last molar, .....	10.3	.262
From the tip of the nasals to the upper fractured margin of the cranium, .....	18.0	.4568
From do. do. to do. along the curve, .....	19.0	.4822
From do. do. along the curve, to where the nasal arch begins to rise from the brow, .....	7.8	.198
From the latter point to the fractured margin of the cranium, .....	11.2	.284
From the tip of the nasals to a chord across the tips of the horns, .....	8.5	.216
From the anterior angle, right orbit, to the first molar, .....	9.9	.251
From the posterior do. do. to the fractured margin of the cranium, .....	12.1	.3075
Width of cranium at the vertex (mutilation at left side restored), about .....	22.0	.559
Do. between the orbits, upper borders, .....	12.2	.3095
Do. .... do. lower borders, .....	16.2	.4108
Do. behind the orbits at the contraction of the frontal, .....	14.6	.3705
Do. between the middle of the zygomatic arches, .....	16.4	.4168
Do. between the bodies of the malar bones, .....	16.62	.422
Do. base of the skull behind the mastoid processes (mutilated on both sides,) ..	19.5	.496
Do. between the cheek tuberosities of the maxillaries, .....	12.2	.3095
Do. of muzzle portion of the maxillaries in front of the first molar, .....	5.8	.149
Do. of do. where truncated (partly restored,) .....	4.1	.104
Do. between the outer surfaces of the horns at their base, .....	12.5	.312
Do. .. do. .... do. fractured tips of ditto, ....	13.65	.347
Perpendicular from a chord across tips of do. to the brow, .....	4.2	.105
Depth from the convexity of the occipital condyles to middle of frontal behind the horns, .....	11.9	.302
Do. from the body of the sphenoidal to do. between the horns, .....	9.94	.252
Do. from middle of the palate between the 3d and 4th molars do. at root of the nasals, .....	7.52	.192
Do. from posterior surface last molar to extremity of the nasals, .....	13.0	.331
Do. from grinding surface penultimate molar to root of the nasals, .....	10.3	.262
Do. from the convexity near the tip of the nasals to the palatal surface in front of the first molar, .....	5.53	.14

\* To facilitate comparison with the large animals described in CUVIER's Ossements Fossiles, the dimensions are also given in French measure.

		Eng. Inches.	Mètres.
Depth from middle of the ala of the occipital to the swell at vertex of frontal, ..		8.98	.228
Do. from inferior margin of the orbit to grinding surface 5th molar, .....		7.3	.186
Do. from the grinding surface 1st molar to edge of the palate in front of it, ....		2.6	.066
Space from the anterior angle of orbit to tip of the nasals, .....		10.2	.2595
Antero-posterior diameter left orbit,.....		3.3	.084
Vertical	do. do. ....	2.7	.0685
Antero-posterior diameter of the foramen magnum, .....		2.3	.058
Transverse	do. do.....	2.6	.066
Long diameter of each condyle, .....		4.4	.112
Short or transverse do. of do. ....		2.4	.0603
Interval between the external angles of do. measured across the foramen, .....		7.4	.188

Among a quantity of bones collected in the neighbourhood of the spot in which the skull was found, there is a fragment of the lower jaw of a very large ruminant which we have no doubt belonged to the *Sivatherium*: and it is even not improbable that it came from the same individual with the head described. It consists of the hind portion of the right jaw broken off at the anterior third of the last molar. The coronoid apophysis, the condyle, with the corresponding part of the ramus, and a portion of the angle are also removed. The two posterior thirds only, of the last molar, remain; the grinding surface partly mutilated, but sufficiently distinct to show the crescentic plates of enamel, and prove that the tooth belonged to a ruminant. The outline of the jaw in vertical section, is a compressed ellipse, and the outer surface more convex than the inner. The bone thins off, on the inner side towards the angle of the jaw, into a large and well marked muscular hollow: and running up from the latter, upon the ramus towards the foramen of the artery there is a well defined furrow, as in the *Ruminantia*. The surface of the tooth is covered with very small rugosities, and striæ, as in the upper molars of the head. It had been composed of three semi-cylinders, as is normal in the family, and the advanced state of its wearing proves the animal from which it proceeded to have been more than adult.



The form and relative proportions of the jaw agree very closely with those of the corresponding parts of a buffalo. The dimensions compared with those of the buffalo and camel are thus :

	<i>Sivatherium.</i>	<i>Buffalo.</i>	<i>Camel.</i>
Depth of the jaw from the alveolus last molar, .....	4.95 inch.	2.65 inch.	2.70 inch.
Greatest thickness of do. ....	2.3	1.05	1.4
Width of middle of last molar, .....	1.35	0.64	0.76
Length of posterior 2-3d of do. ....	2.15	0.95	1.15

No known ruminant, fossil or existing, has a jaw of such large size ; the average dimensions above given being more than double those of a Buffalo, which measured in length of head 19.2 inches (.489 mètres); and exceeding those of the corresponding parts of the Rhinoceros. We have therefore no hesitation in referring the fragment to the *Sivatherium Giganteum*.

The above comprises all that we know regarding the osteology of the head from an actual examination of the parts. We have not been so fortunate hitherto, as to meet with any other remain, comprising the anterior part of the muzzle either of the upper or lower jaw.\* We shall now proceed to deduce the form of the deficient parts, and the structure of the head generally, to the extent that may be legitimately inferred, from the data of which we are in possession.

Notwithstanding the singularly perfect condition of the head, for an organic remain of such enormous size, we cannot but regret the mutilation

---

\* In a note received from Captain CAUTLEY while this paper is in the press, that gentleman mentions the discovery of a portion of the skeleton of a *Sivatherium* in another part of the hills : See *Journal As. Soc. Vol. IV.* " During my recent trip to the *Sindliks* near the Pinjör valley, the field of Messrs. BAKER and DURAND's labours, I regretted much my inability to obtain the dimensions of one of the most superb fossils I suppose that ever was found. It was unfortunately discovered and excavated by a party of work people employed by a gentleman with whom I was unacquainted, and although I saw the fossil when in the rock, I was prevented from getting the measurements afterwards. This specimen consisted of the femur and tibia, with the tarsal, metatarsal, and phalanges of our *Sivatherium*." It is much to be regretted that such an opportunity should have been lost of adding to the information already acquired of this new and gigantic Ruminant.—SEC.

**CAMELUS SIVALENSIS**  
*A linear dentatus*

Fig. 8

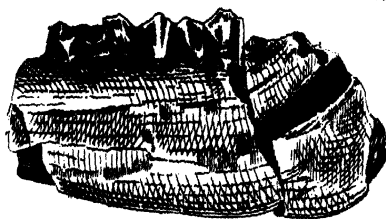


Fig. 9

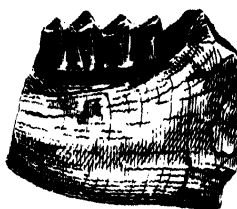


Fig. 10



Fig. 11



Fig. 12



Fig. 13



**FELIS CAINTATA**  
*A linear dentatus*

Fig. 1



Fig. 2

The skull showing the form of the teeth and the jaw.





at the muzzle and vertex, as it throws a doubt upon some very interesting points of structure in the *Sivatherium*: 1st, the presence or absence of incisive and canine teeth in the upper jaw, and their number and character if present; 2d, the number and extent of the bones which enter into the basis of the external nostrils; and 3d, the presence or absence of two horns on the vertex, besides the two intra-orbital ones.

Regarding the first point. we have nothing sufficient to guide us with certainty to a conclusion, as there are ruminants both with and without incisives and canines in the upper jaw; and the *Sivatherium* differs most materially in structure from both sections. But there are two conditions of analogy which render it probable that there were no incisives. In all ruminants which have the molars in a contiguous and normal series, and which have horns on the brow, there are no incisive teeth. In the Camel and its congeners, where the anterior molars is unsymmetrical and separated from the rest of the series by an interval, incisives are present in the upper jaw. The *Sivatherium* had horns, and its molars were in a contiguous series: it is therefore probable that it had no incisives. Regarding the canines there is no clue to a conjecture, as there are species in the same genus of ruminants both with and without them. 2. The extent and connections of the incisive bones are points of great interest, from the kind of developement which they imply in the soft parts appended to them.

In most of the horned ruminantia, the incisives run up by a narrow apophysis along the anterior margins of the maxillary bones, and join on to a portion of the sides of the nasals; so that the bony basis of the external nostrils is formed of but two pairs of bones, the nasals and the incisives. In the Camel, the apophyses of the incisives terminate upon the maxillaries without reaching the nasals, and there are three pairs of bones to the external nostrils, the nasals, maxillaries and incisives. But neither in the horned ruminants, nor in the Camel and its congeners, do the bones of the nose rise out of the plane of the brow with any remarkable degree of saliency, nor are their lower margins free to any great extent towards the

apex. They are long slips of bone, with nearly parallel edges, running between the upper borders of the maxillaries, and joined to the ascending process of the incisive bone, near their extremity, or connected only with the maxillaries ; but in neither case projecting so as to form any considerable re-entering angle, or sinus, with these bones.

In our fossil, the form and connections of the nasal bones, are very different. Instead of running forward in the same plane with the brow, they rise from it at a rounded angle of about  $130^{\circ}$ , an amount of saliency without example among ruminants, and exceeding what holds in the Rhinoceros, Tapir, and Palæotherium, the only herbivorous animals with this sort of structure. Instead of being in nearly parallel slips, they are broad, and well arched at their base, and converge rapidly to a sharp tip which is hooked downwards over-arching the external nostrils. Along a considerable portion of their length they are unconnected with the adjoining bones, their lower margins being free and so wide apart from the maxillaries, as to leave a gap or sinus of considerable length and depth in the bony parietes of the nostrils. The exact extent to which they are free, is unfortunately not shown in the fossil, as the anterior margin of the maxillaries is mutilated on both sides, and the connection with the incisives destroyed. But as the nasal bones shoot forward beyond the mutilated edge of the maxillaries, this circumstance, together with their well defined outline and symmetry on both sides of the fossil, and their rapid convergence to a point with some convexity, leaves not a doubt that they were free to a great extent and unconnected with the incisives.

Now to determine the conditions in the fleshy parts, which the structure in the bony parietes of the nostrils entails.

The analogies are to be sought for in the ruminantia and pachydermata.

The remarkable saliency of the bones of the nose in the Sivatherium, has no parallel, in known ruminants, to guide us ; and the connection of the nasals with the incisives, or the reverse, does not imply any important difference in structure in the family. In the Bovine section, the Ox and

the Buffalo have the nasals and incisives connected: whereas they are separate in the Yâk\* and Aurochs. In the Camel, they are also separate, and this animal has greater mobility in the upper lip than is found in other ruminants.

In the Pachydermata, both these conditions of structure are present and wanting, in different genera; and their presence or absence is accompanied with very important differences in the form of the corresponding soft parts. It is therefore in this family that we are to look for an explanation of what is found in the Sivatherium.

In the Elephant and Mastodon, the Tapir, Rhinoceros and Palæotherium there are three pairs of bones to the external nostrils; the nasals, the maxillaries and incisives.† In all these animals, the upper lip is highly developed, so as to be prehensile as in the Rhinoceros, or extended into a trunk as in the Elephant and Tapir; the amount of developement being accompanied with corresponding difference in the position and form of the nasal bones. In the Rhinoceros they are long and thick, extending to the point of the muzzle, and of great strength to support the horns of the animal: and the upper lip is broad, thick and very mobile, but little elongated. In the Elephant they are very short, and the incisives enormously developed for the insertion of the tusks, and the trunk is of great length. In the Tapir they are short and free except at the base, and projected high above the maxillaries; and the structure is accompanied by a well developed trunk. In the other pachydermatous genera, there are but two pairs of bones to the external nostrils, the nasals and the incisives: the latter running up so as to join on with the former; and the nasals, instead of being short and salient, with a sinus laterally between them and the maxillaries, are long and run forward united to the maxillaries, more or less resembling the nearly parallel slips of the Ruminantia. Of this genera

---

\* CUVIER. *Ossements Fossiles*, tome iv. p. 131.

† CUVIER. *Ossements Fossiles*, tome iii. p. 29.

the horse has the upper lip endowed with considerable mobility ; and the lower end of the nasals is at the same time free to a small extent. In all the other genera, there is nothing resembling a prehensile organ in the upper lip.

In the Sivatherium, the same kind of structure holds, as is found in the Pachydermata with trunks. Of these it most nearly resembles the Tapir. It differs chiefly in the bones of the nose being larger and more salient from the Chaffron ; and in there being less width and depth to the nasomaxillary sinus, than the Tapir exhibits. But as the essential points of structure are alike in both, there is no doubt that the Sivatherium was invested with a trunk like the Tapir.

This conclusion is further borne out by other analogies although more indirect than that afforded by the nasal bones.

1st.—The large size of the infra-orbitary foramen. In the fossil the exact dimensions are indistinct, from the margin having been injured in the chisseling off of the matrix of stone: the vertical diameter we make out to be 1.2 inch, which perhaps may be somewhat greater than the truth: but any thing approaching this size, would indicate a large nerve for transmission and a highly developed condition of the upper lip.

2d.—The external plate of the bones of the cranium is widely separated from the inner, by an expansion of the diploe into vertical plates, forming large cells, as in the cranium of the Elephant: and the occipital is expanded laterally into alæ, with a considerable hollow between, as in the Elephant. Both these conditions are modifications of structure, adapted for supplying an extensive surface for muscular attachment, and imply a thick fleshy neck, with limited range of motion; and, in more remote sequence, go to prove the necessity of a trunk.

3d.—The very large size of the occipital condyles, which are greater both in proportion and in actual measurement than those of the Elephant, the interval between their outer angles, taken across the occipital foramen, being 7.4 inches. The atlas, and the rest of the series of cervical vertebræ,

must have been of proportionate diameter to receive and sustain the condyles, and surrounded by a large mass of flesh. Both these circumstances would tend greatly to limit the range of motion of the head and neck. But to suit the herbivorous habits of the animal, it must have had some other mode of reaching its food ; or the vertebræ must have been elongated in a ratio to their diameter sufficient to admit of free motion to the neck. In the latter case the neck must have been of great length, and to support it and the load of muscles about it, an immense developement would be required in the spinal apophysis of the dorsal vertebræ, and in the whole anterior extremity, with an unwieldy form of the body generally. It is therefore more probable that the vertebræ were condensed as in the Elephant, and the neck short and thick, admitting of limited motion to the head : circumstances indirectly corroborating the existence of a trunk.

4th.—The face is short, broad and massive, to an extent not found in the Ruminantia, and somewhat resembling that of the Elephant, and suitable for the attachment of a trunk.

Next with regard to the horns :—

There can be no doubt, that the two thick short and conical processes between the orbits, were the cores of horns, resembling those of the Bovine and Antilopine sections of the Ruminantia. They are smooth, and run evenly into the brow without any burr. The horny sheaths which they bore, must have been straight, thick, and not much elongated. None of the bicorned Ruminantia have horns placed in the same way, exactly between and over the orbits : they have them more or less to the rear. The only ruminant which has horns similar in position is the four-horned Antelope\* of Hindustán, which differs only in having its anterior pair of horns a little more in advance of the orbits, than occurs in the Sivatherium. The correspondence of the

---

\* The *Tetracerus* or *Antelope Quadricornis* and *Chehara* of authors.



two at once suggests the question, "had the Sivatherium also two additional horns on the vertex?" The cranium in the fossil is mutilated across at the vertex, so as to deprive us of direct evidence on the point, but the following reasons render the supposition at least probable:

1st.—As above stated, in the bi-cavicorned Ruminantia the osseous cores are placed more or less to the rear of the orbits.

2d.—In such known species as have four horns, the supplementary pair is between the orbits, and the normal pair well back upon the frontal.

3d.—In the Bovine section of Ruminantia, the frontal is contracted behind the orbits, and upwards from the contraction it is expanded again into two swellings at the lateral angles of the vertex which run into the bases of the osseous cores of the horns. This conformation does not exist in such of the Ruminantia as want horns or as have them approximated on the brow. It is present in the Sivatherium.

On either supposition, the intra-orbitary horns are a remarkable feature in the fossil: and if they were a solitary pair on the head, the structure, from their position, would perhaps be more singular, than if there had been two additional horns behind.

Now to estimate the length of the deficient portion of the muzzle, and the entire length of the head:—

In most of the Ruminantia where the molars are in a contiguous uninterrupted series, the interval from the first molar to the anterior border of the incisive bones is nearly equal to the space occupied by the molars; in some greater, in some a little less, and generally the latter. In other Ruminantia such as the Camelidæ, where the anterior molars are insymmetrical with the others, and separated from them by being placed in the middle of the diasteme this ratio does not hold; the space from the first molar to the margin of the incisives being less than the line of molars. In the Sivatherium the molars are in a contiguous series, and if on this analogy we deduce the length of the muzzle, we get nearly 10 inches for the space from the first

molar to the point of the incisives ; and 28.85 inches for the whole length of the head, from the border of the occipital foramen to the margin of the incisives ; these dimensions may be a little excessive, but we believe them not to be far out, as the muzzle would still be short for the width of the face, in a ruminant.

The orbits next come to be considered. The size and position of the eye form a distinguishing feature between the Ruminantia and the Pachydermata. In the former it is large and full, in the latter smaller and sunken ; and the expression of the face is more heavy in consequence. In the Sivatherium the orbit is considerably smaller in proportion to the size of the head than in existing ruminants. It is also placed more forward in the face, and lower under the level of the brow. The rim is not raised and prominent as in the Ruminantia, and the plane of it is oblique ; the interval between the orbits at their upper margin being 19.2 inches, and at the lower 16.2 inches. The longitudinal diameter exceeds the vertical in the ratio of 5 to 4 nearly, the long axis being nearly in a line from the naso-maxillary sinus across the hind limb of the zygomatic circle. From the above we infer that the eye was smaller and less prominent than in existing ruminants : and that the expression of the face was heavier and more ignoble, although less so than in the Pachydermata, excepting the horse ; also that the direction of vision was considerably forwards as well as lateral, and that it was cut off, towards the rear.

This closes what we have been led to infer regarding the organs of the head. With respect to the rest of the skeleton, we have nothing to offer, as we are not at present possessed of any other remains which we can with certainty refer to the Sivatherium.\* Among a quantity of bones† collected from the same neighbourhood with the head fossil, there are three singularly

---

\* See Note to page 17. Sec.

† We note here a very perfect cervical vertebra of a Ruminant in our possession, which must have belonged to an animal of proportions equal to that of the Sivatherium, but from certain

perfect specimens of the lower portions of the extremities of a large ruminant, belonging to three legs of one individual. They greatly exceed the size of any known ruminant, and excepting the *Sivatherium Giganteum*, there is no other ascertained animal of the order, in our collection, of proportionate size to them. We forbear from further noticing them at present, as they appear small in comparison for our fossil : and besides, there are indications in our collection, in teeth and other remains, of other large ruminants, different from the one we have described.

The form of the vertebrae and more especially of the carpi and tarsi, are points of great interest, to be ascertained ; as we may expect modifications of the usual type adapted to the large size of the animal. From its bulk and armed head, few animals could be strong enough to contend with it, and we may expect that its extremities were constructed more to give support, than for rapidity of motion. But, in the rich harvest which we still hope to reap in the valleys of the *Markanda*, it is probable that specimens to illustrate the greater part of the osteology of the *Sivatherium* will at no very distant period be found.

The structure of the teeth suggests an idea regarding the peculiarities of the herbivorous habits of the animal. In the description it was noticed that the inner central plate of enamel ran in a flexuous sweep, somewhat resembling what is seen in the *Elasmotherium*, an arrangement evidently intended to increase the grinding power of the teeth. It may hence be inferred, that the food of the *Sivatherium* was less herbaceous than that of existing horned ruminants, and derived from leaves and twigs : or that as in the horse, the food was more completely masticated, the digestive organs less complicated, the body less bulky, and the necessity of regurgitation from the stomach less marked than in the present Ruminantia.

---

characters, we are inclined to suspect that it is allied to some other gigantic species of Ruminant, of the existence of which we have already a tolerable certainty. Of the existence of the Elk, and a species of Camelidae, Lieut. BAKER of the Engineers has shown us ample proof.

# CAMELUS SIVALENSIS

Linear dimensions

Plate.

Fig



Fig. 3

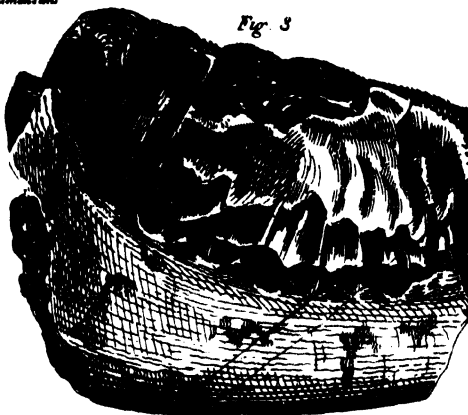


Fig 2



Fig. 7

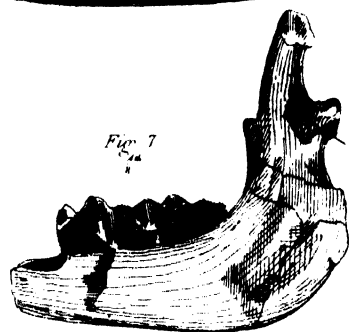
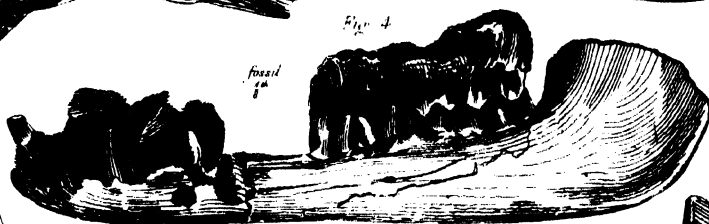
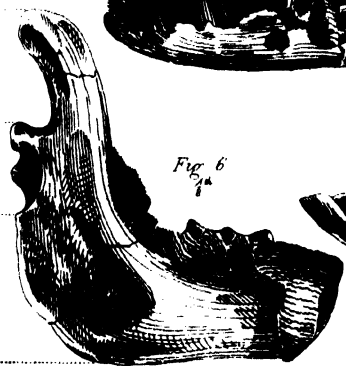


Fig. 4



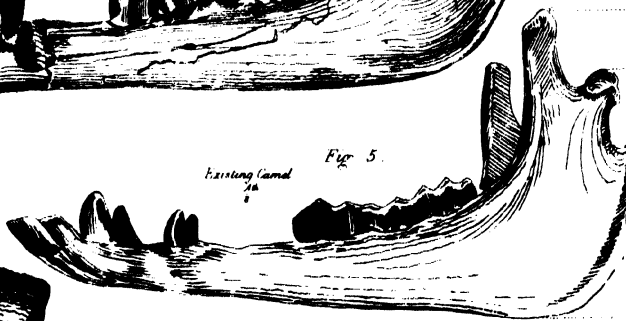
fossil  
7/8

Fig 6



Existing Camel  
7/8

Fig 5





The following dimensions contrasted with those of the Elephant and Rhinoceros, will afford a tolerably accurate idea of the size of the Sivatherium. They are characteristic although not numerous :—

	<i>Elephant.</i>	<i>Sivatherium.</i>	<i>Indian 1-horned Rhinoceros.</i>
From margin of foramen magnum to the first molar, ..	23.10 inch.	18.85 inch.	24.9 inch.
Greatest width of the cranium, .....	26.0	22.0	19.05
Do. do. of face between the malar bones, .....	18.5	16.62	9.20
Greatest depth of the skull, .....	17.60	11.9	11.05
Long diameter of the foramen magnum, .....	2.55	2.6	2.6
Short do. do. do. ....	2.4	2.3	1.5
Average of the above, .....	15.08	12.38	10.22

If the view which we have taken of the fossil be correct, the Sivatherium was a very remarkable animal, and it fills up an important blank in the interval between the Ruminantia and Pachydermata. That it was a ruminant, the teeth and horns most clearly establish ; and the structure which we have inferred of the upper lip, the osteology of the face, and the size and position of the orbit, approximate it to the Pachydermata. The circumstance of any thing approaching a proboscis is so abnormal for a ruminant, that at the first view, it might raise a doubt, regarding the correctness of the ordinal position assigned to the fossil : but when we inquire further, the difficulty ceases.

In the Pachydermata, there are genera with a trunk, and others without a trace of it. This organ is therefore not essential to the constitution of the order, but accidental to the size of the head, or habits of the animal in certain genera. Thus in the Elephant, nature has given a short neck to support the huge head, the enormous tusks and the large grinding apparatus of the animal ; and by such an arrangement, the construction of the rest of the frame is saved from the disturbance which a long neck would have entailed. But as the lever of the head became shortened, some other method of reaching its food became necessary ; and a trunk was appended to

the mouth. We have only to apply analogous conditions to a ruminant, and a trunk is equally required. In fact, the Camel exhibits a rudimentary form of this organ, under different circumstances. The upper lip is cleft ; each of the divisions is separately moveable and extensible, so as to be an excellent organ of touch.

The fossil was discovered near the *Markanda* river, in one of the small valleys which stretch between the *Kyárda-dún* and the valley of *Pin-jór* in the *Siválik*, or Sub-himalayan belt of hills, associated with bones of the fossil Elephant, Mastodon, Rhinoceros, Hippopotamus, &c. So far as our researches yet go, the Sivatherium was not numerous. Compared with the Mastodon and Hippopotamus, (*H. Siválensis*, Nobis, a new species characterized by having six incisors in either jaw) it was very rare.

*Northern Dob, September 15, 1835.*

---

## II.

---

# NOTE

ON THE

# FOSSIL CROCODILE,

OF THE

# SIVALIK HILLS.

---

BY CAPTAIN P. T. CAUTLEY,  
*Superintendent, Doab Canal.*

---

OF the skulls of the existing Crocodile from which the measurements accompanying this note have been taken, one belongs to an animal 7 feet long of which we have the perfect skeleton; and the other was stated by the person from whom it was procured, to have belonged to an animal of 12 feet: we have a correction however in the smaller specimen, which was carefully measured; and taking this as a type, the animals being of the same species (*C. Biporcatus*, Cuvier), a mean of four measurements gives us a length of 132.09 inches, or 11 feet .09 inches, for the latter. In fixing this specimen as belonging to an animal of 11 feet, we shall not therefore be far from the truth.

There is so much difference in the few comparative measurements that we have been able to obtain of the fossil, with these two skulls, that it is hardly possible to take any proportion of the existing animal as a guide to that of the fossil: the measurements taken separately would in some cases reduce our fossil to that of an animal of 11 feet, with distinct ocular proof to the contrary; in others the fossil animal would be 17 feet long, which



may probably be somewhere near the actual size: while an assumption of 20 feet would be extending the dimensions to their utmost limit, our estimate being guided by the proportions of the species now existing in our rivers.

The fossils from which the measurements were taken, consist of two very perfect fragments; first, the anterior portion of the skull of a large and adult animal, the posterior part from the palatal sinus being wanting; in this the front of the lower jaw consisting of the left dental from the 1st to the 8th tooth, and of the right from the 1st to the 4th is fixed—the fragments of the upper and lower jaw being united: a point proving that some at least of these remains were inhumed before the disintegration of the muscles and integument connecting them; and secondly, the posterior part of the skull, from the occipital to the front of the orbits, of an adult but of a smaller animal than the preceding.

The 4th tooth in each side of the lower jaw being received into a groove into the upper—the form and size of the cranial foramina, together with those of the protuberances and indentations of the muzzle, place our fossil amongst the true Crocodiles, the species being *allied* to CUVIER'S *Biporcatus*, or the Crocodile, "*a deux arrêtes*" now existing in these rivers.

The following measurements will facilitate the reference to CUVIER'S Ossements fossiles; and be perhaps of still further use in providing the means for general reference on points relating to the existing Crocodile.

Dimensions of Skull—upper jaw— number of teeth 38.	Existing Crocodile.				Fossil.	
	11 Feet long.		7 Feet long.			
	Inches.	Metres.	Inches.	Metres.	Inches.	Metres.
Length from point of muzzle to posterior extremity or margin of occipital condyle,.....	17.1	0.435	11.3	0.286	—	—
Breadth on the temporal bones at the articulation with lower jaw, .....	11.2	0.284	6.7	0.170	—	—
Ditto between the most prominent points of the alveoli of the 15th tooth,.....	8.1	0.260	5.0	0.126	—	—
Ditto between ditto ditto 10th ditto, .....	6.7	0.170	4.2	0.107	9.2	0.234
Ditto between ditto ditto 4th ditto, .....	4.7	0.119	2.7	0.069	0.0	0.152
Length of intermaxillaries on suture below,....	3.2	0.0805	2.45	0.062	4.3	0.109
Ditto of maxillaries ditto,.....	3.9	0.099	2.4	0.060	3.8	0.096

<i>Dimensions of Cranium—upper jaw—</i>	<i>Existing Crocodile.</i>				<i>Fossil.</i>	
	<i>11 Feet long.</i>		<i>7 Feet long.</i>			
	<i>Inches.</i>	<i>Metres.</i>	<i>Inches.</i>	<i>Metres.</i>	<i>Inches.</i>	<i>Metres.</i>
Length of palatine bones on suture below,.....	5.65	0.142	3.7	0.093		
Ditto of aphenoid ditto,.....	3.4	0.086	1.75	0.044		
Extreme breadth across the pterygoid apophyses of aphenoid, .....	7.2	0.182	4.4	0.112		
Length from point of muzzle to anterior of orbit	11.6	0.290	7.3	0.186		
Ditto ditto to ditto of lachrymal bone,	8.4	0.211	5.5	0.140		
Breadth of the frontal bone on its junction with lachrymal, .....	1.9	0.048	1.1	0.027		
Ditto on the posterior frontals at their junction with the mastoid bones, .....	4.65	0.116	3.0	0.076		
Length of external nostril or nasal aperture, ..	2.05	0.052	1.40	0.035	3.1	0.079
Breadth of ditto ditto, .....	1.7	0.043	0.95	0.024	2.8	0.070
Length of crotaphite foramina or those bounded by the poster. frontal, mastoid and parietal bones, .....	1.3	0.032	0.90	0.022		
Breadth of ditto ditto ditto ditto .....	0.9	0.022	0.70	0.017		
Breadth of occipital condyle, .....	1.3	0.032	0.90	0.022		
Ditto of occipital foramen, .....	0.9	0.022	0.70	0.017		
Depth of ditto, .....	0.65	0.016	0.45	0.012		
Diameter of 4th tooth upper jaw at its alveolus,	0.5	0.126	0.30	0.008	1.0	0.026
Ditto 10th ditto ditto, .....	0.85	0.021	0.42	0.106	1.15	0.029
Length from point of muzzle to maxillary extremity of palatine bone, .....	7.05	0.180	4.8	0.122	7.9	0.20
Breadth of intermaxillaries on suture; i. e. between nasal aperture and point of muzzle,....	1.7	0.043	1.1	0.027	3.6	0.190
Width between grooves on upper jaw for receiving the 4th lower teeth, .....	3.95	0.10	2.35	0.060	5.35	0.136
<i>Lower jaw—number of teeth 30.</i>						
Length from muzzle to posterior extremity of articular bone, .....	21.5	0.548	14.2	0.36		
Extreme breadth at the articular bone, .....	10.0	0.254	6.3	0.16		
Breadth at the oval aperture formed by the junction of the three bones, .....	11.7	0.296	7.1	0.18		
Greatest depth of jaw, .....	3.5	0.088	2.3	0.058		
Length of symphysis, .....	2.95	0.074	1.8	0.046	2.9	0.073
Depth of jaw between 8th and 9th tooth, .....	1.55	0.039	0.0	0.022		
Length of oval aperture at the posterior extremity of dental bone, .....	1.85	0.048	1.1	0.027		
Depth of ditto ditto, .....	1.10	0.027	0.5	0.126		
Distance between posterior extremity of oval aperture and posterior extremity of articular bone, .....	6.55	0.167	4.0	0.102		

From the sutures being obliterated on the upper rugged surface of the fossil, the junction of the lachrymal and anterior frontal on the maxillary

bone is not observable, and as this is one of the points upon which the Cayman and Crocodile differ, it is perhaps to be regretted that this must remain at present doubtful; for although the characters above given distinguish the fossil from the Cayman, the bluntness of the muzzle and the proportions of the bones of the head do, in some respects, assimilate it with the latter sub-genus.

On the lower smooth surface the sutures are well defined, and it is on this measurement that we observe the remarkable distinction between the existing and the fossil animal: the shortness of the maxillary bones and the length of the intermaxillaries, including the nasal aperture, is a peculiarity that will be observed in the table of measurements, the former (maxillary) in the existing animal being to the latter (intermaxillary) as 3.9 is to 3.2. In the fossil as 3.8 is to 4.3. The length of the maxillary bones on the lower suture, or the space separating the palatine from the intermaxillaries, being rather greater in the existing animal of 11 feet than in the fossil. The comparative measurement from the point of the muzzle to the maxillary extremity of the palatine bone, together with those across the skull at the 10th and 4th teeth, will point out in a still clearer way the bluntness and breadth of the muzzle of the fossil animal. By the extension of the intermaxillaries and the great length of the connecting suture between the point of the muzzle and the nasal aperture, this aperture is thrown further back, so that a line drawn transversely through the grooves for receiving the 4th lower teeth, (which in the existing animal would cut the *posterior* extremity,) in the fossil, passes through the *centre* or rather in *front* of the centre of the nasal aperture.

The skulls of the true Crocodile and Cayman differ in the following points. 1. That of the Cayman is less oblong, shorter, and flatter at the muzzle. 2. The 4th tooth of the lower jaw enters into a hole in the upper, instead of a groove as in the true Crocodile. 3. They differ in the number of teeth. 4. The cranial foramina bounded by the posterior, frontal, mastoid and parietal bones, are smaller, and sometimes altogether wanting in

the Cayman. 5. The lachrymal and anterior frontal bones descend lower the Crocodiles than in the Caymans. 6. In the Cayman a part of the vomer is visible in the palate between the maxillaries and intermaxillaries. 7. The palatine bones advance more in the palate and are wider in front in the same animal. 8. The posterior nostrils are wider than they are long.

With regard to the cranial foramina of the fossil, and their proportion relatively to the surrounding bones, we are enabled, by having in our possession a very perfect fragment of the occipital region and that portion of the skull bounded by the orbits, to give the comparative measurements here also; noting that this fossil is a portion of the skull of an animal of much smaller dimensions than that from which the former measurements were taken.

	Existing Crocodile.				Fossil Crocodile.	
	11 Feet long.		7 Feet long.			
	Inches.	Mètres.	Inches.	Mètres.	Inches.	Mètres.
Length of crotaphite foramina, .....	1.30	0.032	0.9	0.022	1.40	0.036
Breadth of ditto, .....	0.90	0.022	0.70	0.017	1.0	0.026
Breadth of the frontal bone on its junction with lachrymal, .....	1.9	0.048	1.1	0.027	2.1	0.053
Ditto on posterior frontals at their junction with mastoid bones, .....	4.65	0.115	3.0	0.076	4.85	0.122
Breadth of occipital condyle, .....	1.3	0.032	0.9	0.022	1.20	0.031
Ditto of occipital foramen, .....	0.9	0.022	0.7	0.017	0.90	0.022
Depth of ditto, .....	0.65	0.016	0.45	0.012	0.60	0.015

It will be observed from the above that the fossil and the existing animal of 11 feet very closely correspond in dimensions, although the crotaphite foramina are rather larger, and the width of the bones in their neighbourhood greater in the fossil than in the existing one. This proportional excess of breadth however, is not so striking as in the measurements of the muzzle before given; although it still bears us out in the general expanded dimensions of the fossil animal.

Of the lower jaw the only comparative measurement that our discoveries have enabled us to make, is of a small portion of the anterior

extremity, shewing an extreme contraction and narrowness of the symphysis ; that of the fossil being actually less than that of the existing 11 feet Crocodile. The form of the suture is similar in each, and the internal process equally well defined.

Further than from an inspection of the plates and description of the varieties of the Cayman and Crocodile, in the 5th volume of the *Ossements Fossiles*, I am unacquainted with the form of any other head than that of the Crocodile which inhabits the Ganges and Jumna rivers in this part of India, and presume that I am correct in placing our existing animal amongst the Crocodiles "a deux arrêtes." The peculiarities of the skulls in my possession resemble those of this species, although there is a point relating to the ridges, which may as well be noted, more especially as the same feature is most prominently marked in the fossil, thereby assimilating our existing and fossil animal still closer to each other.

The ridges (in *C. Biporcatus*) are described as "proceeding from the "anterior angle of the orbit and descending in almost a parallel line along "the muzzle, and gradually disappearing." In both the fossil and existing specimens now under description the above note applies distinctly, with this exception, that the ridges partially disappear at a point half way on the nasal bones, from whence they strike off in an oblique direction right and left towards the alveoli of the 10th tooth, this oblique ridge shewing itself as prominently as that at the anterior angle of the orbit.

There is a general resemblance between the fossil and the head of the existing Crocodile which is striking. The rugosities and position of inequalities on the upper surface closely correspond ; the cranial foramina, the number of teeth, the foramina in the upper intermaxillary bones for receiving the two front teeth of the lower jaw, the grooves for the 4th teeth of the lower jaw, and the general form of the nasal aperture, are features similar in both. We may therefore fairly conclude from analogy that the Crocodile now found fossil in the upper strata of the Siválíks, is of a species closely allied to the present one, with the simple difference of possessing

*CROCODILIUS LONGIROSTRIS*, the Gharial.  
*found and existing species 1<sup>st</sup> scale*

fig. 1

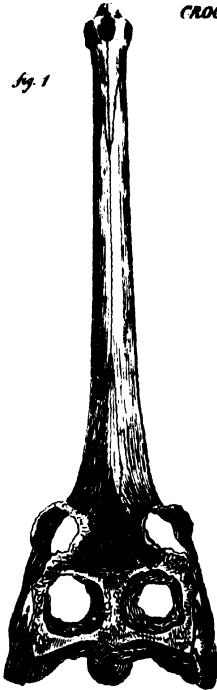
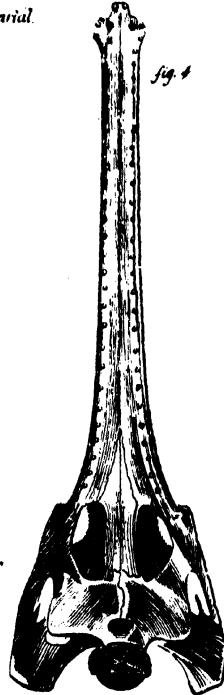


fig. 2



fig. 4



- 1 upper view skull of existing individual of 10 P. 5. 10  
 4 under do  
 2 back of do, fossil.  
 3 cranium of do do  
 under view of. 10. 3

fig. 3

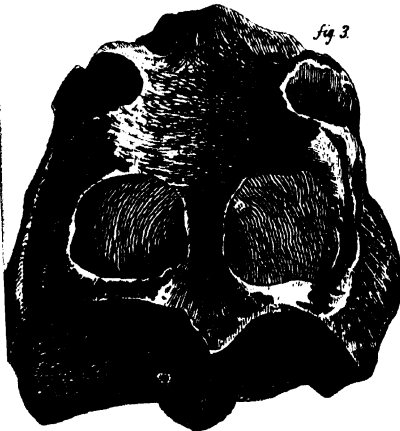
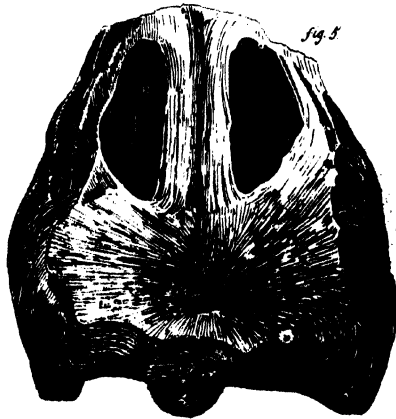


fig. 5





*ROCOWILLIUS BIPORCATUS*  
existing species  $\frac{1}{4}$  in scale.

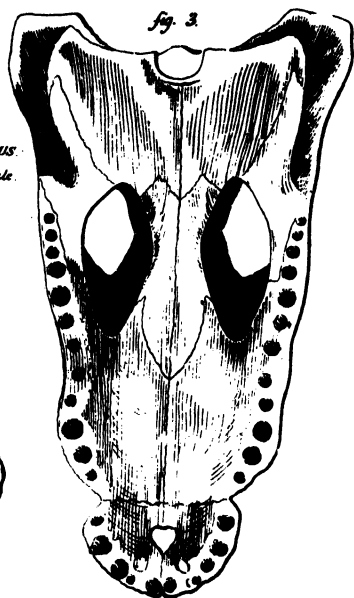


fig. 5.

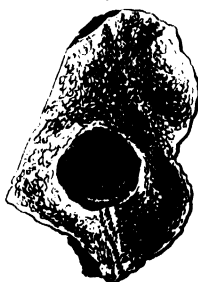


fig. 2



Basal species: variety of *C. biporcatus*  $\frac{1}{4}$  in scale.

fig. 4.

fig. 6.

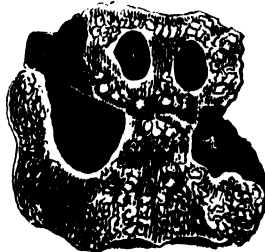
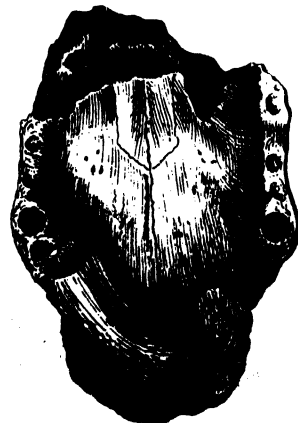


fig. 5. Fragment of muzzle, fossil.  
fig. 6. Fragment of Cranium, do.



greater width in its proportions : in which view we must be satisfied with establishing it as a fossil variety of the *C. Biporcatus* of CUVIER and the *C. Porosus* of SCHNEIDER.

In taking the numerical proportion of the fossils already found as a guide to that of the animals existing on this tract previous to the upheavement of the line of country, it would appear that the Mastodon and Elephant were the most numerous. 2, Ruminants. 3, Hippopotamus of varieties, the largest of which with six incisors, *He Sivalensis*, is in the greatest proportion. 4, Crocodile, Ghariál, and Tortoise 5, Rhinoceros, Hog, and Horse. 6, Carnivora. 7, Fish.

The remains of Saurian animals, although standing high on this list, consist chiefly of fragments of the ossaceous plates of the neck, vertebrae, detached teeth, articulating extremities of bones of the arms and legs, as well as other portions of the skeleton ; while portions of the head have been rarely found. Those referred to in this note are very perfect : others are crushed and distorted ; but the leading differences which have been adverted to, are fairly marked in all those that have come under my observation.

There appears to be a local disposition in the deposits of these remains as would be natural to expect on a varied surface of plain, forest, and marsh. The Mastodons, Elephants, &c., in great abundance at some points, give place to the Hippopotami and Saurian reptiles in others. At many places the latter, with the Tortoise, are totally wanting ; at others, as in a stratum of an impure marble attached to this upper series where fresh water shells (chiefly like the unio of the present day) were found in great abundance, nearly the whole of the remains accompanying them were those of the Crocodile and Ghariál. In considering the length of the fossil species we see no signs of any thing beyond that of the animal now existing. The largest remain in our possession is a vertebra which is one third larger than that figured in the London Geological Society's Transactions amongst the Ava fossils, and described as the remain of an enormous animal : the vertebra abovementioned is either one of the dorsal or lumbar, but the



processes are broken and imperfect; the dimensions of the barrel or cylinder are as follows :

The measurements of the 3rd Lumbar Vertebra of the existing Crocodile are here given.	Existing Crocodile. 7 feet long.		Fossil.	
	Inches.	Mètres.	Inches.	Mètres.
Extreme length, .....	1.4	0.036	4.9	0.124
Breadth under transverse apophysis, taking a mean measurement, .....	0.96	0.024	3.5	0.089

Large as the fossil may appear, the animal to which it belonged did not in all probability exceed 25 feet in length—whereas the Gangetic Crocodile of the present day is said to arrive at the enormous length of 30 feet, and in the pages of the *Calcutta Journal*, an animal of 28 feet long is recorded as having been killed by a gentleman of the Civil Service, (I believe) now residing in Calcutta.

---

## THE FOSSIL GHARIAL

### OF THE SIVĀLIK HILLS.

---

AMONGST the numerous remains of the Crocodilidean Saurians which have been found in such abundance from the oolite up to the more recent strata, it would appear that the greatest proportion has been allied to the *Gharial*,\* and that the existing Crocodile and Cayman have been almost without

---

\* The French mode of writing this word, *Gaviál*, appears to have originated in a misreading of the manuscript of some naturalist; the *r* and *v* being nearly similar in form. As *Gharial* is the correct native name, there seems no reason for perpetuating the misnomer.—SEC.

their prototypes. It is only in the strata above the chalk\* at Montmartre, and the fresh water formation at Argenton where remains have been found, which were considered by CUVIER as appertaining to the latter subgenera ; in these strata however the remains of animals of this description are scarce, and in those still more superficial abounding in the remains of the larger mammalia, in Mastodons, Hippopotami, &c., where we might naturally expect to find the Crocodile, the remains of this family have hardly I believe been found at all.

Of the fossil Crocodile brought by CRAWFORD and WALLICH from Ava, and figured in the London Geological Society's Transactions, the drawings shew a much nearer approach to the living congeners, than had, up to the period of that discovery, been found ; and although we are unacquainted with the geology of the country from which they were brought, the new varieties of the Mastodons, which appear to be common both to the Siválíks and the Irrawaddi deposits, may establish an identity between the two formations.

In the Siválíks we have upheaved alluvium ; or debris from the great Himálayas upheaved at a considerable angle ; at those points especially between the Jumna and Ganges rivers where the shingle and sand are the most developed, their appearance is similar to what we might imagine the beds of the present rivers to exhibit, were they to undergo a similar convulsion. The presence of the fossils has not been satisfactorily determined on the line between the Jumna and Ganges ; those that have been already collected in such great abundance are from the prolongation of the same line between the Sutlej and the Jumna rivers. Up to the present time they have generally been collected from the slopes of the mountains, slips, water courses, &c. They have been dug out near the village of Deoni in the Náhan Raja's territory, but at this spot the position of the stratum from which they were excavated, was not satisfactorily determined. In the Ambwalla Pass

---

\* In the London clay the remains of either the true Crocodile or Cayman with the concavo-convex vertebra are said to have been found, the species allied to *C. d. muscu eigu*, vide Parkinson Int. Org. Rem. p. 387, and also the head of an Alligator in the London clay of the Isle of Sheppey, found in 1832.

however we had the satisfaction of finding a large fragment of bone in situ, in a stratum of sand stone rock, in the face of a cliff, terminating one of those tortuous little streams that drain the steep slopes of the mountains into the main channel. The sand stone stratum in which this was found was inclined as usual in an angle of from  $2^{\circ}$  to  $30^{\circ}$ —and the position of the fossil was perhaps 600 feet from the bed of the main river. In the present state of the enquiry this fact is interesting, for it appears that in the many slips that have been visited and most carefully examined, no fossils have been found actually in the rock, with the exception of the instances above mentioned. The fossils are evidently not confined to the sand-stone; the clays and clayey conglomerates have their proportion also.

Of the Crocodile of these strata I have attempted in the preceding section to shew as far as measurements and my limited means point out, that the main difference between the fossil and the existing animal of the present rivers is in the breadth; a difference that might tend to an opinion of its being allied to the Cayman, did not other more distinct characters separate it at once from that subgenus. In the *Gharial* now under review I am unable to recognize any difference from the living animal; and there are certain peculiarities about the external surface of the skull of the existing *Gharial*, in slight indentations and rugosities, which are singularly coincident with the fossil. The following measurements are taken from two recent skulls, one of an animal 10 feet 5 inches long. and the other 8 feet 8 inches long:—the measurements of the fossil, from a very perfect skull with the beak broken off, which is evidently the remain of a large animal.

UPPER JAW. Number of Teeth, 56.	Existing <i>Gharial</i> .				Fossil <i>Gharial</i> .	
	10 Feet 5 Inches long.		8 Feet 8 Inches long.			
	Inches.	Mètres.	Inches.	Mètres.	Inches.	Mètres.
Extreme length from point of muzzle to outer margin of occipital condyle, .....	22.7	0.577	19.5	0.495		
Breadth on the temporal bones at the articulation with lower jaw,...	8.2	0.21	6.5	0.166		
Ditto on the 20th tooth,.....	4.3	0.108	3.4	0.086	9.3	0.236
Ditto on the 20th tooth,.....	1.95	0.049	1.5	0.038		

UPPER JAW. Number of Teeth, 56.	Existing Gharial.				Fossil Gharial.	
	10 Feet 5 Inches long.		8 Feet 8 Inches long.			
	Inches.	Mètres.	Inches.	Mètres.	Inches.	Mètres.
Length of intermaxillary on suture (below), .....	5.1	0.129	4.4	0.111		
Ditto maxillaries ditto, .....	8.8	0.223	7.9	0.200		
Ditto palatine bone ditto, .....	4.8	0.121	3.8	0.096		
Ditto sphenoid do. to anterior margin of foramen, .....	1.65	0.042	1.4	0.035	3.5	0.081
Extreme breadth on pterygoid apophysis of sphenoid, .....	5.3	0.133	4.15	0.106		
Length from tip of muzzle to anterior of orbit, .....	16.4	0.416	16.4	0.368		
Ditto do. do. of lachrymal bone, ..	14.4	0.366	12.2	0.309		
Breadth of frontal between orbits at the junction with the anterior frontal, .....	2.4	0.060	1.95	0.049	4.9	0.124
Ditto of parietal bones between crotaphite foramina, .....	0.55	0.014	0.65	0.016	1.0	0.026
Length of external nostril, .....	1.1	0.027	0.85	0.021		
Breadth of ditto, .....	0.9	0.022	0.60	0.015		
Length of crotaphite foramina, or those in rear of orbits, .....	2.0	0.051	1.4	0.035	3.3	0.083
Breadth of ditto ditto, .....	2.15	0.055	1.6	0.040	3.8	0.096
Ditto of occipital condyle, .....	1.2	0.030	0.95	0.024	2.5	0.064
Length of occipital foramen, .....	0.9	0.022	0.80	0.020	1.4	0.035
Depth of ditto ditto, .....	0.65	0.016	0.45	0.012	0.9	0.022
Length of palatine sinus, .....	2.65	0.068	2.35	0.059	4.9	0.124
Breadth of ditto, .....	1.4	0.035	1.10	0.048	2.4	0.060
Length from point of muzzle to anterior extreme of palatine sinus, ..	16.45	0.418	14.3	0.361		
Length of upper table of cranium between the anterior margin of the orbits and the posterior mastoid apophysis, .....	5.8	0.147	4.7	0.120	10.4	0.264
Breadth of ditto ditto ditto, .....	6.0	0.152	4.7	0.120	11.4	0.289
LOWER JAW.						
Number of Teeth, 50.						
Length of symphysis, .....	15.1	0.384	13.1	0.332		
Ditto on prolongation to posterior extreme of articular bone, .....	10.7	0.271	9.3	0.236		
Breadth on articular bones, .....	8.6	0.218	5.8	0.147		
Ditto on 23d tooth, .....	3.0	0.076	2.5	0.064		
„ 15th ditto, .....	1.6	0.040	1.3	0.032		
„ 3d ditto, .....	1.55	0.039	1.3	0.032		
„ 2d ditto, .....	1.85	0.047	1.6	0.040		
„ 1st ditto, .....	1.4	0.035	1.2	0.030		
Length of oval hole at posterior extreme of dental, .....	1.35	0.034	1.3	0.032		
Depth of ditto, .....	0.6	0.0155	0.45	0.012		
Ditto of jaw on this oval hole, ..	2.0	0.050	1.5	0.038		
Ditto on the 15th tooth, .....	0.9	0.022	0.7	0.017		

This fossil is water worn, and some of the projecting bones, especially of the sphenoid, are mutilated at the extremities; but the general character of the head, and the form and position of the foramina, &c. appear to correspond completely with that of the existing *Gharial*.

There is no approach to any of the peculiarities pointed out by CUVIER in the Caen and other fossils. On the upper surface we have, in the frontal, the same concavity between the orbits; the same form of the crotaphite foramina, with the parietal surface between them of the same comparative width; the posterior frontal separating the orbit from the crotaphite foramina corresponds; the form of the mastoid bones both in themselves and at their articulation with the apophysis of the os tympani, strictly agree with the existing *Gharial* of the present rivers.—The same may be said of the lateral and lower faces, in the external widening out of the pterygoid apophyses, in the situation of the hinder nasal fossa; the elevation of the orbital edge of the pyal; with the deep emargination, the form and proportions of the jugal; with the temporal fossa, and the sharp elongated internal process of the squamous bone: the form of the palatine holes, and the relative situation of the teeth to these holes, are points all of which agree with the living animal!

The animal to which this fossil belonged was not quite 20 feet long—the complete head from the tip of the muzzle to the posterior margin of the occipital condyle being about 47 inches. The measurements which I have made of the existing *Gharial* shew the proportion of the head to the length of animal as 1 to 5.

The following measurements of another fragment, consisting of the anterior extremity of the beak or muzzle of the upper jaw will still further go to establish the resemblance.

	Existing Animal.				Fossil.	
	10 Feet 5 Inches long.		8 Feet 8 Inches long.			
	Inches.	Mètres.	Inches.	Mètres.	Inches.	Mètres.
Length of intermaxillary on suture below, .....	5.11	0.129	4.4	0.111	8.30	0.210
Breadth on 9th tooth, .....	1.55	0.038	1.25	0.031	2.70	0.069
Ditto 4th „ .....	2.00	0.050	1.60	0.040	3.40	0.086
Ditto 3d „ .....	2.20	0.055	1.80	0.045	4.00	0.101
Ditto 1st „ .....	0.70	0.017	0.60	0.015	1.40	0.035
Depth on 9th tooth, .....	0.90	0.022	0.70	0.017	1.40	0.035

The above is the remain of a smaller animal than the former one, shewing the alveoli and some of the teeth, as far back as the 10th, on each side of the maxillaries. A more perfect resemblance to the living animal than this could not well be conceived; and it moreover establishes, in the absence of a connected beak and skull, that the fossil animal had precisely the same number of teeth with the living species. The suture connecting the intermaxillaries with the maxillaries is fortunately strongly marked in the fossil; the posterior point of the suture occurring opposite the 9th tooth, exactly as it does in the existing animal. The teeth, the form of anterior extremity of muzzle, the outer nasal aperture, with the lower indentations, correspond in every way; and, to descend still further to minutiae, at the commencement of the suture connecting the intermaxillaries and maxillaries, at a point in the former bone immediately in front of the 8th tooth is a small hollow or indentation: this hollow exists in the same situation and bears the same form in our fossil *Ghariál*.

Of the lower jaw we have only an imperfect fragment of the two branches connected at the commencement of the symphysis:—from the extreme hardness of the crystalline rock in which it is imbedded, we are unable to see further than that the angle of these branches corresponds with the existing animal, a point however which is proved by the fragments of skull which are in our possession, and which, imperfect as they are at the muzzle extremity, shew distinctly the commencement of that tapering form which is peculiar to the *Ghariál* of the present rivers.

In volume 5, of the *Ossemens Fossiles*, CUVIER, in recapitulating the peculiarities and differences between the Crocodiles and *Ghariáls*, says of the latter “Les pterygoidiens forment au dessus des palatins des espèces de grosses vessies renflées et ovales de la grosseur d’un œuf de poule, au lieu d’une simple voute cylindrique comme dans les Crocodiles et les Caimans, &c.,” and then “Je n’ai point observé cette vessie dans le petit *Gaviál*, mais je suppose d’autant plus qu’elle est un produit de l’âge

“ que, dans les vieux Crocodiles des Indes, cet endroit est beaucoup plus renflé que dans les jeunes.”

These demi-cylindrical swellings are highly developed in the 10 feet 5 inches specimen of which the measurements have been given ; whereas in the smaller and younger animal measuring 8 feet 8 inches, there is no appearance of them ; the sphenoid portion lying under the palatine and extending up to the anterior frontal's apophysis, in a flat uninflated laminated bone. From the little difference that exists between the bones of the *Ghariál* and of the Crocodile, we are unable to separate the remains of one from those of the other ; a great quantity have been found, teeth, osseous plates, ribs, vertebræ, &c., the latter, having the concavo-convex body, and the sacral vertebræ, with their transverse processes compressed and cylindrical, agree in every respect with the existing animal.

*Northern Dob, October 1, 1835.*

Plates II. and III., lithographed subsequently to the printing of the above description, illustrate the Author's observations on the comparison of the fossil with the existing species of *Crocodile* and *Ghariál*. The necessary explanations are given on the Plates. SEC.

---

III.

---

N O T E

ON THE

FOSSIL HIPPOPOTAMUS

OF THE

SIVALIK HILLS.

---

BY HUGH FALCONER, M. D.,

*Superintendent Botanical Garden, Saharanpur,*

AND

CAPTAIN P. T. CAUTLEY,

*Superintendent, Doab Canal.*

---

FROM the abundant remains of this genus that have been procured from the Siválíks, and particularly the perfect specimens now in our own possession, we are at no loss in recognizing the characters which distinguish the Siválík species so remarkably not only from the existing Hippopotamus of Africa, but also from the fossil species hitherto found and described.

The great point of peculiarity is, that the Siválík fossil has six incisors of a character peculiar to itself, independent of the form of cranium which differs very materially from other varieties. The numerous fragments in our collection enable the proportions of the bones of the head and face to be very tolerably ascertained; and these, added to three nearly entire skulls, one of which is that of an animal just approaching adult, and the other two of a more advanced age, are so perfect as to leave no doubt of the characteristic distinctions of one or more new species.



To the fossil variety now to be described, we propose the name *Siválensis*, a name so far applicable as attaching it to its locality and commemorating the region in which its remains have been scattered in such profusion.

In the African Hippopotamus figured by CUVIER and so fully described in the first volume of the *Ossemens Fossiles*, we find the incisors consisting of four slightly curved teeth in the upper, and in the lower jaw four straight teeth projecting forwards at an obtuse angle with the plane of the grinding surface, the two centre ones being of considerably larger proportions than the others, and being formidable weapons either for tearing the roots and weeds from which the animal derives its nourishment or for defence. In the fossil Hippopotamus before us these large and powerful teeth are replaced by others of a smaller size but in a greater number, there being no less than six, those in the upper jaw being slightly curved downwards, and those in the lower projecting forwards; the diameter of these teeth, which are cylinders with truncated ends, is less in the upper than in the lower jaw, and the central teeth may be considered as being in some degree larger than those on the right and left. When we advert to the uses to which the incisive teeth of this unwieldy animal are applied, the means of tearing up the food, and the sieve to cleanse that food afterwards;\* we see in this form of tooth, and this arrangement of the muzzle an adaptation to the wants as perfect as, although for defence less powerful than, in the existing species. With the six incisors our fossil animal has the canine teeth of the upper jaw with a uniform outline in transverse section, whilst

---

\* Vide *Lancet*:—Prof. GRANT's *Lectures*.

that of the lower jaw is pyriform or pear shaped. The molars resemble those of the existing species, and are numerically the same, the first milk or deciduous tooth which, as in the Horse, falls and is not again replaced, is here also conspicuous.

In proceeding to a comparison between the fossil head and that of the Cape Hippopotamus, we are at once struck with the position of the orbit of the Sivalik fossil. Viewing it in profile, the orbit is considerably more advanced and the general contour of the head thereby modified ;—taking a measurement from the posterior extremity of the occipital condyle, to the anterior ridge of the orbit, and from that point to the front of the muzzle, we have in the existing animal a proportion of 3 to 5 and in the fossil 9 to 13½, giving to the orbit of the latter a more central position on the face ; this peculiarity leads to the muzzle and the zygomatic arch being separated by a hollow much more abrupt and much shorter on its antero-posterior line than in the Cape Hippopotamus. The anterior termination of the zygomatic arch on the malar angle is more acute, and the general form of this arch more prominent. The temporal fossæ are longer, and the temporal apophysis in its descent to join the malar bone is slightly inclined forwards, placing the posterior angle of the zygomatic arch in a more advanced position and more in front of the occipital surface than in the existing animal. The occipital crest is also more elevated, and the general appearance differs, owing to this position of the orbit ; which, as will be naturally concluded, leads to a different proportion in the bones of the head ; those of the cranium being lengthened, whilst those of the face are shortened in proportion respectively. In the suture separating the temporal apophysis from the jugal, we see the same direction and inclination as in the existing animal.

We will here introduce the table of measurements in juxtaposition with CUVIER's of the Hippopotamus of the Cape, and of the European fossil.

Dimensions of Skull.	Existing Hippopotamus.		Fossil Hippopotamus.					
	Africa.		Europe.		Siválík 1st.		Siválík 2d.	
	Inches.	Mètres.	Inches.	Mètres.	Inches.	Mètres.	Inches.	Mètres.
Length from the posterior surface of occipital condyle to the alveolus of the middle incisors, .....	....	....	....	....	....	....	22.6	.566
Length from the upper margin of one orbit to the other, to the rear, .....	9.85	.249	11.85	.300	....	....	12.4	.315
Ditto greatest width of zygomatic arches, .....	15.75	.400	17.7	.450	....	....	14.4	.366
Width of head over the suborbital foramen, .....	4.75	.120	5.7	.145	3.75	.95	4.34	.110
Height of ditto ditto from the border of alveoli, .....	5.1	.130	6.3	.160	4.45	.114	5.3	.134
Distance of posterior extremity zygomatic apophysis of malar from suborbital foramen, ....	10.65	.270	13.4	.340	....	....	11.25	.285
From ditto to the middle of occipital crest, .....	10.25	.260	12.6	.320	....	....	10.25	.260
Antero posterior diameter of orbits, .....	2.8	.070	3.55	.090	2.30	.058	2.63	.067
Greatest interval between inner side of zygomatic arch and surface of cranium, .....	5.1	.130	5.1	.130	....	....	3.8	.096
Height of head from posterior border occipital foramen to top of occipital crest, .....	5.5	.140	7.5	.190	5.7	.144	6.8	.173
Width of head between inferior angles of occipital crests, ....	11.0	.280	12.8	.325	8.8	.224	9.7	.246
Length of occipital foramen, ....	2.0	.050	2.6	.066	2.0	.050	2.48	.062
Width of ditto, .....	1.6	.040	1.6	.040	1.3	.032	1.5	.038
Length of line of molars, .....	10.25	.260	11.85	.300	10.5	.266	9.46	.240
Distance between alveolus of first molar and canine, .....	4.3	.110	6.7	.170	....	....	1.4	.035
From summit of occipital crest to alveolus of middle incisors, ..	25.2	.640	29.9	.760	....	....	23.15	.588
From ditto to anterior margin of orbit, .....	....	....	....	....	9.0	.228	10.2	.250
From anterior margin of orbit to alveoli of middle incisive, ....	....	....	....	....	....	....	12.4	.314
Vertical diameter of orbits, ....	....	....	....	....	2.4	.06	2.3	.058
Interval between alveolus of first or deciduous molar and middle incisors, .....	6.8	.170	8.3	.210	....	....	3.8	.096
Width of cranium in rear of the frontal angle, .....	....	....	....	....	3.7	.093	4.4	.112

The Siválik fossil noted as No. 1 is a perfect skull with the exception of the incisive bones, and fortunately exhibits the sutures on the upper surface ; a second specimen consisting of the occipital and parietal regions with the frontal as far forward as the front of the orbits ; and a third fragment consisting of the incisive bones and teeth with the anterior extremity of the nasals and maxillaries, are those from which we draw a comparison on the bones on the upper and lower surface, and on the form and position of the molars.

On the upper surface of the fossil the chaffron instead of running in a flat line slightly concave as in the existing animal, is considerably depressed in the region between the orbits, the superior ridges of which are elevated in proportion, and stand considerably forward on the cranium. From the remarks on the elongated form of the temporal fossa it may be hardly necessary to advert to the similar extension of the sagittal crest, which is proportionally longer, and more marked, with a greater elevation at its junction with the occipital. The broken and fractured boundaries of the nasal aperture in all our specimens of skulls, will not admit of our measurements extending to that point, but we are able from a fragment above referred to, containing the incisive bones and nasal aperture, to note, that the nasal bones are advanced as far forward as those in the living animal, so that a straight line touches their anterior extremities drawn from the front of the canine alveolus on one side to that on the other. The nasal bones do not expand so much towards the rear as in the existing Hippopotamus, and that part connected with the frontal is more blunt and rounded ; the distance between the nasal bone and the orbit and the lachrymal juncture is comparatively larger. The lacrymals descend upon the jugal much the same as in the existing animal, but they appear to advance considerably more forward on the face, the anterior extremity in conjunction with the nasal and maxillary being exactly over the last vicarious molar, whereas that figured by CUVIER represents this point as over the second true molar. The suborbital foramen is also more advanced and the hollow in which it is situated, formed by the bulge of the jugal and

canine alveolus, is as we before remarked more abrupt. The figure of the muzzle is very similar to the African variety, with a modification in the form of the incisives adapted to the particular form of the teeth. The width of the muzzle is comparatively greater, but the separation of the whole into four bluff swellings with the spaces intervening for the incisive sutures, is a point which has a close resemblance in the existing animal.

The frontal angle is more acute in the fossil ; the coronal crest runs more obliquely backwards, and the antero-posterior length of the frontal is twice as much as in the African. From the rounded form of the nasal suture in its contact with this bone, the anterior part of the frontal forms a tongue bounded by the lachrymal in front and by the nasal and orbit on the two sides. From the depth of the temporal fossa, as in the existing animal, the width of the cranium is somewhat less than that of the muzzle over the suborbital foramina, and the interval between the inner side of the zygomatic arch and the surface of the cranium is somewhat less than the width of the cranium.

On the lower surface we are unfortunately not so well provided with sutures to guide us in our comparative dimensions ; for, with the exception of those between the lines of molars which are in themselves not very distinct, there are none whatever. The position of the bones in rear of the palatal sinus appears to correspond with that of the existing animal, although the relative dimensions and proportions will, it is supposed, be modified by the peculiarities described in the upper surface, and dependent on the lengthened form of this region. The basillary mastoid apophyses, and the slightly concave surface of the glenoid cavity, appear to resemble those of the Cape Hippopotamus ; this latter cavity is more in rear of the most salient projection of the zygomatic arches than in the living animal. In the form and position of the molars the only remark that may be made is on the non-parallelism of the lines : CUVIER describes those of the Cape Hippopotamus as parallel but slightly curving outwards towards the front (*un peu écartées en avant*) ; we see some difference in our different specimens, but in all, there is a curving outwards both in front and rear, the middle of the palate being the

most contracted. This curving outwards is most shewn towards the front where the lines of molars appear to attempt a parallelism with the outer line of the maxillary bone, instead of running parallel to each other. The space between the most advanced molar and the canine is very much smaller in the fossil than in the existing animal, a point that may depend perhaps on the substitution of the six small incisors requiring but small alveoli, for the large ones (especially the two central) require a much larger surface and a much greater depth to admit of their being securely fixed. The palate is, as in the living animal, marked by a deep fissure in front, between the incisive bones; and the suture appears similar; but this is not very distinct in the fragment from which we draw our comparisons; the two incisive holes are very distinct, but those referred to by CUVIER as commencing on the edge of the maxillaries in a small channel and terminating on the incisives by another hole, are not so distinctly marked, although it is by no means improbable that in clearing the fossil which is imbedded in a hard and crystalline sandstone, the two holes have been made into one; we have before noted the fissure separating the incisive bones, and those (not so strongly marked but equally open outwardly) of the junction between the incisives and maxillaries, or that space between the canine and the third incisive. The extremity of the muzzle in front of the two canines, forms part of a circle; if this segment be divided into seven equal parts, and one part given to each echancrure (of which there are three), and two parts to each of the incisive bones containing the alveoli of the incisors; a tolerable idea of the proportions of this region will be obtained. The incisors of the upper jaw as before remarked are in diameter smaller than those of the lower; they project but slightly from the alveoli, are directed downwards, and obliquely truncated on their internal faces.

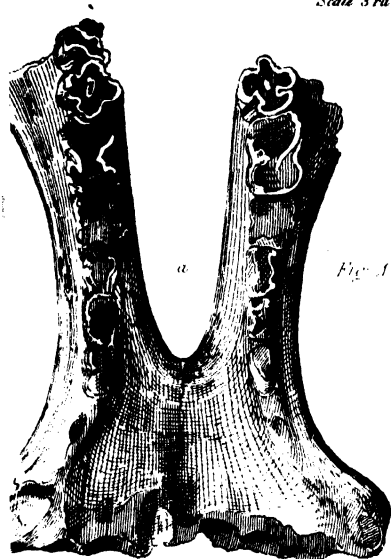
It now merely remains with us to compare the occipital face with that of the African animal which may be best done by a reference to our table of measurements. We note however the great difference in the proportions in breadth to height, which in the above animal are as 2 to 1, whereas in the

Siválik fossil the proportion is as 3 to 2, shewing as was before remarked an increased height of the occipital crest.—To proceed therefore to the lower jaw :

In comparing the lower jaw with that of the existing animal, independently of the additional incisors, we have a marked difference and distinction in the form of the ramus, the enormous descending process of which is if any thing more extravagantly developed. This strange appendage peculiar to the genus, and formed for the attachment of the masseter and temporal muscles is here of a form less tapering and more deep and massive in its proportions than in the existing animal ; the posterior margin is more round and the anterior, or that descending from the base of the maxillary bone, which in the existing animal is curved and pointed forwards, is here blunt and unmarked by any peculiarity of form. This angle is inclined outwards, and the outer surface is as depressed for the reception of the muscles as that of the living Hippopotamus. We observe no increase of height in the coronoid process, but it differs from the living animal in not being projected so much forward. There appears to be no difference in the condyles nor in their position with reference to the form of the jaw ; the line of the grinding surface (the specimen from which we draw this description is a lower jaw joined at the symphysis, and only broken at the posterior extremities) is inclined to the outwardly curved direction, described as a peculiarity in the upper surface : the teeth do not appear to differ from those of the animal now living, but the space between the front molar and the canine is, as in the upper jaw, more contracted. The canines protrude from the alveoli considerably, in a curve slightly inclined backwards at the point, which is obliquely truncated on the internal surface, from the root or point where it leaves the alveolus to the tip. The space for the incisors and the incisive teeth themselves differ as was before remarked, from the existing animal, the large central incisors of which are here replaced by much smaller ones. The number of incisors in the fossil is six, of nearly equal dimensions, cylindrical, inclined outwards at an obtuse angle to the plane

*Fossil HIPPOPOTAMUS of the Sub Himalayas.*  
*Scale 3rd of natural dimensions*

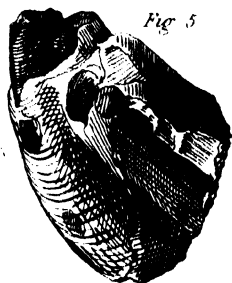
*Plate*



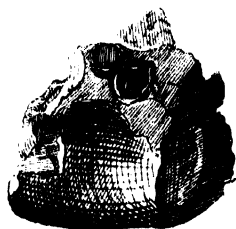
*Fig. 1*



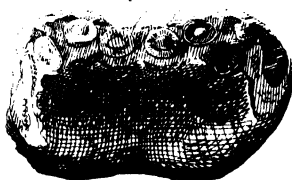
*Fig. 2*



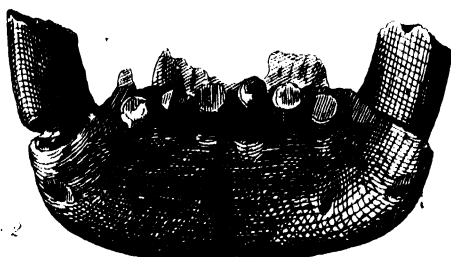
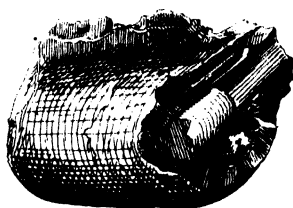
*Fig. 3*



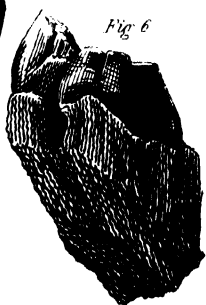
*Fig. 4*



*Fig. 6*



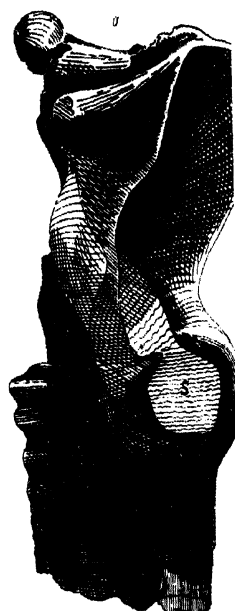
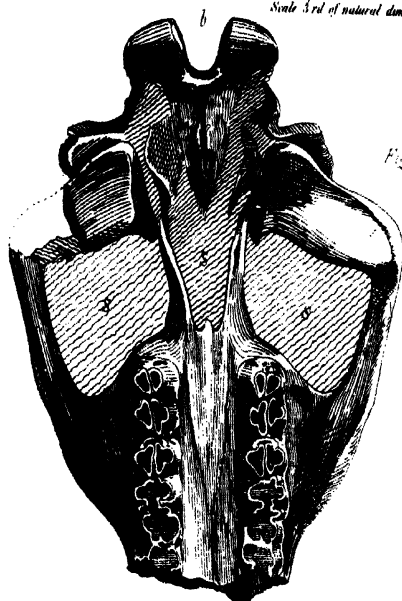
*b*



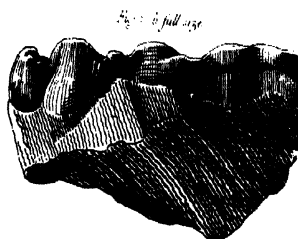
*Fig. 9*



*Fossil HIPPOPOTAMUS of the Sub Himalayas*  
*Scale 3rd of natural dimensions*



*Fig. 4. full size*



of the grinding surface, and sharply truncated at the internal side at the point. In taking the dimensions of the incisive teeth of the upper and lower jaw from two specimens of adult animals we find their proportions as follows:—

	<i>Inches.</i>	<i>Mètres.</i>
Diameter of incisor—upper jaw, .....	0.9	0.022
Ditto ditto—lower ditto, .....	0.7	0.018

If there is any fixed difference in the size of the teeth of each jaw, it exists in the second incisor being a little less than the others. It may be necessary to note here with regard to the number of molars in the lower jaw, that amongst the great number of specimens before us of animals of all ages, we see no mark or vestige of the first milk tooth, or that which, as was mentioned before, falls and is not replaced; and the space between the adjacent molar and the canine is so contracted as hardly to admit of room for another tooth; but as this tooth exists in the upper jaw in every specimen in our possession, we may infer that its non-presence in the lower jaw is accidental. In viewing the lower jaw in profile, we see that the anterior angle below the canines is somewhat more abrupt, and more inclined to the form represented as belonging to the European fossil species, the depth of the inferior maxillary is more regular, and the form of the posterior branches as before described, very different. The lower surface exhibits a width of symphysis equal to that of the living animal, and the angle formed by the branching off of the two sides is also similar. The width across the muzzle from the exterior side of the canine alveolus to the other is comparatively greater in the Sivalik fossil, and the extreme width of jaw, over the penultimate false molar, less. It will be seen that these differences of form correspond with those of the skull; the advanced position of the orbit and the contraction of the sinus in which the infra-orbitary holes are situated, leading to a modification in the whole form of the grinding surface.

Having made the comparison with the Cape and existing Hippopotamus, we will cursorily note the differences that strike us when comparing

it with the fossil described by CUVIER as belonging to the cabinet of the Grand Duke of Tuscany and figured in the first volume of the *Ossements Fossiles*. The distinctive differences will be perhaps best observed by a reference to the table of measurements : we see however that our fossil in the gradual slope of the malar process towards the cheek corresponds ; but differs completely in the hollow formed at this point between the jugal bone and canine alveolus which in our fossil is more abrupt and marked. The length of the parietal region of the European fossil is even less than that of the existing animal, and their proportions relatively with the bones of the face less. In the Sivalik fossil, the advanced position of the orbit completely modifies the whole form, and, by equalizing the proportions of the anterior and posterior divisions, gives a new style of appearance to the cranium. In the fall of the occipital crest towards the region between the orbits, and a consequent increased height of occipital surface, the Sivalik and Florence fossils also agree. In the proportion of the frontal surface to the area of the rest of the skull the resemblance also holds good ; but we have the same difference in the relative position of the canines to the molars ; the Florence and African species corresponding in this respect. The grand distinction of the incisives and canines, both in form and number, is peculiar to the *Hippopotamus Sivalensis*. In the lower jaw the space between the two branches, and the angle which is internally formed by them does not resemble that of the Florence fossil ; but, as we before remarked, is more assimilated to that of the existing animal in being round at the angle, and the whole interval space being more open : the descending process of the ramus differs, as explained before ; and the form of the anterior angle of the jaw below the canines is somewhat similar and not so gradually rounded off as in the living animal. The difference in size and number of the incisors leads to a difference which, as before noted in the comparison with the living animal, needs not be made the subject of further remark here.

With the *Hippopotamus Sivalensis* and that figured in the *Reliquiæ Diluvianæ*, described as found in a peat bog in Lancashire, and of which

a drawing is given in Professor BUCKLAND's work alluded to, little resemblance is recognizable. The Lancashire fossil has the four incisors, with a lower jaw of proportions apparently quite unique, and with a prominency of arch in the nasal bone equally so. We may however remark the elevated occipital crest, and the fall towards the space between the orbits which exists in the Lancashire fossil, as this appears to be general to the fossil species, relieving the head from that straightness of chaffron which is noted as one of the peculiarities of the African Hippopotamus.

Having concluded our remarks regarding the *Hippopotamus Sivalensis*, we now come to another and a smaller species of this genus which appears to have been less numerous, but with the remains of which we are sufficiently provided, although in the possession of only two fragments; one the imperfect skull of an old animal with the teeth much worn; and the other the right side of the lower jaw, shewing an unusual contraction or narrowness in the symphysis; this latter fragment contains five molars, the rear one perfect, and the last false molar sufficiently marked to establish the age of the animal; this was past adult, the first and second advanced cylinders of the rear molar being worn, and the third or rear one in the state of germ, but fully out of the alveolus. The form of this tooth differs from the great *Hippopotamus* in the absence of the trefoil, the wear of the coronals of each pair recollines taking a crescentic form outwards, not unlike that of ruminants, The grinding surface sloping outwards, very similar to the description given by CUVIER of the *Hippopotamus Minutus*. The form of the jaw, however, is peculiar, the marked features consisting of a general slenderness of proportions, and an inequality in the depth, which being contracted at the point of the descending process, gets gradually deeper, and diminishes again still more gradually up to the symphysis: in the great *Hippopotamus* we have a straight, thick, massive jaw. The foramen for the artery distinctly exhibited in the fossil, enters just behind the last tooth on the internal face of the ramus, and shews itself again on the opposite side just between and under the fourth and fifth molar, in a markedly large hole from which, to

the space between the tusk and the most advanced molar, there is a deep channel or indentation running upwards in a curved line parallel to the lower face of the jaw. The anterior and posterior portions of this beautiful fragment are unfortunately wanting, but a small part of the symphysis, at which point the fossil terminates, is distinctly marked, as well as the transverse section of the canine or tusk which as in the large animal is pear-shaped. A considerable portion of the anterior extremity is wanting, and with the tusk the fracture shews only one alveolus or hollow for an incisive tooth: the existence of two, however, can hardly be doubted, but the narrowness of the front may make a greater number than four between the two canines problematical. The ramus of this specimen is strongly marked on its anterior part by an elevated ridge pointing angularly forwards, and pushing forward a nearly flat surface to the centre of the rear tooth; the descending process is unfortunately too much broken to allow of our speaking decidedly, but the angle of departure from the straight line of the jaw is abrupt. The other remains of this smaller species to which we have alluded, consist of a skull, the front and rear of which is broken off, and one line of molars with the palate only perfect. The superimposed cranium would appear to be contorted by pressure, as is by no means uncommon, but this circumstance would lead us to refrain from an attempt at characterizing its peculiarities. The molars consist of the three rear permanent ones, and the last false molar, this latter one exhibiting the crescentic form of wear on its coronal surface described as peculiar to the first fragment. The other molars are much worn, and therefore with the exception of the encircling ridge of enamel, we have but those flexures which would have brought us to a correct conclusion. These molars are remarkably broad in proportion to their antero-posterior dimensions, and have an oblique grinding surface as before described in the other fragment. We may remark, that should these two remains belong to a small Hippopotamus of the same species, the great difference in the breadth of the grinding surface in the upper and lower jaws, as marked as is in the Rhinoceros,

would establish a species with (in this respect) rather unusual peculiarities. To this smaller species we propose the name of *dissimilis*, from the differences of form from the rest of the genus.

From the above additions to the species of the *Hippopotamus*, and from the marked distinctions in the incisive apparatus of the *Hippopotamus Sivalensis*, we shall perhaps be justified in at once establishing a new subgenus in this genus of mammalia, fixing the subgeneric characters on the incisive teeth. So marked a distinction in the form, number and character of the incisors will we imagine admit of such an arrangement, with every advantage to science, and in taking this step we place the new subgenus in the following position and order :—

**Genus—HIPPOPOTAMUS.**

**1st Subgenus—HEXAPROTODON.**

1. *Species*, *H. Sivalensis* (NOBIS.)
2. „ *H. Dissimilis* (NOB.) an hic, vel infra, potius referendus ?

**2nd Subgenus—TETRAPROTODON.**

1. *Species*, *H. Amphibius*.
2. „ *H. Antiquus*. (Cuv.) fossil.
3. „ *H. Minor* (Cuv.) fossil.
4. „ *H. Medius* (Cuv.) fossil.
5. „ *H. Minimus* (Cuv.) fossil.

The specific characters of the first species of our new subgenus being as follows :—

**Genus—HIPPOPOTAMUS.**

**Subgenus—HEXAPROTODON.**

**Species—SIVALENSIS.**

Char. *H. dentibus primoribus utrinque sex, subequalibus; laniariis difformibus: superioribus nempe quoad sectionem transversalem reniformibus; inferioribus pyriformibus; cranio elongato; oculo ad medium caput fere attingente; facie ad latera valde sinuata.*

Before closing this paper, we may make a few general remarks on the remains of this genus, which, with the exception of the *Mastodons* and *Elephants*, are by far the most numerous.

As may be imagined in such an extensive collection we find the remains of animals of all ages, with teeth in every variety and state of detrition ; from the young animal with the complicated and triple cylindered milk tooth, to the old and worn-down molar without any mark of the trefoil, and with a simple encircling ridge of enamel. In the fossil skull described as approaching adult (from which the measurements noted as No. 1. have been taken) we have a beautiful exhibition of the teeth in that state when the animal has just lost its last milk tooth, and the new molar or '*dent de remplacement*' is just shewing itself in germ, whilst the last permanent molar, or that most posterior, is in the same state of advancement, having just pierced the bone : the oldest tooth in the head or the first permanent molar is just worn to that state, when the development of the trefoil crown is most perfect ; the second permanent molar is just shewing this appearance on its two front pillars ; the front false or pointed molars are unworn, and exhibit in all their perfection the richly embossed surface, which is peculiar to these teeth in the Hippopotami. The first false molar or milk tooth seems to have retained its position in many of our fossils long after the fall of the other milk teeth, and long after the arrival of the animal at the adult state. In some of our skulls which are the remains of very old animals, we observe the alveolus of this tooth very distinct, and having the appearance more of having been broken off in the fossil, than of having been lost previous to the death of the animal, in which case moreover a filling in of the pit from the growth of the bone would be more or less evident in the fossil. From the natural wear of the tusks upon each other, the truncated extremity of the upper one, and in the Hippopotamus Sivalensis that which is described as reniform occurs on the convex or outer side of the tusk ; and this must be the case wherever the tusk belongs to the upper jaw. Amongst a very extensive and very large collection, containing as we before remarked three perfect skulls, with a number of fragments of nearly perfect lower jaws, with a great number of pieces of both more or less mutilated, the reniform tusk is an invariable appendage to the upper, and the pyriform to the lower jaw.

Our collection however exhibits one solitary instance of the anterior extremity of a reniform tusk truncated on the inner or concave surface; this unfortunately is a separate fragment, and unattached to any portion of the jaw, and bearing in itself no further mark of its having existed in the *lower* jaw than this truncation of the extremity. It is difficult to imagine any fortuitous circumstance that would have produced such an anomaly, and it is at the same time difficult to come to a conclusion contrary to the facts elicited by such an extensive collection of remains, in which we see no sign of the reniform character of the canine in the upper jaw; should the truncation alluded to *not* be accidental, or caused by some deformity in the position in the alveolus, we have yet to discover a variety of the Hippopotamus with the reniform tusk in the lower jaw. The fact of the existence of this fragment however may be as well noted; as we observe peculiarities of form in other fragments of the bones of the head that may ultimately prove to belong to different species. We have contented ourselves with drawing our comparisons from the bones of the head, without any reference to the osseous structure generally of the animal, in which our collections however abound, especially in vertebræ, and the solid articulating extremities of the bones. A more lengthened period of search and examination, will add much to the value of an enquiry upon this point, and a comparison with the actual bones of the Cape Hippopotamus instead of with CUVIER's drawings, will render any attempt at a discrimination of existing differences, easier, and when completed and worked out, doubly valuable.

*Northern Doâb, November 15, 1835.*

NOTE.—At the time of ordering this article to press, (25th January 1836,) the drawings of the varieties of Fossil Hippopotamus in the Museum of Messrs. FALCONER and CAUTLEY have not reached the Society. The omission is however in a great measure supplied by the drawings of the specimens in the *Dadupur* Museum of Lieutenants BAKER and DURAND, presented to the Society by the latter Officer, which are published, together with his descriptive Note, in the following article. SEC.

---



## IV.

## SPECIMENS

OF THE

## HIPPOPOTAMUS AND OTHER FOSSIL GENERA

OF THE

## SUB-HIMALAYAS

## IN THE DÁDÚPUR COLLECTION.

BY LIEUTENANT H. M. DURAND,

ENGINEER.

THE discovery of the existence of fossil organic remains in the vicinity of the village of *Rayawála* and in the *Marakanda* pass, has led to the examination of the tract of tertiary hills lying between the river *Jumna* and *Pinjor*. From different parts of the line specimens have been obtained, and the fact of its richness in such relics fully established.

The greater number of the specimens in the *Dádúpur* collection are from the hills lying between the *Marakanda* pass and *Pinjor*; the calcareous sandstone prevalent in these formations has usually afforded them; an exception however occurs in the neighbourhood of *Dudgehr*, when the matrix, instead of sandstone, is a red indurated marl in which not only the remains of mammalia and reptilia are found, but those of mollusca also. The native collector reported them to occur together, and along with the shells produced fragments of bones and vertebræ of *Saurians*. Having had no opportunity of visiting the place, I can neither corroborate his statement, nor particularize the site of the deposit. The shells appear to belong to

MISCELLANEOUS FOSSILS  
of the Sub-Himalayas

PLATE 7.

Fig. 9. a

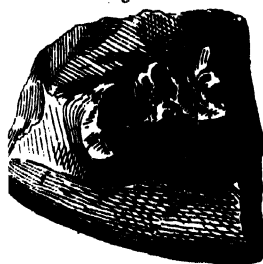


Fig. 10. a.



Fig. 10. b.



Fig. 9. b.

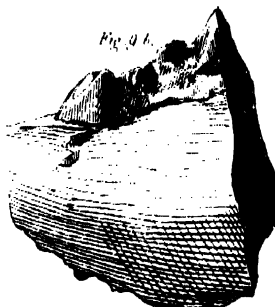


Fig. 7.



Fig. 11.



Fig. 12. c.



Fig. 11.

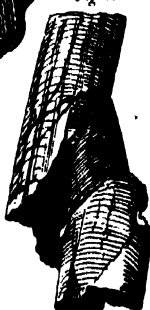


Fig. 8.

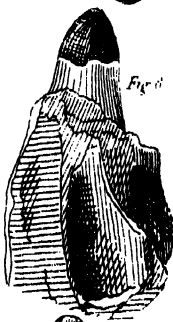


Fig. 12. b.

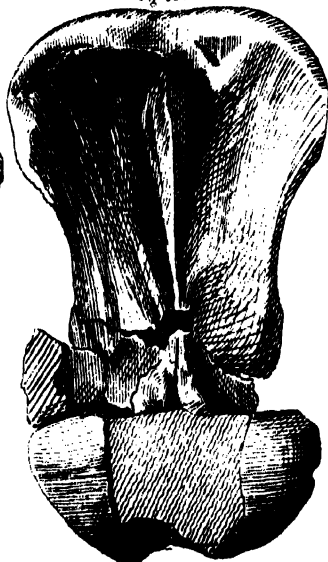


Fig. 6.

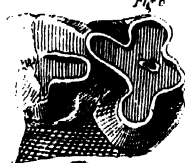
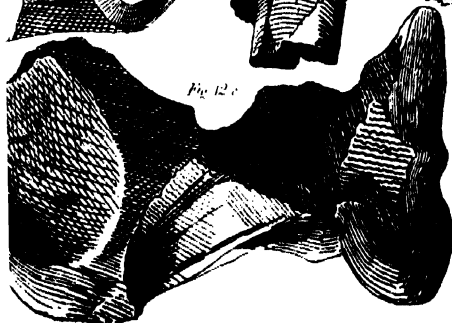


Fig. 12. c.



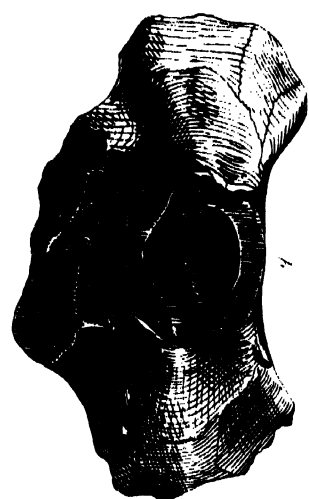


Fig. 4

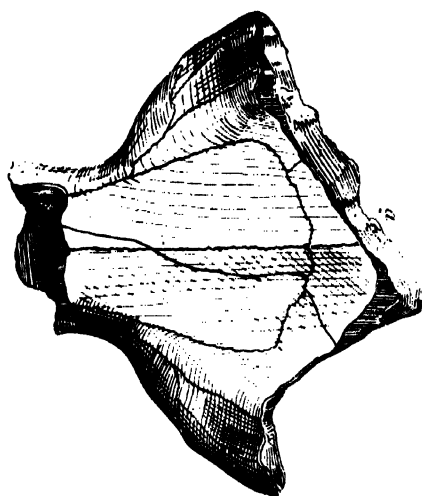
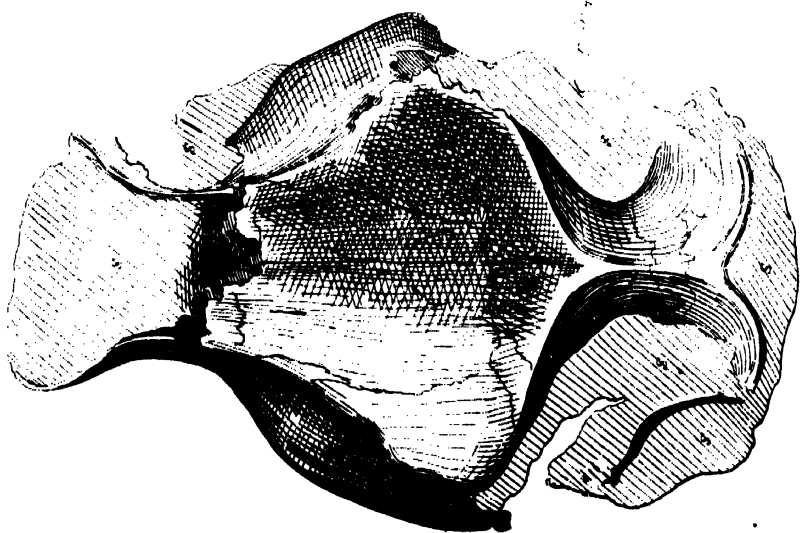
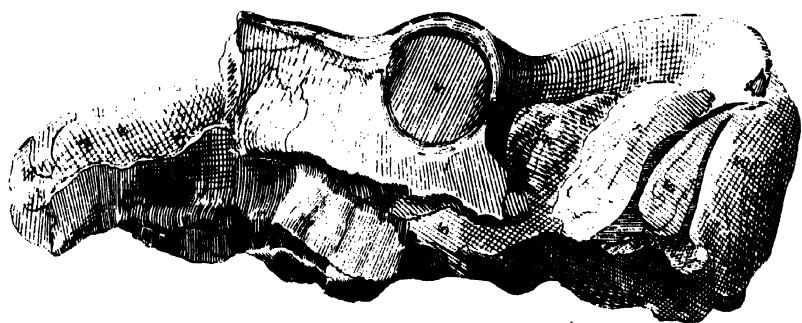


Fig. 5  
*Scale and a second bone in situ*



fresh-water species ; they are not abundant and are generally in a bad state of preservation. The red marl is with difficulty disengaged from the specimens, any attempt to separate the shell from the matrix being usually at the expense of the epidermis, and too frequently at that of the valves themselves.

The varieties are few in number, but the determination of fossil species requires so much experience and nice discrimination that no apology will be requisite to excuse silence on this interesting point. A selection which is to be placed at the Society's disposal, will it is hoped afford the means of determining the question.\* The univalves bear a small portion to the bivalves, being on the ratio of 1 to 100 ; it must however be remarked that the quantity hitherto collected being small, the above proportion might be materially affected by an inconsiderable increase to the number of specimens.

The same remark is applicable to the result deduced from the number of upper and lower jaws, or portion of jaws at present in the collection ; the proportion of the *proboscidia* to the *pachydermata*, properly so called, is in the ratio of 3 to 1—that of the *proboscidia* to the *ruminantia*, 5 to 1. Both proportions may be expected to vary considerably in the course of future researches.

Many of the specimens have undergone fracture since they were imbedded in their present matrix ; some are much distorted ; and a few are crushed. The Hippopotamus' upper jaws have in consequence of their shape, been frequent sufferers : out of eight upper jaws more or less complete scarcely can two be called straight ; the remainder are crooked. Illustrative of the effect produced on some of the relics is the sketch fig. 11, Pl. VII. This horn evidently must have undergone fracture when imbedded ;

---

\* Some of them are figured in Pl. XLVIII. figs. 45, 46, 47, 48 of the *Journal of the Asiatic Society*, vol. IV. They resemble precisely the shells transmitted from the Promé fossil field in Ava, by Lieut.-Colonel BURNES. SEC.

the pressure of the circumjacent sandstone has kept the splinters in their places until they were cemented together, as at present. When adverting to any of the accompanying sketches I shall notice those which have suffered.

I may here remark that the following brief notes and their accompanying sketches, are forwarded with the view of filling up any hiatus which may be found amongst the Hippopotamus remains, transmitted by Colonel COLVIN, to the Asiatic Society; and of bringing part of the *Dadupur* collection to notice when his valuable despatch is examined and classified.

#### HIPPOPOTAMUS—LOWER JAWS.

Fig. 1. Pl. IV, is the lower jaw of a full grown animal; the small anterior molars are absent, the posterior molars much worn; the junction of the two halves of the jaw presents a curve of much regularity; the narrowest part of the jaw occurs at the third molar, or at the second if the advanced ones be not counted; the exterior curve of the maxillaries both anteriorly and to the rear is bolder, giving a longer versed sine than observable in CUVIER's plates of the existing and fossil species described by him: the base line of the incisor teeth, or that at which they protrude from the jaw is in a line with the centre of the canines, so that taking a side view their protrusion from the jaw is not seen.

Fig. 2, Pl. IV, is from a specimen in the possession of Conductor DAWE which doubtless belonged to a younger and smaller animal than the former. One of the 1st molars is present; the 6th and 7th are little worn. The incisors are nearly equal in diameter; the right central one presents a worn angular surface, produced it may be supposed by an upper incisor.

The above specimens appear to be of one species.

Figs. 3 and 5, Pl. IV, are mere fragments, interesting however from the shape and striæ of the canines and the proportion of the diameters of the incisors amongst themselves. The centre ones are the largest; those next to

them the smallest, and the exterior ones hold a mean between the two. No whole jaw of this description is in the collection, and the fragments are such as not to warrant any deductions from the distinctions here noticed. Fig. 4, Pl. IV, presents a marked difference in the shape of the incisors, which are more elliptical than in the preceding varieties. The exterior incisors have a section not observable in any other specimen; and are, relatively to the four centre incisors, set lower than the analogous incisors of other varieties—may not this be considered a distinct species?

Fig. 3, Pl. V, is a fragment from the lower jaw of a small Hippopotamus, it contains the two posterior molars, the advanced one differs in shape and proportionate dimensions from the analogous molars of the larger species; the fore part of the tooth is much narrower than the after part; the length of the tooth measured along the jaw is equal to that of the same tooth in the larger species, the jaw is more curved and fines off more rapidly towards the front than in the larger animals: it is so narrow in front of the advanced tooth as to suggest the possibility of their having been fewer molars than seven.

#### HIPPOPOTAMUS—UPPER JAWS.

Fig. 1, *a*, *b*, Pl. VI, is from the head of an old animal, the teeth being very much worn: the specimen is so much cracked, that the sandstone could not be cleared from the temporal fossa. On comparison with the species described by CUVIER many differences may be observed. I shall however confine myself to noticing a few distinctions which exist among the specimens before me, without alluding to those which will immediately strike the eye on comparing CUVIER's plates and the accompanying sketches.

Fig. 1, Pl. V, is taken from a specimen, the head of an adult animal; it varies from the former in the shape and prominence of the orbits, in the

greater concavity of the head between the orbits, and the more rapid rise of the ridge : this specimen is also much cracked and consequently could not be altogether cleared of matrix.

Another specimen in our collection (omitted for want of room in the engraving) has, in general form and degree of preservation, a resemblance to Fig. 1, of Pl. VI. It is from the head of an aged animal : the roots of the canines are visible and present a heart-shaped section. There is however much difference between the two ; the most striking dissimilarities are the insertion and start of the canines, which attest shorter nasal bones to have belonged to this species ; the shape and prominence of the orbits ; and the greater concavity of interorbital-space. The specimen under consideration, has a nearer resemblance to Fig. 1, of Pl. V, but belonged to a somewhat smaller animal.

Fig. 2, Pl. VI. is given as shewing distinctly the sutures, which disagree in several points with those of species hitherto described, both as existing or in a fossil state.

Fig. 1, Pl. VI. may be considered as one species ; Fig. 1, Pl. V, and Fig. 2, Pl. VI, as having belonged to another species possessing the cardi-form canines of which so many fragments are disinterred.

Fig. 12, *a. b. c.* Pl. VII, belonged to a small Hippopotamus, and presents two peculiarities—1st, the great breadth of its ridge as shewn in Fig 12, *a.* 2ndly.—The depth of its occipital condyles, which is greater in proportion to the height of the occiput, than those of the large Hippopotamus.

Fig. 12, Pl. VII, though possessing the peculiarities above noticed, affords too narrow grounds for the establishment of a separate species.

The lower jaws agree in one respect, namely that of all having six incisors, in this differing from the existing and fossil species hitherto described.

The upper jaws have the proportion between the external breadth of their occipital condyles and the breadth at their orbits similar to that

stated to exist in the living species by Dr. AOAMS, twice the occipital condyles' breadth equalling the breadth at the orbits.

Figures 2a, 2b, 2d, Pl. V, and Fig. 6, Pl. IV, are taken from a specimen which is the only one of the kind hitherto met with. It is a fragment from the jaw of some pachydermatous animal\* ; but differs materially from all with which it has been compared : further discoveries will it is hoped throw light on this interesting fragment.

Fig. 9, a, b, c, Pl. VII, is a fragment from the jaw of an animal supposed to belong to the genus *Sus*. (*Sus Sivalensis*, FAL. and CAUT.)

Fig. 6, Pl. VII, molar of a small Hippopotamus.

Fig. 7 and 10 a, b, molars supposed to belong to species of the *Sivatherium*.†

Fig. 8, a perfect tooth, the lower part of which has a white enamel ; the upper part is a dark brown cone, longitudinally striated—I have delineated it in consequence of its dissimilarity to the drawings or specimens of Saurian teeth which have come under my observation.‡

\* The drawing of this fragment so much resembled CUVIER's plates of the Hippopotamus, that I wondered at the author's misgivings on the subject, and wrote to interrogate Dr. FALCONER previous to putting the present page to press. Dr. F. however assures me that the fragment undoubtedly does not belong to that animal ; but, as Lieuts. BAKER and DURAND had rightly conjectured, to a new pachydermatous animal, to which Captain CAUTLEY and himself have from other specimens given the name of *Charotherium* : "the engraving is imperfect, and so much like the Hippopotamus, that it might be easily mistaken. The difference in the original tooth however is well marked. There is no real trefoil on it ; the appearance is spurious : the plane of wearing is oblique ; the spur is strongly bifid, and the collines or mamillary processes are wide apart." J. P.

† Dr. FALCONER remarks on the engravings: Figs. 10, a, b. "they exhibit the form well, but they do not give the characters of the surface of the teeth, which is striated reticularly with rugous eminences." A tooth of the same kind, obligingly sent down by dāk for my inspection, exhibits these peculiarities very distinctly ; I hope shortly to have an opportunity of engraving it.—J. P.

‡ *Croc. biporcatus* of the preceding paper by Captain CAUTLEY.



## V.

## INDICATION

OF A

## NEW GENUS OF THE CARNIVORA,

WITH DESCRIPTION OF THE SPECIES ON WHICH IT IS FOUNDED.

By B. H. HODGSON, Esq.

*Resident in Nepal.*

FAMILY CARNIVORA. TRIBE PLANTIGRADES.

GENUS URSITAXUS. MIHL.

*Cheek Teeth  $\frac{3}{4}$  of ursine flatness almost, but musteline disposition;\* the tubercular of the upper jaw, smooth-crowned, narrow, parallelogrammic and smaller than the Carnivorous: none in the lower jaw: two false molars above and three below on either side: general conformation of the animal similar to that of the Badger, but wanting external ears: anal glands as in Mydaus.*

REMARK.—*The natural affinities of this Genus are with Ursus, Taxus, and Mydaus; but chiefly with Taxus.*

THE single animal from which the above characters are drawn was procured by me in 1829, since which period I have in vain endeavoured to obtain another: and, as I see no immediate prospect of better success in my search, I shall not longer defer giving such account of it as my materials

---

\* That is, a disposition partially transverse, exhibited in the inner heel of the carnivorous tooth, and the whole body of the tuberculous one of the upper jaw. This arrangement of the teeth appears to be appendant to the true cutting type, and is not therefore developed in Ursus, or in other true plantigrades. Amongst the digitigrades it is common, and particularly so in the mustelids.

enable me to supply.\* The specimen I obtained was a mature male. It was recently killed, but had had the intestines removed before it was brought to me from the vale of *Muckwanpúr*, at the southern base of the last mountainous range towards India, whence I infer that its habitat is the hilly portion of the southern region of *Népál*.

*Species*—*URSITAXUS INAURITUS*. EARLESS *URSITAX*. *Miki*.

This is a low-legged unwieldy massive animal, with the general conformation and size of the Badger, from which, however, it differs most materially in its system of dentition, and more obviously in the want of external ears, the harshness and scantiness of its single coat of hair, and the disposition and number of its palmary tubercles.

The Earless *Ursitax* or Bear-Badger is thirty-two inches from the snout to the root of the tail, which is five inches long, or six and a half if measured with the terminal hair. The girth of its body, behind the shoulder, is twenty-nine inches, and the massiveness thence inferrible is maintained uniformly throughout its proportions. It is purely plantigrade and fossorial, dwelling in burrows on the southern slopes of the hills, and very seldom appearing abroad by day. The face, though not elongated, is conic and suddenly sharpened towards a neat, round, immobile, clearly defined and ungrooved muzzle in which the nostrils are opened to the front, but have a narrow prolongation to the sides. The lips are closely applied to the jaws and entirely void of mustachios: nor are there any bristles on the cheeks, above the eyes or on the chin: the cheeks are full and fleshy: the head broad, and as much depressed almost as the Otter's: the eyes small,

---

\* This animal is mentioned by the local name of *Bhārsiakh*, in the catalogue of Nipalese Mammals, (1832); and its peculiar dentition is therein summarily described.

round, level with the cheeks, possessed of a third lid which may be drawn two-thirds over the cornea, and of a round pupil ; their position nearly equidistant from the snout and ear. The nude ears are shaped and disposed pretty much as in the human subject : but the helix is wholly wanting, being replaced by a marginal obtuse swelling of the skin merely. The parallel portion of the anti-helix is rather more sharply defined ; but the transverse is wholly absent : the tragus distinct, but the anti-tragus and lobe evanescent. The conch is elongated vertically like the rest of the organ, with but a small cavity and no superior definite limitation : the opening into the interior simple, apert, and round : the neck of the animal short and very thick : the body still thicker ; being as deep almost as the length of the limbs, which are short and powerful, particularly the anterior ones. The digits are 5 in all four extremities, blended with the metacarpal and metatarsal joints so as to constitute solid pads for the feet, the anteal half only of the last phalanges being free, and connected superiorly by a small strong membrane which is firmly attached to the nails. The inferior surface of the hands and feet, to the back of the wrist and to the os calcis is perfectly nude, the palms and soles being full, soft, and fleshy. At the forward end of each anterior digit is a very large ball, suitable to keep the huge nails from embarrassing the animal's walk ; but the *bases* of all the 5 digits rest on one, undivided, round pad, behind which is another, as large almost, and of similar shape, for the metacarpi. The balls of the hinder extremities resemble those of the fore, save that the metatarsal pad lies less centrally behind the termino-digital one, and is somewhat less developed. The gradation of the anterior digits is thus : the central largest, then the index, next the annular, then the external finger, retracted as in our hand, and with its nail similarly diminished ; last the internal one, subremote as with us, but much the feeblest of all. The hind feet are considerably smaller than the fore : they have the external digits less retracted ; the talons of the whole much less developed ; more nearly equal



fig. 1



fig. 3



fig. 4



fig. 2



fig. 5



fig. 6

URSITAXUS INAURITUS, nobis

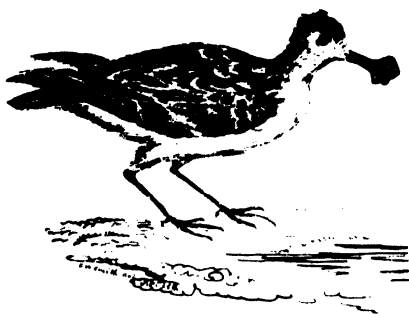
type of the

new genus Ursitax nobis

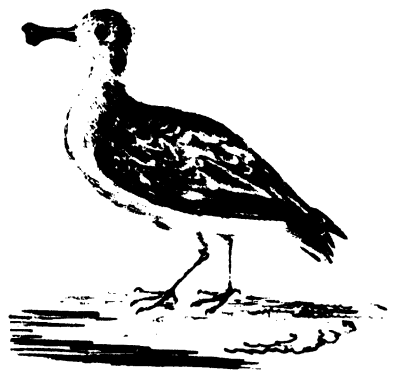
Reichenow, Leipzig

T. Black, etc.

As. Res.



N. IX

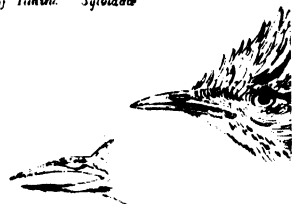


*Eurynorychus Griseus*

Type of *Torix Mipalensis*



Type of *Yukun. Sylviadae*



Type of *Ducula*, (*Vinagina*)



in size; and gradated upon a different principle—the outermost being the stoutest, and the rest, gradually but trivially diminished in strength towards the inmost. The nails of the anterior extremities are typically fossorial, sub-arched, shallow, stout, obtuse, obliquely compressed with broad convex backs, and a sharpened edge below.

The feet and hands of *Ursitaxus* are precisely similar to the same organs in the Bears, except that the digit answering to the thumb is rather remote in our animal—not so in *Ursus*—and that the interval between the terminal balls of the digits and their confusion with the palmary mass is nude in *Ursitaxus*—clad with soft hair in the Bears

The anal glands of the *Ursitax* differ considerably from those of the Badger, agreeing point by point with the same organ in *Mydaus* (Horsfield), save only that the excretory ducts are rather longer in our animal and have their termination in the rectum rather nearer to its orifice and to one another. The tongue of the *Ursitax* resembles that of the Badger, being wholly covered with small papillæ, neither horny nor aculeated backwards. The covering of our animal consists of harsh hair only, and that very scantily furnished. It is about two inches in utmost length, straight and adpressed, sufficient in quantity to hide the skin upon the superior aspect only of the head, neck and body; the face, neck and body below, with the limbs internally, being partially nude. The colours are dirty yellow and black, clearly defined by a line passing from the brows along the flanks to the edges of the tail, and leaving all above it of the former—below it, of the latter, hue. The dirty tinge of the yellow upon the superior parts is caused by an admixture of yellow and black hairs, of which the former are more abundant and longer too than the latter, but both of similar harsh character. The tail, 5 inches long and scarcely reaching to the middle of the buttocks, is cylindrico-tapered and covered with hair like the back, the point being fine and a little recurved

The following are the detailed dimensions of our animal—

	<i>Feet.</i>	<i>Inch.</i>
Tip of snout to base of tail, . . . . .	2	8
Tail only, . . . . .	0	5
Tail and hair, . . . . .	0	6½
Carpus (inclusively) to longest finger, . . . . .	0	4½
Heel to longest toe, . . . . .	0	4½
Length of the head, . . . . .	0	6¾
Nose to fore-corner of eye, . . . . .	0	2
Thence to opening of ear, . . . . .	0	3¼
Girth of body, behind shoulder, . . . . .	2	5
Longest fore-nail, . . . . .	0	1½
Ditto hind ditto, . . . . .	0	0½

The skull is 5¼ inches long, 3¼ wide and 2¾ high. The width is taken, not between the zygomatic arches but between the alæ of the transverse crista. There the lateral dimensions are largest owing to the great development of the transverse or lambdoidal ridge of the skull before it sweeps upwards to join the zygomatic arches. The skull bears, upon the whole, so great a similitude to that of the Otter, that it may be very well illustrated by pointing out the differences merely between the two. These consist in the slight arcuation of the outline along the parietal portion of the skull in *Ursitaxus*; the greater development of the frontal, nasal, and malar, bones; the diminished length of the zygomatic arches; the rather more incomplete and less advanced orbits; the very small size of the infra orbital foramina—which are besides two on either side—and, lastly, the larger development (+ more) of the tympanal bones. In respect to the teeth of the two animals there is no very noticeable difference in the incisors and canines which

indeed are apt to assimilate in most of the carnivora.\* The canines, however, are thicker, shorter and blunter in our animal than in the Otter. The molars, too, of both are formed upon the same ultimately sectorial model and have a similar arrangement in the skulls: but they are fewer in number in *Ursitaxus*; and the trenchant processes of the crowns are almost obliterated. And, as if to defy all exclusiveness of system on our part, the Otter, with its sharp processes, has a very large flattish heel to the upper carnivorous tooth, and an extremely broad transverse tubercular behind it. On the other hand, the heel of the same tooth in *Ursitaxus*, though flatter, is smaller; and the tuberculous tooth behind it exhibits a much less, but a smoother, surface. I regret that I have no Badger's skull wherewith to compare that of the *Ursitax*. Independently, as far as may be, of all comparisons the skull and teeth of our animal have the following characters.

*The Skull.* It is very thick and solid with numerous rugosities all over its surface; is rather depressed than compressed, and very slightly but uniformly arched along the vertical line: parietes amply developed, affording a large cerebral cavity and shallow temporal fossæ: the cristæ of medial height, but running unbrokenly from the bifurcation of the brows to the zygomatic arches; their chief development being at the point where they sweep round to join those arches: frontal bones of considerable length and width: nasal, short but wide: both slightly convexed across; and, lengthwise, the former convex, the latter, sub-concave: malar bones uncompressed, with two small infra-orbital foramina on either side: zygomatic arches, short, stout, considerably bulged outwards: orbits medial, very incomplete, there being no process from the zygoma, and but a small one from the os frontis: frontal sinuses medial or largish: occipital bones dipt vertically from the junction of the lambdoidal and sagittal sutures,

---

\* In the form of the incisor teeth *Ursitaxus* differs entirely from *Mydaus* with which animal it has several points of affinity. Other differences occur in the structure of the ears and of the extremities—not to mention the cardinal distinction between the molar teeth of the two.



so that the condyles of the foramen magnum are neither postea nor antea to that junction. There is a short but strong vertical crista on the occiput, and a transverse one of much greater extent, parallel and closely approximated to the lambdoidal ridge. The bony separation of the cerebrum and cerebellum is very strong and much developed, leaving a long, elliptic, vertical foramen in the midst, nearly twice the size of the great foramen: the tympanal bones amply developed, semi-ovoid, and reaching forwards to the articulation of the jaws which is so complete, in the cylindrical hinge manner, that the lower jaw can be barely removed from the skull. The rami of the lower jaw are nearly straight, very powerful, short, uncompressed or remote, and furnished with large subvertical coronoid processes, and small styloid ones: the condyles nearly on a line with the upper cheek teeth.

*The Teeth.*—The incisors are all disposed rectilinearly to the front, erect, strong, cylindrical in their bodies, and broad-crowned; the crowns of the lower ones being horizontal—of the upper, obliquely sloped inwards. The external incisors are the stoutest, and the rest gradually decrease in thickness to the central pairs. These teeth are all in contact with each other; and, in lower range, with the canines also: but the front teeth of the upper jaw have a necessary interval from the canines for their passage. The canines are short, stout, obtuse, conic, and of equal size above and below. They are mutually scarped by friction against each other, but exhibit no heel. The upper canines are straight; the lower, subcurved. All the molars are in contact with each other, but not quite with the canines. They are sixteen in all—four on each side of either jaw, of which the two first of the upper, and three first of the lower range are false molars; the 3d above, and the 4th below, the carnivorous tooth; and the 4th above, the tuberculous one. Below there is no such tooth. All are disposed lengthwise, save the tuberculars of the upper jaw which have a transverse arrangement, causing a triangular vacancy between them and the internal

neels of the carnivorous teeth of the same jaw. The molars gradually increase in size as they recede from the canines in the lower jaw ; but, in the upper, the carnivorous tooth is considerably larger than the tubercular; which latter is of the form of an oblong, narrow, parallelogram, with a perfectly smooth concave crown. All the molars are fanged and essentially constructed as in the digitigrade or normal carnivora ; but, owing to the nearly obsolete development of the cutting processes of their crowns, they bear a character of greater resemblance to the molars of the typical planigrades.

The scissor action or true cutting process must in respect to these teeth be limited to the carnivorous ones, and even there be more than matched by the crushing action of one crown on another. The whole of the molars are longer considerably than broad: but they are almost as evidently broader than high. Heretofore it has been remarked that in proportion to the diminished number of the molars is the high development of their sectorial attributes: but in *Ursitaxus* we have molars less only in number than those of the cats proper, which yet are distinguished for the remarkable flatness of their crowns.\*

Deeply imbedded in the cellular membrane at the outlet of the pelvis and centrally on either side the large anus, the *Ursitaxus* has an oblong, spheroidal, hollow gland, which communicates, by a distinct tubular canal, with a round pore opening on the caudal margin of the anus. Each gland is  $1\frac{1}{4}$  inch long and  $\frac{3}{4}$  wide, being large enough to contain a walnut ; and each has its own canal and its own pore. These pores or anal orifices of the glands are about  $\frac{3}{4}$  of an inch apart. The ducts uniting them with the glands take a superior direction to open at the upper margin of the anus,

---

\* I make due allowance for detrition by use owing to the age of my specimen : but there still remains a remarkable flatness of crown in the molars, greatly exceeding that of the semi-frugivorous *Paradoxuri* for example. Such teeth, being only sixteen in total number, of which but two are tuberculous, constitute surely a singular and unique type amongst the Carnivora.

under the tail ; and they exhibit at either end a muscular ring. The walls of the glands are about  $\frac{1}{4}$  inch thick, and purely glandular ; and their lining membrane lies closely in contact with the walls and is secretory throughout. But no pores can be traced on this lining for exuding the secretion which yet is contained in the cavity of the glands whence it passes by the tubes and anal pores into the rectum. The secretion found in the dead subject was dark, thick, and very foetid.

*Nepal, February* , 1836.

---

## VI.

---

### NOTE

ON THE

## EURINORYNCHUS GRISEUS:

---

BY J. T. PEARSON, ESQUIRE,

*Assistant Surgeon, Curator Mus. Ac. Soc.*

---

*Class.*—AVES. *Auctorum.* *Ord.*—GRALLATORES. *Ill.*

*Trib*—————? *Fam*—————?

*Gen.*—EURINORYNCHUS. Wilson.

*Gen. Ch.*—Bill, elongated, depressed, dilated at the tip, covered with feathers around the base. Upper mandible serrated along the middle of the roof of the mouth.

*Nostrils* entirely hidden by the feathers at the base of the bill.

*Legs* four-toed, three toes forward, and one backward; cleft; the hinder toe elevated, so that its tip alone rests on the ground; toes margined along the sides, and furnished with short curved nails, of which that upon the middle toe has a sharp margin on its inner side.

*Tail* short, of twelve feathers, rounded.

*Wings* long, extending beyond the tail: first quill longest.

*Sp.—EUR. GRISZEUS. Wilson. (Plate IX.)*

*Eurinyrnchus*, grey above, white beneath, black bill.

*Platalea Pygmaea*, Linn. System. Nat. Edit. 12, vol. 1. p. 231, Gmel. Syst. Nat. Edit. 13, vol. 1. p. 615, Latham Gen. Hist. vol. 9. p. 7, Shaw Gen. Zool., vol. 11. p. 645, *Eurinyrnchus Griseus*, Wils. Thun. Acad. Suec. 1816, pl. 6, (as quoted in Griffith's Regne. Animal, Edit. 1829,) vol. 1. p. 528, Griffith's Cuvier, vol. 8. p. 383, Temminck's Manual, vol. 2. p. 594.

*Sp. Ch.*—Size that of a sandpiper. Length, from tip of the bill to the end of the tail, 6 inches ; length of the bill  $\frac{1}{6}$  inch. Breadth, from tip to tip of the wings, 11 inches. Bill, both above and below entirely black, dilated at the tip to the breadth of  $\frac{1}{16}$  inch ; it consists at the base for two-thirds of its length of a central keel or ridge, flattened at the top, which is continued to the tip, and narrow margins, altogether about  $\frac{1}{16}$  inch in breadth : At the anterior third, the margins become dilated on each side, having a sharp angular projection in front, and the sides sloping off posteriorly so as to form a rhomboidal tip, the dilated part of the upper mandible being somewhat convex above, and concave below. Within the mouth, the upper mandible is margined all round the tip, and down the sides ; whilst along the middle there is a sulcus, corresponding to the keel above, furnished with small conical, sharp projections, to enable the bird to secure its prey. Under mandible in form like the upper, but with a somewhat smaller dilated end, fitting in when the bill is closed within the margin of its antagonist ; having a membranous fossa between the rami for two-thirds of its length, as far as their junction ; and from thence to the tip a central angular keel, or ridge, with the sides dilated like those of the upper mandible. Within the mouth the lower mandible is furnished all round with a slightly elevated margin ; and has a broad deep central fossa, for the reception of the tongue. In the dried specimen the tongue is black with a white tip, and it extends forward from the base of the bill  $\frac{1}{7}$  inch ; and appears to have been rather broad and fleshy, and as long as the bill.

The Pigmy Spoonbill is ash grey above, and white below, the ground colour being of a blueish ash. Crown of the head, back of the neck, middle of the back, upper tail coverts, middle of the tail, scapulars, greater and lesser wing coverts, and primary and secondary quills more or less of an ash colour, shaded with brown, and tipped with white. Feathers of the head, back of the neck, upper part of the back and wing coverts dark in the centre, and margined round the tips with white. Tail coverts darker, with white shafts for three-fourths of their length, and black at the tip, where the webs, also, are black. Tail  $1\frac{3}{16}$  inches long; shafts of all the feathers white, two central ones dark on the inner webs, lighter on the outer, and tipped with white; the other feathers gradually becoming lighter to the outermost one, which is almost white. Remiges with white shafts; webs dark brown, almost black on the outer one and tip; lighter on the inner; and white at the base for one-third of the outside, and two-thirds of the inside webs: First quill longest. Secondaries white at the base for two-thirds of the inner margin of the inner web, the rest dark brown, with a narrow border of white. Tertiaries still lighter, some of the inner feathers being altogether white on the inner web and tip. Lesser under coverts white, mottled with ash. Forehead, cheeks, throat, front of the neck and breast, inner coverts, sides, belly, and under-tail coverts snow-white. Legs and feet black.

The Pigmy Spoonbill is noted in Griffith's Cuvier as "one of the most rare birds existing, for, but a single individual is known." It is said to be a native of Surinam and Guiana. The present specimen is stated by Mr. NEWCOMBE, who presented it to the Society, to have been "shot on Edmonstone's Island, which is situated a little to the northward of the centre of Saugur Sand." Captain LLOYD, of the Indian Navy, informs me that he also once met with a specimen in Arracan.

---

## VII.

## DESCRIPTION

OF

## THREE NEW SPECIES OF PARADOXURUS,

INHABITING THE SOUTHERN, CENTRAL, AND NORTHERN  
REGIONS OF NEPAL RESPECTIVELY,

WITH NOTICES OF THE

HABITS AND STRUCTURE OF THE GENUS.

By B. H. HODGSON, Esq.

*H. C. Resident in Népál.**Genus* PARADOXURUS. Cuvier.*Species* P. HIRSUTUS. Miln.

THIS species is peculiar to the open parts of the Nipalese *Tarāi* and is also found very generally in the British districts on this (the left) side of the Ganges. It is possibly identical with BLAINVILLE's *Viverra Bondur*, described from a drawing at the India House; and, should it prove so, the trivial name *Bondur* can be retained; if otherwise, the epithet *Hirsutus*, affixed by me in consequence of the extreme length of the animal's hair, may serve to designate the species.

In North *Bihar* as well as in the *Nipalese Tarāi*, this animal is known by the names of *Machabba* and of *Malwa*. It is no more shy of inhabited and cultivated tracts than the common *Mongoose* or *Herpestes Griseus*; and its favourite resorts are the old and abandoned mango groves. In holes of the decayed trunks of the trees it seeks a place of refuge, making such its ordinary dormitory as well as invariable breeding place, and even

procuring its food almost as much amongst the branches as in the grass which is suffered to grow up in these groves after their cultivation has been laid aside. However rapacious its ordinary habits—and those of few of the carnivora are more so—it feeds freely upon the ripe mango in season, as well as upon other ripe fruits : but its more usual food consists of live birds and of the lesser mammals—the former of which it seizes upon the trees as well as on the ground with a more than feline dexterity. It readily kills and devours snakes as well as hares and their young, with mice and rats ; but will not touch frogs or blattæ. One that I had alive escaped from confinement ; and, as soon as the gray of twilight set in, it made its way into the poultry yard, climbing a high wall and killing one goose, two ducks, and seven fowls, in less than an hour !

The Hirsute Paradoxurus is 45 inches in length from the tip of the snout to the end of the tail and about 6-lbs. in weight. The length of the tail, inclusive of the hair projecting beyond its tip, is equal to that of the animal—exclusive, about an inch less. The female is somewhat smaller than the male and rather paler coloured : but the difference is trivial, neither sex nor nonage causing any noticeable diversity in this species. The colour of the animal is a full clear yellow, largely tipped with black, and entirely void of marks or lines upon the body. The entire bridge of the nose, with the upper lip, the whiskers, and broad band thence proceeding over the cheeks, the ears, the chin, and lower jaw, the fore legs wholly, and the hind from the heel downwards, together with the terminal third of the tail, are black or black-brown. The region of the genitals, and a zone encircling the eyes posteriorly, are pure, pale, yellow. The soles of the feet and the snout are brownish fleshy gray : the nude part of the lips, the palate, tongue, and bare portions of the ears and of the genital region, pure fleshy white.

The fur is of two kinds, viz. hair and wool. The former is straight elastic, not rigid, of great length and free set, not even ordinarily applied



to the body and considerably erigible under excitement. It is two inches and a quarter long, and, for the most part, equally so over the whole body and tail, the face only and limbs being dressed in short adpressed fur. The colour of the hair is, generally, ~~for~~ two-thirds from the root, yellow, and for the terminal third, black ; but here and there a hair wholly black intervenes ; and, sometimes, the hair has a third dusky ring towards the base. The wool is soft, wavily curved in its length, somewhat more than half as long as the hair, and almost entirely of a yellow hue, though close to the skin, it has a dusky colour. This species in its general form exhibits a good deal of the vermiform type ; both the face and body being longer and more attenuated than in either of the subsequent animals. The head is depressed and rather broad ; the face or nose considerably elongated and sharpened : the muzzle largish and vaguely defined : the nares anterior and lateral, opened chiefly to the front, but freely to the sides also, whither they proceed with a strong curve ; being divided both anteaally and superiorly by a deep groove : eyes large, prominent, and possessed of a variable pupil which is, however, for the most part, vertical and linear : Ears well developed, freely exerted from the head and thence having considerable mobility, ovoid, nearly nude, the interior complex, and the fissure at the posterior part of the helix divided and furnished with two salient processes : the body (as already noticed) subvermiform : the neck thick and short : the limbs short and stout, and equally so in both extremities : the feet large, broad, spreading freely, and furnished with full soft fleshy soles : 4 basi-digital, and 2 elongate metatarsal and metacarpal balls : the action and structure plantigrade ; but not typically so, the fur extending in the hind feet  $\frac{3}{4}$ ths of an inch below the os calcis, and the animal using at speed the digitigrade motion with the hind extremities, proceeding by bounds with all four feet at once : the talons  $\frac{3}{4}$ ths vaginate, and as sharp and curved almost as in the Felinæ : the tongue aculeated backwards : the tail equal to the body and head, cylindrico-tapered, thick at the base, not prehensile,

untwisted, and carried sub-horizontally with the terminal part a little raised so as to keep it off the ground.

The females have 4 ventral teats, and produce, I understand, but one brood per annum. The habits of the species render them more active by night than by day—a circumstance clearly provided for by the largeness of their eye with its extremely convex cornea. They sleep rolled up in a ball: when angered, spit like cats; and, like cats and dogs, drink by lapping with the tongue. They are extremely ferocious and unruly when taken mature; but are apparently very capable of being tamed, if caught when young, though the natives of the plains or hills never attempt to subject to discipline their various and high natural endowments. Their cerebral development is much greater than that of the Mongooses; and they have a finer sense of smell, but less acute hearing and diurnal vision. When fighting they grapple with each other like wrestlers, scratching and biting at the same time, but never quitting their hold on the body of the adversary. They are matchless climbers; and derive the extraordinary energy of their double grasp with both hands and feet, whether in ascension or in contests with each other and with their prey, from the high articulation and free lateral motion of their limbs, the great strength and firm insertion in the large humeri of their pectoral muscles, and from the sharpness and curvature of their very mobile sheathed nails,—all points in which they differ remarkably from the Mongooses, and approximate, through the Diluri, to the Bears and Cats. Their rapid action is by digital bounds of the feet,—palmary, of the hands: their walk slow, wholly plantigrade, and deliberate, with the head and tail lowered and the back arched. Their intestines are usually from 4 to 6 times the length of their bodies,  $\frac{1}{10}$ ths of the canal consisting of small gut, and the rest, of the large. They have a short cæcum of about an inch in length, and commonly of the same equable diameter with the large intestine which, as well as the small, is thin, coated, and free from valves, sacks, or any other apparatus calculated to retard the passage

of the food. The stomach is a smooth membranous bagpipe, exhibiting on its outer surface the faintest indication merely of muscular fibre.

The above remarks relative to the organization and habits of the *Hirsute Paradoxurus* are, in the main, equally applicable to the two following species which I shall therefore characterise principally by such differences as they exhibit.

**PARADOXURUS NIPALENSIS, Mihi.** The more peculiar habitat of this species is the central region of *Nepal*, where it is very common : but it is also found in the northern, and occasionally on the confines of the southern, region. It never quits the untamed forest, and very seldom the mountainous country. The intestines of this species are somewhat longer than in the last, or six times the length of the body and head ; and the crowns of its molar teeth are rather flatter—indications of a less carnivorous habit than are supported by the relative manners of the living animals as seen by me in confinement, as well as by the contents of the stomachs of such as were killed in the state of freedom. I kept an individual of this species for four years ; and, though I took no pains to tame it, it exhibited many more signs of docility than I ever witnessed in *P. Hirsutus*. The stomach too of one which I shot in the forests of the central region contained only seeds, leaves, grass, and unhusked rice. The caged animal was fed on boiled-rice and fruits, which it preferred to animal food not of its own killing. When set at liberty it would lie waiting in the grass for sparrows and mynas, springing upon them from the cover like a cat ; and when the sparrows, as frequently happened, ventured into its cage to steal the boiled rice, it would feign sleep, retire into a corner, and dart on them with unerring aim. Birds, thus taken by itself, it preferred to all other food.

This animal was very cleanly, nor did its body usually emit any offensive odour, though when it was irritated, it exhaled a most fetid stench caused by the discharge of a thin yellow fluid from four pores, two of which are placed on either side the anus just within the sphincter. The organs

secreting this liquor are scattered granular specks, from which no ducts are traceable to the pores which emit it.

No similar pores exist in either the preceding species, or in that which will be subsequently described; and yet both of them were ordinarily fœtid whilst the present one was not so.\* Doubtless the secretion exists in all, though the pores which carry it off are no more visible to the eye in these species than are the ducts in the other.

The distinctive secreting apparatus of the genus, and which is disposed on either side of the whole length of the male and female organs of generation, has the same form in all three species, and the same secretion. This organ consists of two almond-shaped glands, one of which is laid edgewise along either side of the membrum virile or of the rima sexualis. These glands are covered on the outer side with fur, but are nude on the inner side; and, the skin being lax and subvalvular, when closed they conceal the sheath of the penis or the lips of the vulva—when opened, exhibit a shallow longitudinal fossa between the glands and those parts—but so shallow that both are laid bare upon a nearly level and wholly nude surface.

Longitudinally the glands are clearly defined by a slight constriction of the skin, especially on their anal extremity, between which and the opening of the anus there is a clear space of an inch, covered with fur like the proximate parts, and forming a simple peroneum, from which, in the male, the testes are suspended in a small hairy scrotum. If you press these glands, with the skin on, they yield a clear thick substance like congealed honey, in small globular particles, issuing from numberless small and similar pores disposed all over the surface of the glands. Pressure, when the skin is removed, causes the protrusion of the same substance. in

---

\* This may be explained by the constant state of irritation in which the two former species lived during the short time I had them alive, whilst the latter, from having been taken young and reared in confinement, was ordinarily tranquil.

the form of strings, like vermicelli. The odour of this secretion is strong and musky.

I now proceed with the description of the *Nipalense* species. This species is 48 to 50 inches long from the snout to the tip of the tail; the tail being, as in *Hirsutus*, equal to the body in length when measured with the terminal hair, and about an inch less, if the tail only be admitted. The weight is from 9 to 10lbs., and the whole habit considerably more robust than in *Hirsutus*. In this respect, as in the twisted tail and shorter face of *Nipalensis*, it differs materially from *Hirsutus*, agreeing with the Pongouné or *P. Typus* of CUVIER. Indeed so strictly similar is the conformation of *Nipalensis* to *Typus* that it is unnecessary to say more on that subject; so that we may proceed at once to the fur and colours of our species.\*

The fur is of medial length and of two sorts, pretty much as in the domestic Cat, only longer and thicker. The length of the hair is about  $1\frac{1}{2}$  inches: of the wool, about 1 inch. The former is triannulated from the base with dusky slaty ( $\frac{1}{2}$ ) rufous yellow ( $\frac{1}{4}$ ) and black ( $\frac{1}{4}$ ): the latter or wool wholly slaty. The general effect, in point of colour, is a medial cat gray or brown gray, void of all marks upon the body. Centre of the neck, on the abdominal aspect, chest, belly, and insides of the arms and thighs, pure rufous yellow: tip of tail, paws, ears, lips, chin, a curving line on the cheeks proceeding from the upper lip to the eyes, and a longitudinal mark over the eyes, black or blackish: iris brown: nude skin of the soles, lips, and ears, fleshy brown: palate and tongue, fleshy white: whiskers half white and half black. Those of the lips are very strong, long, and adpressed. There are lesser salient tufts of bristles on the cheeks, above the eyes, and under the chin—attributes common to all the three species.

---

\* *Typus*, according to CUVIER, has 6 teats. *Nipalensis* has but four: so also *Hirsutus*. And, as the difference is material, I beg to state my facts have been carefully determined by the examination of several individuals.

The ears in the present species are covered, outside, with hair which also forms a margin round the inner surface. The fissure of the posterior part of the helix is simple, and the processes of the interior are less developed than in *Hirsutus*. Both, as well as the one to be next described, have a small stripe of fur below the os calcis ; and in all the large lax interdigital membrane is covered with hair.

The females have four ventral teats. They are rather less than the males, but otherwise entirely like them : nor does nonage afford any material distinctive signs.

*PARADOXURUS LANIGERUS*, Mihi. This species is strictly confined to the northern region of *Nepal*, for warding off the cold of which its woolly fleece is peculiarly well adapted. In general conformation and physiognomy it is mediate between the two preceding animals, being less vermiform than *Hirsutus*—less robust than *Nipalensis*. In size it is considerably less than either. It measures only 32 inches from the snout to the tip of the tail, whereof the length of the tail is but 12 inches, or barely more than a third of the entire dimensions. The ears are hairy on the outer side : and the tail is without twist.

The fur consists entirely of wool precisely similar to that of a coarse fleeced sheep. It is about an inch long, and collected into flocs or clumps which incline to a curled appearance. On the legs and face the fur is shorter, closer set, and more like the fur of the congeners of this singularly robed species. The colour is an uniform earthy brown, but paler and fading into yellow, on the belly : the whiskers are white : and the nude parts, fleshy gray. As the *Paradoxuri* generally, and the *Hirsuti* species in particular, bear a resemblance in several respects to the *Viverræ* proper, with which they are ordinarily compared ; the following anatomical details may excite some interest, as well by their novelty, as by the demonstration they afford of striking differences of form and consequently of habits exist between the one group of animals and the other.

The *Muchabba*, as already noticed, is the *Paradoxurus Hirsutus*: the *Catarse* or *Catás*, the *Viverra Rasse vel Indica*; and by these, the popular names, the animals are described in the ensuing memoranda for the greater part of which I am indebted to Dr. CAMPBELL.

The skull of the *Catás* throughout very considerably compressed and elevated in comparison of that of the *Muchabba*, the one bearing in its general form the same resemblance to the cranium of the spaniels as the other does to the skull of the mastiffs. This comparison refers more particularly to the cerebral portion of the heads. In other words, the parietes of the *Catarse* shelve insensibly towards each other, and are surmounted by very large longitudinal and transverse cristæ; whilst those of the *Muchabba* have an ample swell, with ridges far less developed. The articulation of the jaws is somewhat deeper in *Catás* than in *Muchabba*; the coronoid processes considerably larger and more inclined in the latter than in the former. The form of the zygomatic arches and of the orbits, and the proportional length of the frontal and nasal bones, are pretty much the same in both: but the contour of the latter bones is materially different in the one and the other animal. In the *Muchabba* the frontal and facial line, from the commencement of the longitudinal crista to the end of the nose, is straight in its length; whilst, in the *Catarse*, it is arched: and, if these parts be regarded in reference to their transverse outline, in the *Catarse* they present a strong and perfect convexity throughout—in the *Muchabba*, a level, depressed along the mesial attachment into a groove which occupies the whole extent of the nasal bones and the anterior half of the os frontis. The receptacles of the auditory apparatus are three times as large in the *Catarse* as in the *Muchabba*: but those containing the olfactory organs are somewhat larger, though by no means compensably so, in the latter than in the former skull. The infra-orbital foramen is twice as great in the *Muchabba* as in the *Catarse*, corresponding to the superior size of the whiskers in that animal. The teeth have in both skulls the same positions, forms;

and numbers: but the canines are sharper and rather more curved, and the processes of the molars are much more acute and longer too, in the *Catarse* than in the *Muchabba*. The skull of the *Muchabba* measures  $4\frac{1}{4}$  inches in length, 2 and  $\frac{1}{4}$  in width, and  $1\frac{1}{8}$ th in height: That of the *Catarse*  $4\frac{1}{8}$  in length,  $1\frac{1}{4}$  in width, and  $1\frac{1}{8}$  in height. In proceeding with this comparison the osteology of the *Muchabba* will be chiefly detailed, the differences, merely, presented by that of the *Catarse* being noticed as they occur.

The cervical vertebræ are seven, and measure together 4 inches. The lateral processes or alæ of the atlas are broad and strong, as is the spine or crest of the vertebra dentata.

The six anterior vertebræ only of the neck are pierced in the transverse processes by the canal of the vertebral arteries; and, with the exception of the two first and the last, all have strong transverse processes resembling those of the lumbar ones. To this may be attributed the strength and thickness of neck so prominent in the animal when alive and so essential to his predatory habits. The vertebral arteries enter the spinal canal in the articulating cup of the atlas, having a tortuous course through its body, and they penetrate the condyles of the occipital bone immediately after entering the skull. The seventh cervical has all the characters of the dorsal vertebræ except the depression for the articulation of the rib. In the *Catarse* the cervical vertebræ are seven as in the *Muchabba*; but they are so much longer in the former animal as to measure one-third more, or six inches. The crest too of the vertebra dentata is higher and arched, giving that graceful bend of the neck so noticeable in the living *Catarse*.

Dorsal vertebræ 13, smaller in their bodies and transverse processes than the cervical ones. The 10 anterior ones have spinous processes pointing backwards: the three posterior ones have no transverse processes for the articulation of the ribs, which are merely articulated with a small depression on the anterior end of the body of the vertebræ. The lumbar



vertebræ are seven in number and large: the transverse processes of all pointing forwards, those of the two first and of the last one, smaller than the others. Sacral vertebræ three, united by ossification of the lateral processes—passages being left opposite the intervertebral spaces for the transmission of the sacral nerves. Caudal vertebræ 28, the first four having a remains of the spinal canal. The number of vertebræ here exceeds that of the *Catarse* by 4. The pelvis is shorter and broader in the *Muchabba* than the *Catarse*, the symphysis pubis being in the latter  $1\frac{1}{2}$  inch long, and in the former, only  $\frac{3}{4}$  inch. In the *Catarse* the acetabulum is much smaller in circumference and not so deep: but the groove in the anterior margin for the lodging of the round ligament is the same in both animals. The sternum is composed of eight distinct bony pieces of a cylindrical shape: the posterior one furnished with heart-shaped cartilage  $\frac{3}{4}$  of an inch long, projecting beyond the attachment of the last pair of true ribs. The ribs are 13 pair, 9 true or articulated with the sternum by intermediate cartilage, and four false. The scapulæ present nothing remarkable to assist in elucidating the muscular powers of the animal, save the largeness of the spine and the extent and shallowness of the glenoid cavity—the former indicating the strength of the scapular muscles, and the latter, a great latitude of motion in the humerus. The glenoid cavity is oval-shaped and twice the extent of that in the scapula of the *Catarse*. And here we have the first indication of a prominent difference in the motive organs of the one animal from those of the other.

The humerus is  $3\frac{3}{4}$  inches long, strong in its shaft, and bearing prominently all the marks of a bone subjected to vigorous and varied muscular power. Its head is large and represents a small segment of a large circle. It appears twisted towards its distad extremity, where it dilates into two large condyles for the origin of the strong muscles of the hand and fingers; and the ridge for the insertion of the great pectoral muscles is strongly marked. Contrasted with the humerus of the *Catarse* it helps much to

illustrate the structure required for a plantigrade and climbing action, as compared with a digitigrade one.

The animals are as nearly as possible of an equal mean height: but the length of the corresponding bones is far from equal. The *Catarse* moves solely on his fingers by which means the length of his metacarpal bones and of his wrist are added to his height. The *Muchabba* walks entirely on his hands and wrist, being thus deprived of his carpus and metacarpus as a part of his stature from the ground. But he is compensated for this by an increased length of humerus and forearm nearly amounting to the length of the metacarpus which is added to these bones in composing the height of the *Catarse*. The centre metacarpal bone of the *Catarse* is one inch long: His humerus half an inch shorter than that of the *Muchabba*, and his radius (the true forearm)  $\frac{3}{4}$  of an inch shorter than that of the other animal. The humerus of the plantigrade animal is strongly marked with a large ridge for the insertion of a pectoral muscle which rises from the whole length of the sternum; is furnished with broad condyles for the origin of the muscles of the hand and fingers; and has an extensive surface for articulation with the scapula. All these signs indicate free action of the arm on the trunk, with extensive motion of the hand and wrist. The humerus of the digitigrade animal, compared with the above, is weak and short; is not so prominently marked with ridges; its condyles scarce project beyond the articulating surface or trachlea; and it shews a limited surface for articulation with the scapula. These marks attest a more limited power of arm and hand, and a less free motion of the extremity on the trunk. The radius in the *Muchabba* is much stronger and  $\frac{3}{4}$  of an inch longer than in the *Catarse*: its articulating surface which enters into the composition of the elbow joint, is twice as large as that of the other: its rotatory motion on the ulna is much more free and extensive, enabling the animal to bring the hand from the state of pronation freely round to that of semi-supination;

and its distad extremity is dilated into a large articulating surface for the attachment of the wrist. The ulna, as is usual where the radius is capable of rotation and forms the chief articulation with the carpus, becomes gradually smaller towards its end where it terminates in a round point. In both animals it enters but sparingly into the wrist joint, being articulated with one carpal bone only. The bones of the carpus are seven : those of the tarsus are seven also : the metacarpal and metatarsal ones are five,\* corresponding to the number of fingers. The latter bones, as well as those of the digits, are all nearly of equal length. The articulation of the metacarpal and metatarsal bones with the carpus and tarsus is free, affording much power of motion on one another. These bones admit also of flexion and extension on the wrist and ankle ; instead of forming a compact arch, as in the *Catarse*, where they are raised from the ground. The five digits of the hands and feet are all produced to the front, the thumbs not being retracted as in the *Catarse* ; and they are armed with feline talons. Each digit has three phalanges endowed with the most extensive motion. To all these peculiarities of structure it is owing that the *Muchabba* is enabled not only to climb trees with ease and rapidity, but in its own defence as for purposes of aggression to grasp an object with considerable strength and with the feet as well as the hands. It cannot of course bend the digits on the palms, but with one hand opposed to the other and the free rotation of the radius on the ulna the *Muchabba* clasps the branch of a tree or the body of its antagonist when fighting with the greatest ease, and apparently with much force. The *Muchabba* in these respects differs much from the *Catarse*, whose efficient fingers are, besides, only four, with a small fifth, one behind and before, but of little use from

---

\* There are also two small sesamoid bones placed over the articulation of each metacarpal and metatarsal with the first phalanx, to serve as fulcra for the digits.

their elevation and imperfect development. Nor are its talons either so acute, so curved, or so mobile, as those of the *Muchabba*.

The bones of the fore arm and leg are separate in both : and the wrists and ankles of both contain the same number of bones : so also do the digits :\* but in the *Catarse* there are only 4\* metacarpal and metatarsal bones, instead of 5 ; and the bones of the fore arm and of the leg are more slender and have smaller articulating surfaces in *Catarse* than in *Muchabba*.

From the foregoing remarks it is apparent that the whole structure of the limbs down to the talons is in the *Muchabba* suited to scansion, in the *Catarse* to running. The few observations which follow will shew that these osteological differences are accompanied by others in the structure of the soft parts. The urinary and generative organs with their appendages, although in one point essential for classification bearing a resemblance, are widely different in each. Placed on the sheath of the penis anterior to the scrotum there is a secreting organ : but, while in the *Catarse* it consists of a hairy lump, having the size and nearly the shape of a walnut, with a deep cleft in its centre terminating in a cavity which is again subdivided transversely into two hairy depressions, in the *Muchabba* it is simply a longitudinal naked secreting space wholly exposed to view.† The penis of the former is very small, bony, and pointing to the ground : that of the latter large, without bone, pointing anteriorly, and covered by a strong membrane thickly studded with horny points. The prostate gland of the

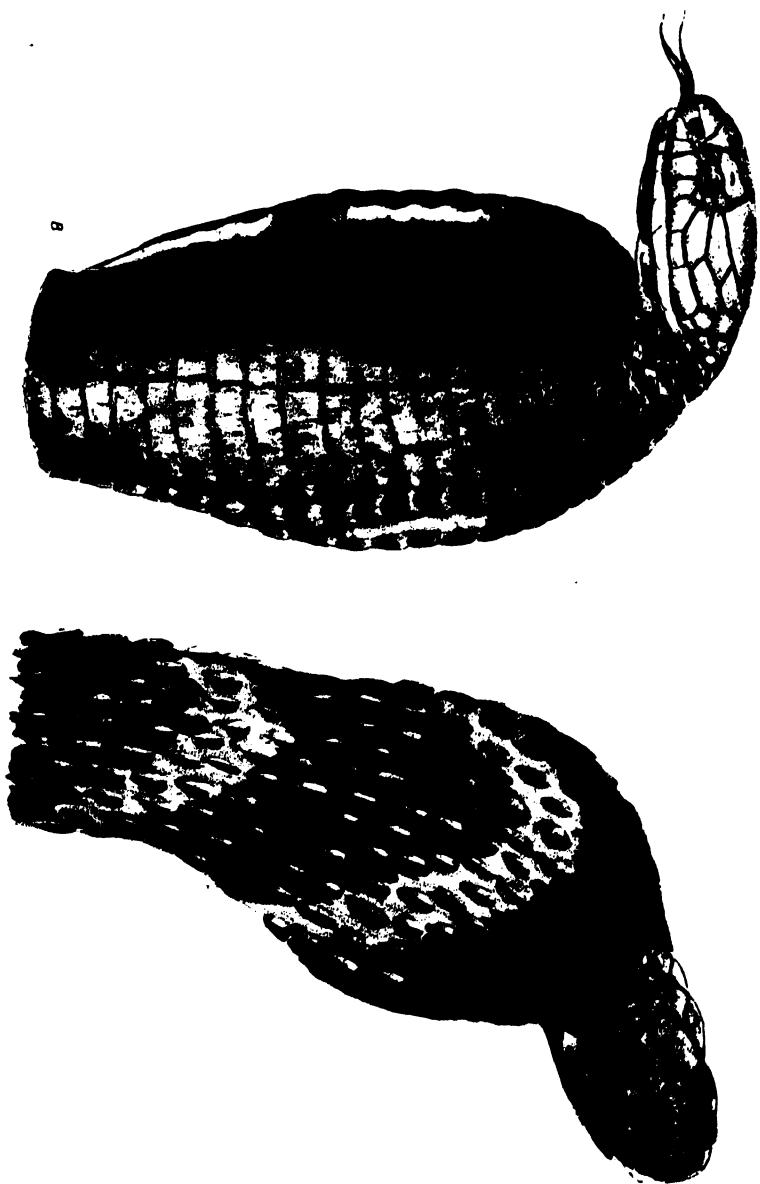
\* In respect to the metacarpal, metatarsal and digital bones of *Catarse*, it would perhaps be more correct to say that there are five bones to the former, and only two to the inner digits : removing the deficiency from the one part to the other.

† Dissection proves the secreting organ to consist of two bodies in both animals. But in *Catarse* the two parts of it are closely and firmly knit together over the penis, whilst in *Muchabba* they are quite separated, and have the penis lying freely between them. The secretion is more musky in *Catarse* than in *Muchabba*.

one is small, two-lobed, and has the urethra passing through its centre: That of the other, as large as man's, and with the third lobe largely developed, lies high in the pelvis, and has the urethra passing through its surface nearest the rectum; the mass of the organ being between the pubes and urethra. The anus in both animals is without palpable secreting glands, ducts, or pores.

The small salivary glands and the general nature of the chylopoetic viscera in both proclaim carnivorous habits, as contrasted with the same parts in herbivorous animals. Throughout the stomach and intestinal canal of the *Muchabba*, there is nothing found to retard the speedy passage of the food. The œsophagus enters the stomach close to the left extremity leaving no cul de sac. The intestines are thin coated: the small cæcum undilated at its distad extremity: and, although the intestine is wider from that to the anus than above it, there is no trace of sacculi in it, and its course is nearly straight to the vent. The whole intestines in both animals are usually about four times the length of the body and of small calibre. But the smaller ones of the *Catarse* are thicker in their coats: its cæcum is longer, and dilated at its further extremity; and there are three valvulæ conniventes found in its large gut. Its stomach also is thicker and less purely membranous. These circumstances would lead to the idea of this animal being less blood-thirsty than the *Muchabba*.

---



8

*HAMADRYAS HANNAH.*



# VIII.

---

## S K E T C H

### OF AN UNDESCRIBED H O O D E D S E R P E N T,

WITH

FANGS AND MAXILLAR TEETH.

---

BY. DR. TH. CANTOR.

---

HAMADRYAS, *Nov. Gen.*

*Caput latum, subovatum, deplanatum, rostro brevi, obtuso. Canthus frontalis obsoletus. Buccæ tumidæ. Oculi magni, prominentes, pupilla rotunda. Nares late apertæ, laterales, duorum scutellorum in confinio. Scuta rostralia frontalibus minora; scuta supraorbitalia scuti verticis ejusdem magnitudinis, scutella præorbitalia duo, postorbitalia tria; scuta occipitalia maxima, sex magnis scutis circumdata. Dentes veneni antici, pone quos pauci dentes maxillares. Gula squamosa. Collum dilatabilis. Truncus teres, abdomine rotundato, squamis lævibus, per series obliquas dispositis, imbricatim tectus. Cauda brevis, scutis & scutellis tecta.*

HAMADRYAS HANNAH.

*Superne olivaceo-viridis, striis sagittalibus nigris cincta; abdomine glauco, nigro-marmorato; cauda fere  $\frac{1}{2}$ .*

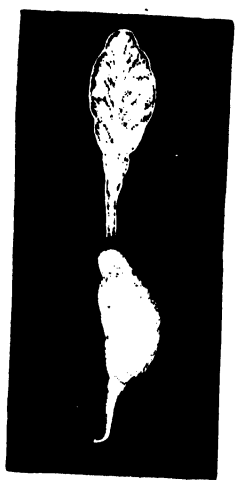
The shape of the head is very like that of the *Naja tripudians*, MERREM, the Cobra Capello, covered above with 15 larger shields in 5 ranges, the first of which containing 2 scuta rostralia, the second 2 frontalia, the third 2 supra-orbitalia and the scutum verticis, the fourth 2 occipitalia, surrounded by the fifth range, consisting of 2 postoccipital and a temporal shield on each side. These scuta as well as the others, covering the temples and lips,



are of a drab color, edged with black. The integuments of the upper part of the head as well those of the side and of the chin, are represented in the accompanying drawings. The muzzle obtuse, rounded, with a wide semi-circular opening for the tongue, which organ is black, thick, bifurcate. The nostrils lateral, wide, between 2 shields. The eyes prominent, large, brilliant; golden iris, round pupil, surrounded by 3 postorbital, 2 præorbital and 2 labial (the 4th and 5th from angulus oris) shields. The upper lips covered with 7, the under lips with 8 shields. The mouth large; in the upper jaw, a little longer, than the lower, 2 rows of palatal, sharp, reflex, distant teeth: two fangs on each side, covered as usual with a duplicature of the palatal membrane, behind those a few (3-5) maxillar teeth. Two rows of sharp, reflex teeth in the lower jaw. The neck dilatile, <sup>(1)</sup> though in a less degree, than that of the *Naja tripudians*, so that the hood or disque of this Serpent, is comparatively more oval, narrower, but thicker, than the hood of the latter. The back of the hood is covered with oval smooth scales of an olive green color, those which cover the black skin with a black margin, those covering the white skin of a lighter colour and without black edges. The anterior part of the hood is formed by the first 16 to 18 abdominal scuta, of a reddish yellow color, and the two lowest rows of scales, between which appear two black spots on each side, formed by the interstitial black skin. The trunk thick, cylindrical, tapering towards the tail, covered with 21 oblique ranges of smooth, imbricate scales of 3 different shapes (Pl. XII. Fig. E.) Their color is olive green; the interstitial skin is partly black, partly white, disposed in such a manner, that it forms a number of bands, converging in the direction of the head; the black prevalent towards the tail, near which the colors become much more bright, which is in general not the case with Serpents. The broad abdominal

---

(<sup>1</sup>) The power of dilating the skin of the neck and thus forming a hood or disque is a characteristic of the genus *Naja*, LAURENTI, of which two distinct species are known, viz. the *Naja tripudians*, with a number of varieties, most of which are mentioned and figured by RUSSELL, and the *Naja haje*, Coluber haje, Linné, L'Aspic, the Aspis of the Classics, represented by GEOFFROY ST. HILAIRE, and SAVIGNY, in "Description de l'Egypte."



HANADRYAS HANNAH



scuta are bluish grey, interspersed with black as they approach the tail. The tail cylindrical, gradually tapering into a sharp point, covered above with hexagonal, yellowish green scales, marked with pitch black, so that its general appearance is black, divided by yellow rings, and interspersed with spots of the same color. From the broad semicircular plate, covering the anus, proceeds a number of blackish blue, somewhat chequered, scuta, after which commence by pairs the subcaudal scutella.

How little confidence can be put in counting the abdominal scuta and subcaudal scutella, using as a guide their number, which varies nearly in each single individual of the same species, is a remark made long ago by several Naturalists. The following Tables shew the difference in this respect as well as the respective dimensions of four specimens, which have come under my inspection.

	1 (*)	2.	3.	4.
Scuta abdominalia,.....	245	215	210	235
Scuta subcaudalia, .....	13	10	11	32
Scutella subcaudalia, .....	68	79	71	63

	1.	2.	3.	4.
	Feet. Inch.	Feet. Inch.	Feet. Inch.	Feet. Inch.
Length of the head,.....	0 2.0	0 2.3	0 2.1.	0 2.5
„ of the trunk, ....	6 6.3	7 0.0	6 2.3	8 0.2
„ of the tail, .....	1 6.0	1 0.2	1 7.4	1 7.0
Total length, ....	8 2.3	8 11.5	7 11.8	9 9.7

	1.	2.	3.	4.
Circumference of the neck,	0 3.6	0 4.7	0 3.0	0 5.2
Greatest circumference of } the trunk, ..... }	0 6.3	0 8.2	0 6.8	0 8.4

(\*) No. 1 is the specimen here described.

The natives say, that individuals are found upwards of twelve feet in length; at all events this Serpent for a venomous one is remarkable for its size, which, even if attained by any of the others hitherto described, is certainly not surpassed. In general these reptiles are of a comparative small size, and perhaps the greatest ever described is a species of DAUDIN's genus *Bungarus*, which attains according to CUVIER seven or eight feet (*Règne Animal* II. p. 96). Another venomous Serpent, generally reckoned amongst the greatest, is *Vipera lanceolata*, DAUDIN, *Trionocephalus lanceolatus*, OPPEL, the size of which is six to seven feet; that one has ever been seen upwards of nine feet, is considered very doubtful (*Diction des sc. nat.* LV. p. 302.) Three of the above-mentioned specimens were caught in the Sunderbuns, the fourth in the jungle not far from Calcutta. According to the natives, this Serpent chiefly feeds upon other Serpents; two specimens in my possession were regularly fed by giving them a living Serpent, no matter whether venomous or not, every fortnight. (\*) As soon as this food is brought near, the Serpent begins to hiss loudly, and expanding the hood raises about two or three feet, and darts upon its prey just in the same way, as the *Naja tripudians* does. Dr. RUSSELL says, (I. p. 85), he could never induce the venomous Snakes to feed spontaneously. I have had various opportunities of verifying this with the *Naja tripudians*, *Vipera elegans*, DAUDIN, *Bungarus annularis* DAUDIN. The *Hamadryas* only makes an exception. This, however, is not the case with those venomous Serpents armed with fangs behind the maxillar teeth, (à crochets postérieurs), which I have had opportunity to observe, viz. *Cerberus Grantii* mihi and *Potamophis Lushingtonii* mihi, both of which readily enough swallow their food.

---

(\*) The Snake-catchers before they feed Serpents, kept in cages, are accustomed to give them a quantity of water, which is readily swallowed. As I have witnessed this fact very often, I cannot help remarking how perfectly wrong the physiologists are, who state, that Ophidians never drink. On the contrary, these animals both drink and moisten their tongues, which, with the Serpents whose tongues are not situated immediately in the cavity of the mouth, become two quite different acts.

The fresh poison of the *Hamadryas* is a pellucid fluid, in consistence like a solution of gum-arabic in water. It reddens slightly litmus paper, which is also the case with the fresh poison of the *Naja tripudians*, *Vipera elegans*, *Bungarus annularis*, and *Bungarus caeruleus*; when kept for some time it acts much stronger upon litmus, (the color of which is easily restored by the application of carbonate of magnesia,) but after it is kept, it looses a great deal of its deleterious effects. Reserving the experiments made with the poison of this Serpent upon living animals, I shall merely state here, that the poison seems to act less quickly than that of the *Vipera elegans* and the *Naja tripudians*; but it should be remarked, that the experiments were made during the cold season. This specimen, which was brought me in the beginning of November last, changed its skin in the end of December, a process, which I have reason to believe takes place in this as well as in the other Ophidians of this country several times during the year.

---

In consequence of the strong resemblance between the *Hamadryas* and the *Naja*, I should consider them as neighbouring genera, and I even at first thought I could refer this Serpent under the genus *Naja*. Circumstances however prevented me till latterly from being able to examine specimens, whose fangs were untouched (those of the former having been drawn by the Snake-catchers, who are much more afraid of this, than of the Cobra,) when I discovered the peculiarity of the maxillar teeth behind the fangs, which is found in the *Bungari* and *Hydri*, but never in the *Najas*. This material anatomical difference, in addition to the others existing in the external appearance, occasioned me to form a new genus. (\*)—*Hamadryas Hannak* differs from *Naja tripudians*:

1. By its having maxillar teeth behind the fangs.
  2. By the spina on the os occipitale inferius, which, like that of the *Vipera elegans*, is of a remarkable size and much more developed, than the same of the *Naja*.
- 

(\*) *Hamadryas H.* is said to inhabit hollow trees, and is frequently observed between their branches.

3. By the integuments of the head.

4. By the integuments covering the abdominal surface of the tail.

5. By its color.

6. By its food, chiefly consisting of other Serpents, which is not known to be the case with any of the other Ophidians, which shew themselves rather inclined to evite, than to attack each other.

7. By its size.

I have often heard asserted, that "*Cobras*" (which name is naturally enough attributed to every hooded Serpent,) have been met with of an enormous size, but I strongly doubt their belonging to the *Najas*, which scarcely exceed 5 to 6 feet in length. Some time before I discovered the *Hamadryas*, I was favoured by J. W. GRANT, Esq. with an interesting description of a gigantic hooded Serpent, he had observed at Beauleah, and which he remarked was no Cobra, adding, he was of opinion, that besides Cobras there are other hooded Serpents in this country. By inspection Mr. GRANT denied the *Hamadryas* to be identical with the above-mentioned, from which it differed in size and color.

The native name of *Hamadryas Hannah* is '*Sunkr-Choar*'; another hooded Serpent, called '*Mony-Choar*,' is said to attain a much larger size than the former.

---

## EXPLANATION OF THE PLATES.

---

### PLATE X.

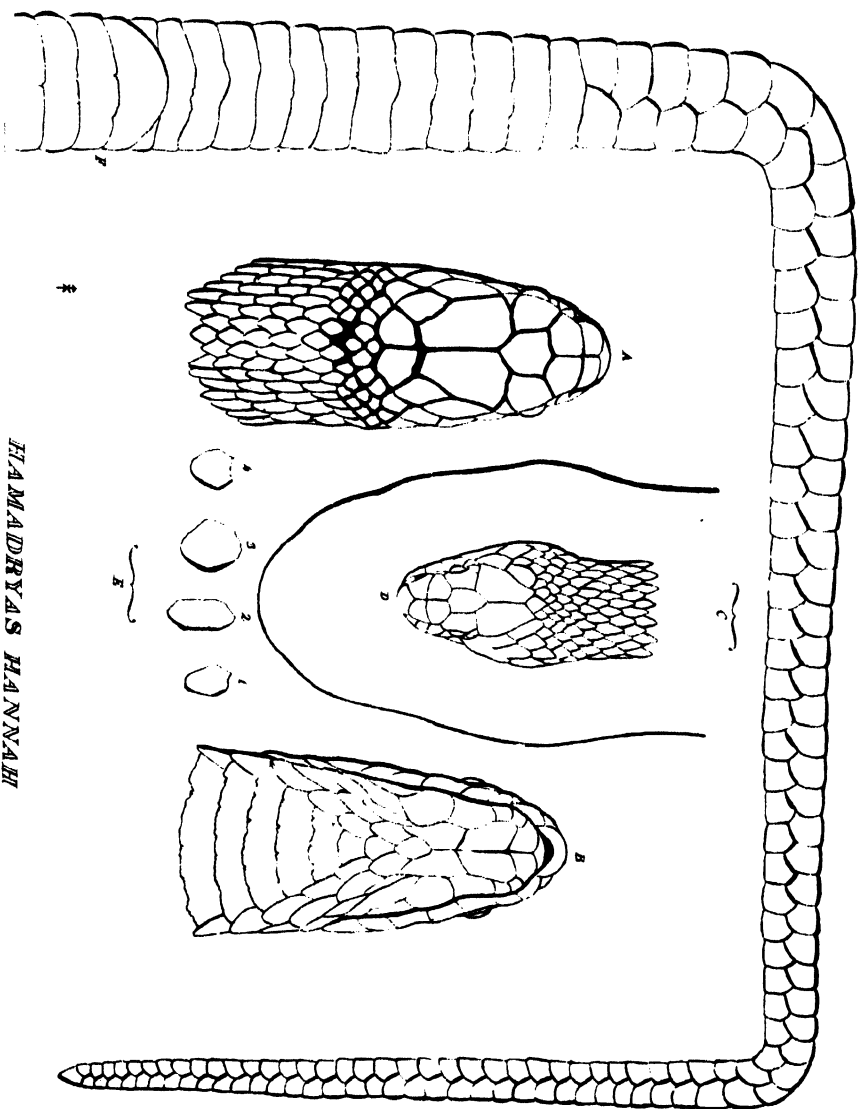
- A. Head of the Serpent preparing to attack, expanding the hood.
- B. Front view of the completely expanded hood.

### PLATE XI.

- A. The venomous apparatus and the surrounding parts.

### MUSCLES.

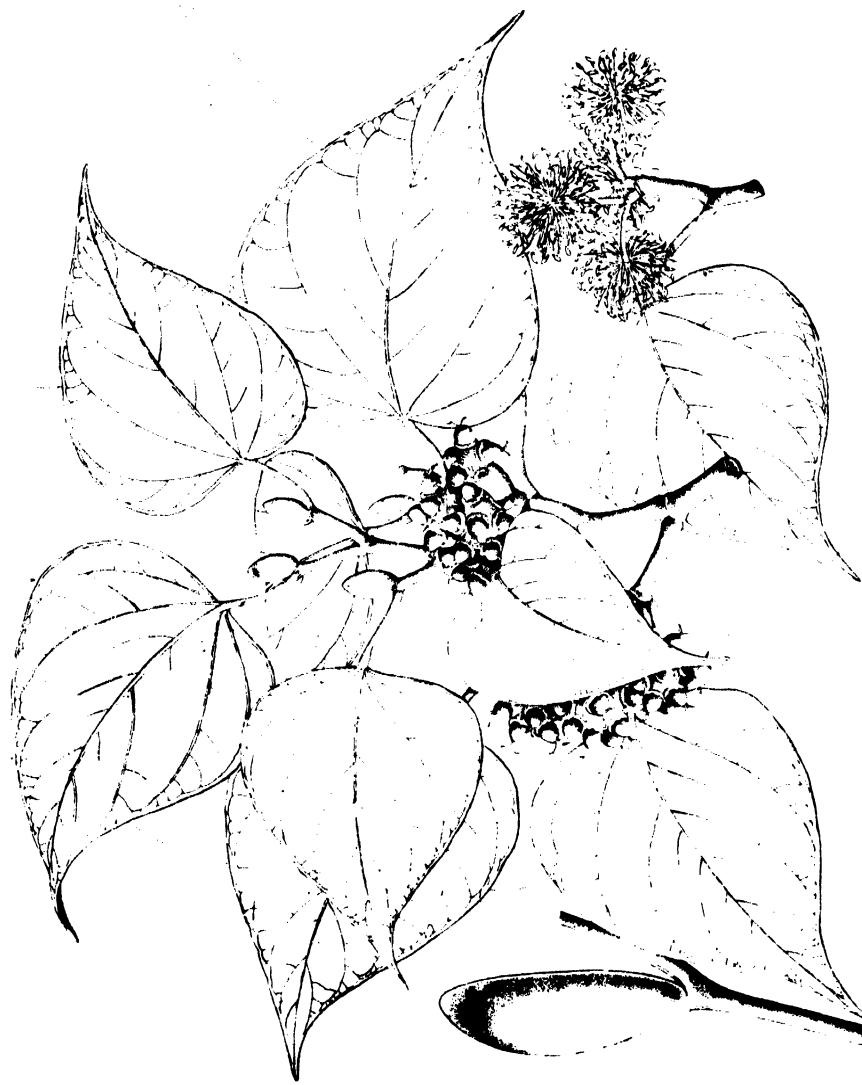
- 1. Vertebro-mandibularis.
- 2. Cervico-angularis with
- 2' its cutaneous portion.



*HAMADRYAS HANNAH*



*Boehmeria populacea* Br.



3. Digastricus with
- 3' its cutaneous portion.
4. Temporalis posterior with
- 4' its maxillar portion.
5. Temporalis medius.
6. Temporalis anterior with
- 6' its maxillar portion.
7. The sac surrounding the venomous gland.
8. The excretorian duct.
9. The duplicature of the palatal membrane, covering the fangs.
10. Submaxillar salivarian gland.
11. Submandibular salivarian gland.
12. Tendo articulo-maxillaris, spreading carneous fibres over the sac.
- B. The venomous gland and its surrounding muscles loosened and vent over to shew the subjacent muscles.
  1. Vertebro-mandibularia.
  2. Cervico-angularis.
  3. Digastricus.
  4. Temporalis posterior.
  5. ——— medius.
  6. ——— anterior.
  7. The venomous gland.
  8. Pterygoideus externus.
- C. Lateral view of the skull.
- D.
  1. External appearance of the venomous gland.
  2. The gland longitudinally divided, by which the cells and their little ducts proceeding into the common excretorian duct, are laid open.

PLATE XII.

- A. The integuments covering the head and part of the neck.
- B. The integuments of the lips, chin and throat.
- C. Outline of the head of the specimen No. 4, in the text.
- D. Outline of the head of a *Naja tripudians*, about 4 feet in length.
- E. Scales.
  - 1 of the neck.
  - 2 and 3 of the trunk.
  - 4 of the tail.
- F. Outline of the integuments covering the abdominal surface of the tail.

## IX.

## DESCRIPTION

OF

TWO GENERA OF THE FAMILY OF

HAMAMELIDÆ,

TWO SPECIES OF PODOSTEMON

AND

ONE SPECIES OF KAULFUSSIA.

By WILLIAM GRIFFITH, Esq.,

*Asst. Surgeon, Madras Establishment.*

## 1. BUCKLANDIA.

R. Brown in Wall. Catal. No. 7414, (sine caractere).

Syst. Linnæan DODECANDRIA DIGYNIA

Char. gen. *Flores* polygami, capitati, nudi. *Antheræ* valvâ dehiscentes.

Ord. Nat. HAMAMELIDÆ. R. Brown loc. citat.

Char. gen. *Flores* capitati: *capitula* 8-flora. *Antheræ* valvâ dehiscentes. *Capsula* bilocularis, 12-sperma: *semina* bina infima cujusque loculi perfecta, hinc alata.*Arbor* magna, facie *Populi* cujusdam. *Ramuli* abrupte terminati, apice gemmiferi. *Squamæ* vel tegmenta gemmarum binæ oppositæ! *Folia* alterna exstipulata. *Pedunculi* terminales.

BUCKLANDIA POPULNEA. R. BROWN loc. cit. Ejusd. Vermischte Schriften 7. p. 374.

Hab. in collibus Khasiyanis a *Chirra Punji*, ubi arbuscula, usque ad *Sarrarim*, ubi arbor magna.


Florentem fructiferamque legimus mense Octobris, 1835.

*Arbor* in locis idoneis ex auctoritate WALLICHII 60—70-pedalis, cortice suberoso brunneo, coronâ irregulari. *Lignum* compactum, grave, e vasis parvis plurimis fibrisque minutis formatum. Medullæ carnosæ densiusculæ cellulæ punctatæ. *Radii medullares* plurimæ angustissimæ. *Zonæ* concentricæ inconspicuæ. *Vasa spiralia* circa medullam disposita, interdum composita. *Vasa corporis* lignei annulata punctataque? *Fibræ* punctatæ, punctis istis coniferarum similibus. *Ramuli* flexuosi, glabri, lenticellati, articulati, articulis tumidiusculis, hinc cicatrice folii lapsi notatis; novelli læviusculi, abrupte et oblique terminati, foliaque vel viridia vel rubro-colorata et glaucescunt cito evanidâ tecta. *Gemmæ* semper terminales, foliiferæ vel folio-floriferæ, bisquamatæ! *Squamæ* oppositæ, foliaceæ, ovales, coriaceæ, integerrimæ, marginibus cartilagineis arcte approximatis. *Foliiferæ* (vel *ramuliferæ*) diu persistentes clausæque, planiusculæ, facibus interioribus basi tantum exceptâ arcte cohærentibus, sæpius (an semper?) foventes ramulos tres minutos, quorum quisque hinc apice gerens folium conduplicatum, hispidissimum pilis ferrugineis, crebre septatis acutis, summoque apice gemmarum squamas pariter hispidissimas; longitudinaliter et inconspicue venosæ sunt, externe et præsertim supra medium stomatosæ, cuticulâ interiore quasi fibrosâ et hinc illinc stomatibus incompletis rarius donatâ. *Folii-floriferæ* oblongæ, ventricosæ, sub-inflatæ, ad anthesin secus marginem alterum spathæ in modum fissæ, cito bivalves, demum nec tarde deciduæ, membranaceo-coriaceæ, præcedentibus minus foliaceæ, extus brunnescentes, intus albidæ, utrinque (an semper?) stomatibus orbatæ; fovent ramulos ejusdem fere formæ ac in istis, apice floriferos et pilis brevioribus hispidos, folio ramuli exterioris tantum complete evoluto. *Folia* alterna exstipulata, ramulos semper

oblique terminantia, longiuscule petiolata, late cordato-ovata, interdum fere deltoidea, longe cuspidato-acuminata, sæpissime indivisa, aliquando bitriloba, coriacea, integerrima, subrepanda, margine cartilagineo, supra læte viridia lucidaque, subtus subglaucescentia, novella utrinque, sed præsertim subtus (vel in gemmis extus) ad venas et ad margines pilis antea memoratis cito deciduis hispidissima. *Venatio*: vena primaria (costa auctorum) ad apicem recte excurrit, secundariis duabus infimis utrinque basi folii approximatis, ideoque folium basi subquinquevenium, omnibus sed his præsertim arcuatis et mediantibus venis tertiariis connexis; venulæ intramarginales inconspicuæ. Pagina cæterum areolatim reticulata est. Cuticula iuxta tantum stomatosa, utraque e cellulis varie angulatis parvis conflata. Stomata ovalia, parva.\* *Petioli* longitudine valde variabiles, interdum 4-unciales, sæpius 2-unciales, utrinque incrassati transverseque rugosi, supra a medio usque ad apicem sulcati. Flores polygami, hermaphroditi nempe et fœminei in arboribus distinctis, capitati; octo in singulo capitulo verticillis binis alternantibus dispositi. *Capitula* subterna, in pedunculis solitaria, globosa, viridescencia, interstitiis florum præsertim fœmineorum dense pubescenti-pilosis. *Pedunculi* teretes, longitudine varii, semiunciales, vel unciales fere. *Calyx* semisuperus, subcampanulatus, ore truncato carnosio repando sub-5-lobo, lobis medio sulcatis, sinibus alternis profundioribus; fructûs induratus,  $\frac{1}{4}$ -superus, cæterum parum mutatus. *Petala* perigyna, floris hermaphroditi numero varia, sinibus profundioribus oris calycini opposita, lineari-spathulata, carnosæ, integræ, deciduæ, per æstivationem arcuatim incurvæ, sæpe in stamina incomplete mutata; floris fœminei subquaternæ, rudimentaria, subulata, cito sphacelata deciduaque. *Stamina* 10-14 (an unquam plura?) perigyna, diutius persistentia; floris fœminei nullæ, nō rudimentaria quidem. *Filamenta* subulata, subæqualia,

---

\* These bodies consist of a central opaque areola, generally furrowed along the middle, surrounded by a transparent ring. But in other states the central areola is neither opaque nor furrowed, and appears under an indifferent lens of the focal distance of  $\frac{1}{10}$  of an inch to be closed by a membrane.

per æstivationem varîe flexa, post anthesin versus apicem sphacelata (an semper?); horum petalis alternantia semper solitaria. *Antheræ* oblongæ, prope basin adfixæ, per anthesin sæpe tortæ, biloculares, valvatim dehiscentes, loculorum sulco connectivo approximato; valvulæ valde inæquales, interna angustissima, externa lata longitudinaliter et extrorsum revoluta, ambæ persistentes, nudæ, cito coriaceæ, demum rectæ et faciebus externis mutuo applicitæ. *Connectivum* lineare angustissimum, apice ultra loculos in apiculum brevem productum. *Pollen* ovale, læve, hinc centraliter et longitudinaliter sulcatum. *Ovarium* (in flore fœmineo majus) semi-inferum, ovato-oblongum, biloculare, loculis anticis posticisque , 12-sporum, septi dimidio superiore tantum placentigero, parte liberâ primum pilis brevibus albis pubescens, demum glabratum. *Styli* duo, subulati, glabri, revoluti. *Stigmata* plana, facies internas stylorum a medio circiter supra occupantia. *Ovula* cuique loculo 6, biseriatim collateralia, pendula (duobus infimis appensis, difformia; 4 superiora semper abortientia. Duo summa minima, intima, ovali-oblonga, supra ad foraminis situm quasi truncata, tegumentis nucleoque vix distinctis. Duo intermedia majora, sursum paullo, deorsum valde elongata, ambitu ovato-lanceolata, mutuâ pressione ad faciem anteriorem angulata, extus convexa, foramine supero distincto hiantes, tegumentis nucleoque manifestioribus. Duo infima et extima semper fertilia, fundum loculi implentia, convexo-trigona, facie nempe anteriore angulatâ, posteriore convexâ. Tegumenta bina, distincta, utraque celluloso-membranacea; *exterior* ratione interioris maximum, sursum in alam loculi parietibus externis applicitam productum; foramen superum, rimæforme, transversum, alæ basin versus situm, ideoque quam maxime inæquilaterale; *raphe* parum elevata, hinc ad latus internum anguli seminis intimi currens; *chalaza* maculâ brunneâ notata. *Interior* lageniforme, nucleum ovatum discretum continens, colli ore denticulato, foramen longitudine subæquante vel paullo superante. *Fructus* multiplex, subglobosus, induratus interstitiis calycum rugosis. *Capitula*  $\frac{3}{4}$ -supera, demum omnino libera, calyce indurato inferne cincta, ovata, stylis stigmatibusque induratis rectiusculis coronata,

glabra, ecorticata, bilocularis. *Endocarpium* osseum fragile nitidum. *Septum* bilamellatum. *Dehiscentia* loculicida, incomplete bivalvis, valvis medio septiferis, demum bipartitis, sæpe stylis longitudinaliter bipartitis apiculatis. *Semina* cujusque loculi 6, situ ovulorum. Quatuor superiora abortiva solida, extus ossea; duo summa sursum truncata, deorsum producta, extrorsum curvata; duo situ et magnitudine intermedia sursum paullo, deorsum longe producta et in sinubus alarum seminum inferiorum quasi nidulantia, intus angulata, extus convexa; duo infima fertilia formâ auriculam humanam referentia, convexo-trigona. *Tegumenta* bina leviter accreta; *exterius* celluloso-membranaceum, subcoriaceum, e cellulis sinuosis conflatum, secus marginem exteriorem ab ipsa basi fere sursum productum in alam oblongam bilamellatam, lamellâ exteriore maximâ alæ formam dante, interiore oblique truncatâ. *Foramen* immutatum! *Interius* cellulosum, brunnescens, albumini leviter adnatum; collo brunneo-sphacelato, ore dilatato dentato ultra rimam foramen nunc exsertum. *Albumen* parcum, album, carnosum. *Embryo* inversus, albus, longitudine et latitudine fere albuminis, axillis, directione obliquus. *Radicula* conica, subulata, cotyledonibus duplo brevior, apice collum membranæ interioris subintrante. *Cotyledones* planæ, carnosæ, ovales, inconspicue venosæ, faciebus seminis parallelæ. *Plumula* inconspicua.\*

## 2. SEDGWICKIA. WALL. ET GRIFF.

Ord. Nat. *Hamamelidea*.

Character gener. Flores capitati, numero indefiniti. Capsula bilocularis. Semina indefinita, unico infimo cujusque loculi perfecto, marginato-alato.

\* Seeds of this plant which were sown in the Honorable Company's Botanic Garden at Calcutta, on the 2d November 1835, commenced germinating on the 18th of the same month. Of these I have examined two in an early and dried state. The integuments were ruptured irregularly at their apices and the wing had totally disappeared. The inner one had become quite distinct, the albumen had disappeared. The radicle had reached a considerable length. The cotyledons were for the greater part enclosed within the integuments, but had enlarged and assumed a greenish tint. No plumula had been developed.

*Arbor* excelsa Cerasum quodammodo habitu referens, aromatica. *Gemmæ* axillares terminalesque imbricatim squamatae. *Folia* alterna stipulata. *Pedunculi* axillares.—Locus in systemate Linnæano incertus.

Jam anno 1832 genus Bucklandiæ Hamamelidearum Indicarum Geologo summo Oxoniensi dicavit Robertus Brown; alterum nunc genus novissimum ejusdem ordinis consecramus viro reverendo Adamo Sedgwickio, Geologiæ apud Cantabrigienses professori pariter illustri.

SEDGWICKIA CERASIFOLIA. Wall. et Griff.

Hab. in regione Assamiæ superioris Muttack dicta, inter Debrookh et Rangagurrah, in gradu longitudinis orientalis 95, latitudinis borealis 27. Fructiferam invenimus mense Februarii, 1836. Humida amat.

*Arbor* 50—60-pedalis, satis formosa. *Truncus* sæpe basin prope divisus; cortice læviusculo cinereo-albido, gummi-resinam piperaceo-aromaticam parcam continente vel effusa. *Corona* oblonga apicem versus præsertim fructifera, ibidemque ut plurimum foliis orbata. *Lignum* grave compactum ut in Bucklandia. *Fibræ*, eæque præsertim circa vasa dispositæ, punctatæ, punctis persimilibus istis Coniferarum, 1-seriatis. *Ramuli* teretiusculi, griseo-brunnei, hinc illinc lenticellis exasperati, fructiferi abbreviate et apicem versus confertim foliosi. *Gemmæ foliiferae* conspicuæ axillares, præsertim in ramis sterilibus, et terminales, cylindraceo-subulatæ: squamæ arcte imbricatæ mucronatæ, sursum majores; inferiores rotundatæ, scariosæ, coriaceæ, rubro-brunneo plus minus tinctæ, glabræ vel leviter pubescentes; superiores oblongæ ferrugineo-pubescentes, sursum magis magisque in folia abeuntes. *Pubescentia* simplex. *Folia* alterna, petiolata. ovato-oblonga, acuminata, serrata, (serraturis glandulosis) subcoriacea, supra lutescenti-viridia, subtus pallidiora, matura supra glabra, subtus subpubescentia, axillis venarum secundarum villosis, contusa (haud secus ac cæteræ arboris partes) odorem aromaticum piperaceum effundentia; vernatione involuto-imbricata. *Venatio*: venæ infra prominulæ; secundariæ alternantes, supra medium arcuatæ et ope tertiariarum irregulariter nexæ; cæterum venulæ reticulatim anastomosantes, venulis additoriis secundariis sæpe interjectis.



*Cuticula* utraque e cellulis sinuosis conflata; superior stomatibus *expers*. *Stomata* minuta, ovata, disco opaco quasi glanduloso, areolæ circumambientis parietibus rectis. *Petoli* basi inarticulati, utrinque paullo incrassati, supra canaliculati, apice utrinque glandulosi. *Stipulæ* lineares, angustæ, obtusæ, secus marginem anteriorem glandulosæ, vel caducæ sunt, vel subinduratæ persistunt, et tunc elongatione petioli supra basin hujus paullo elevantur. *Inflorescentia* axillaris, sed ob approximationem foliorum terminalis sæpe videtur. *Flores* desiderantur. *Fructus* indefinite multiplex, globosus, magnitudine cerasi majoris, induratus, rugoso-verrucosus, stylis stigmatibusque persistentibus induratis subrevolutis quasi echinatus, pube brevissimâ ferrugineâ simplici velutinus. *Pedunculi* sesquiunciales, adscendentes, insertione articulati, læviusculi, brunneo-cinerei. *Calyx* fructûs  $\frac{3}{4}$ -superus induratus, truncatus, ore varie lobato, lobis angulatis medio sæpe conicis, minutissime ferrugineo-velutinis, demum liber. *Stamina* (an perfecta?) hinc illinc diu persistentia, perigyna, subsessilia. *Connectivum* angustum. *Antheræ* adnatæ, oblongæ, apice nunc mucronulatæ, biloculares, longitudinaliter dehiscentes; valvulæ æquales persistentes. *Capsula* initio  $\frac{1}{4}$ -supera, ibidem corticata minuteque ferrugineo-velutina, demum libera, bilocularis (loculis anticis posticisque  $\bigcirc$  facile solubilibus) polysperma, incomplete septicidium bivalvis, valvis demum bipartitis, valvulâ alterâ stylo indiviso, vel ambabus stylo longitudinaliter bipartito apiculatis. *Septum* bilamellatum, basin versus eplacentigerum. *Placentæ* planiusculæ, læves. *Semina* numero indefinita, sæpissime omnia abortientia, uno plura numquam perfecta, pluriseriata, saltem medium placentæ versus, summo infimoque solitariis. *Sterilia* cujusque loculi numero variantia, a 29 usque ad 36, forsân plura, valde difformia, varie angulata, cava, ossea, aspectu sub lente extus cellulosa, directione varia, superiora transversa, inferiora pendula (appensa); intermedia valde compressa. *Tegumenta* bina; *exterius* osseum, paginâ exteriore cellulosum, interiore ægre fibrosum; *interius* tenuissimum, celluloso-membranaceum, apicem seminis versus brunnescens, cavitate omnino nudâ. *Semen fertile*

solitarium, omnium extimum infimumque, pendulum (appensum), parieti loculi approximatum, extus convexiusculum, intus pressione angulatum, marginato-alatum, ab interiore latere visum aurem humanam apprime referens, ambitu irregulariter ovatum, brunneum, alâ lutescente. *Rapheos* situs lineâ angulis cæteris saturatius brunneâ indicatus. *Chalaza* inconspicua. *Foramen* superum, inconspicuum ob partium approximationem, oblique et interne situm, æquilaterale. *Tegumentum* duplex; *exterius* e membrana duplicata, tenuissima, decolorata, plicaturâ fibras plurimas, elongatas, lutescentes, longitudine variabiles fovente, margine fibris orbato sub lente pulchre crenato; *interius* tenue, celluloso-membranaceum, brunneum, albumen arcte vestiens, supra in collum productum breve, pressione complanatum, concolor, inter alæ fissuram foramen constituentem inclusum et nullo modo exsertum. *Albumen* parcum, carnosum, album. *Embryo* inversus, axilis, albus, longitudine et latitudine fere albuminis. *Radicula* supera, cylindraceo-conica, cotyledonibus fere triplo brevior, basin colli membranæ interioris fere attingens. *Cotyledones* faciebus seminis parallelæ, planæ, foliaceæ, ovaes, venosæ, venis vix prominulis. *Plumula* inconspicua.

Obs. 1. These genera are nearly allied, although they differ importantly in habit, gemmation and stipulation, in the number of flowers entering into the composition of the capitula, in the dehiscence of the anthers, (so far at least as may be judged from the examination of the antheriform bodies of *Sedgwickia*) and in that of the capsules, in the number of abortive and perfect seeds and in the structure of their integuments.

2. Both agree remarkably with *Fothergilla* in the structure of the calyx, ovary, styles and stigmata, and *Sedgwickia* would appear to have an additional and very important resemblance in the dehiscence of its anthers.

3. They both likewise agree in a very important character, and one which has hitherto been considered as peculiar to naked-seeded orders. I allude to the punctuations, which are probably confined to the fibrous

tissue, and which are most abundant in Sedgwickia. These punctuations, at least those of Sedgwickia, are much smaller than those of Coniferæ, neither has the central areola that lucid appearance, which those of the latter have. In both genera they would appear to be arranged in single rows. But upon this subject I must abstain from making further remarks as I have no lenses with me on which I can confidently rely.

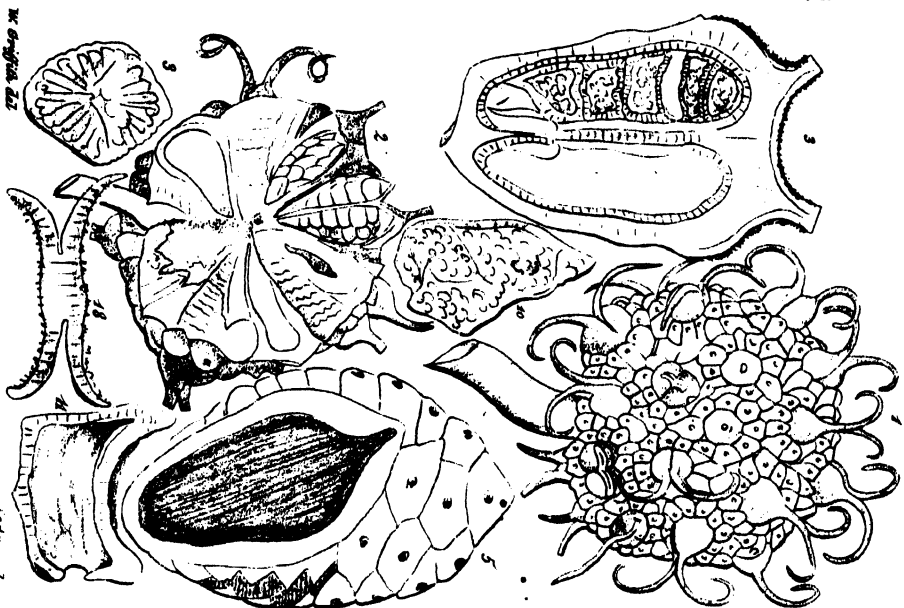
4. Bucklandia is remarkable for its curious ramification. I have invariably found that of the new branches, that which is opposite the terminal mature leaf is much more developed than any of the others, and this would appear rarely to produce flower-bunds. These being generally confined to the shorter branches.

5. This genus likewise departs from the usual character of the order in the quinary division of the hermaphrodite flowers; although the female flowers would still appear to be arranged in the usual quaternary one. The fact of the frequent and often incomplete transformation of the petals into stamina would appear to corroborate the opinion of M. DE CANDOLLE, that Fothergilla is apetalous from a similar but total and complete transformation. This idea will be much strengthened if some of the stamina of Fothergilla are solitary, while others are arranged in a double row.

6. The same genus is remarkable for the similarity that exists between the form of the lowermost ovula, and the same when developed into perfect seeds. I believe that the fact of the exsertion of the apex of the second membrane in the ripe seed has hitherto been unnoticed.

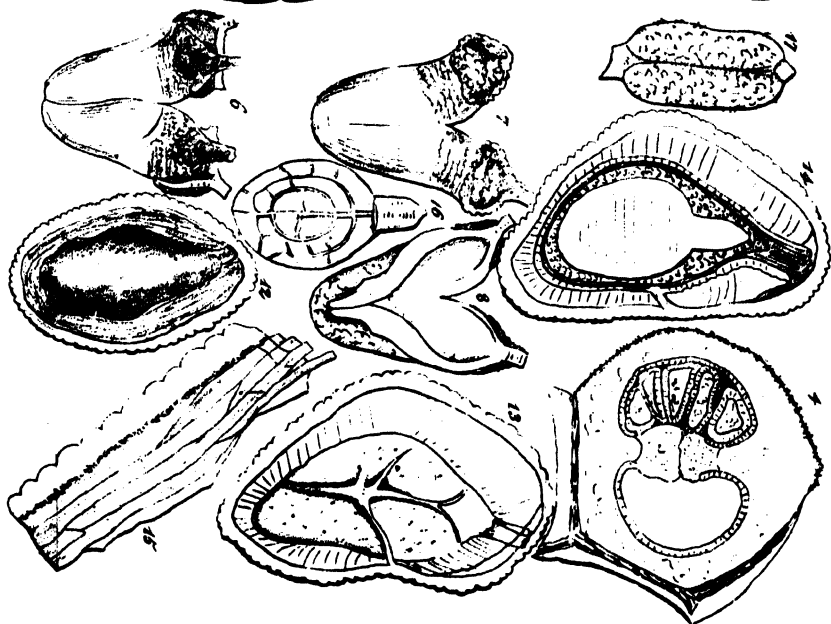
7. In conclusion I must observe, that the character of Hamamelideæ, as originally given by Mr. BROWN in the appendix to ABEL'S China, will now require to be modified as regards the completion and composition of the flower, the number and situation of the stamina, the dehiscence of the anthers and number of the ovula. But it is a remarkable fact, that although the ovula are increased in number in Bucklandia and even indefinite in Sedgwickia, the perfect seeds are in both definite.

*W. angusta* 22



*Sedgwickia serratifolia* W. & Gr. 23

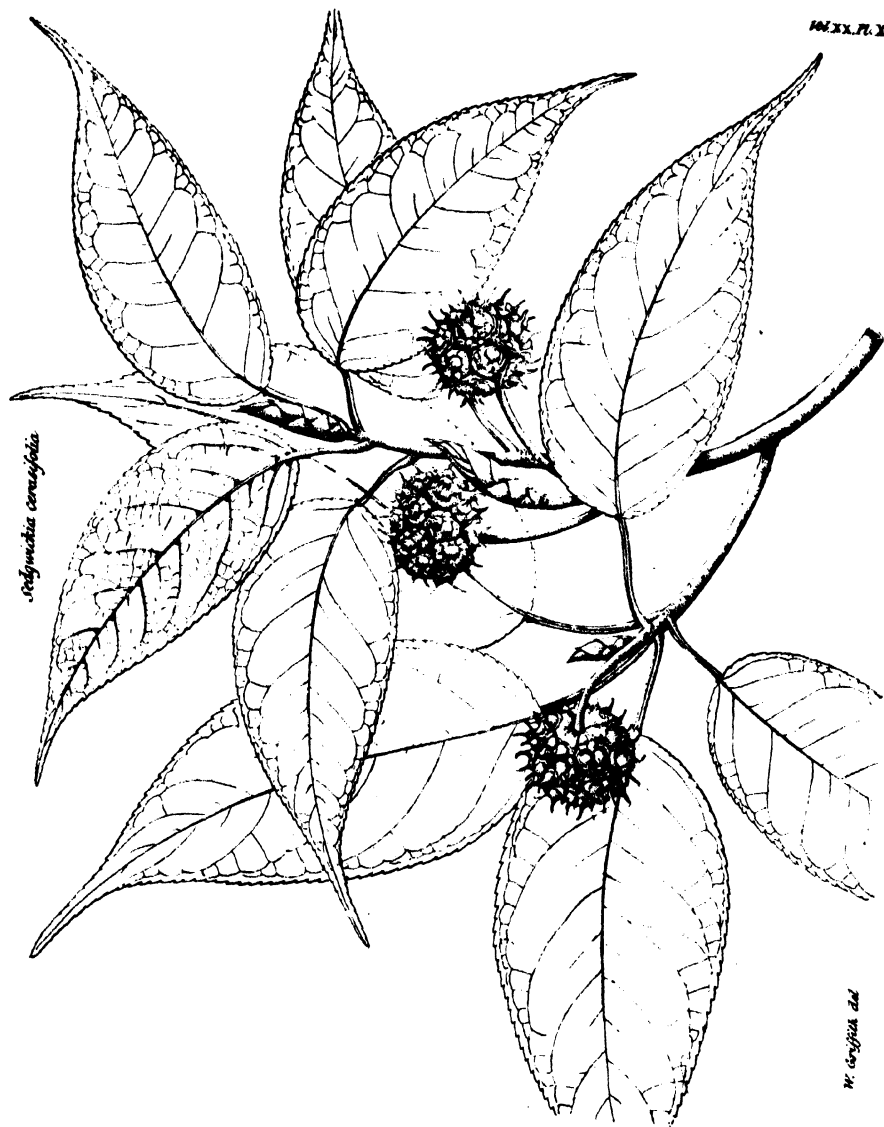
1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22.



*Fraxinodendron* by Th. G. G. 24

As. Rac.

1822. Pl. XV.



*Polysiphonia corniculata*

W. G. Smith del.

*PODOSTEMON*. Michaux.

Syst. Linn. *Monadelphia Diandria*.

Char. Gen. Flores nudi.

Ord. Nat. *Podostemeæ*, Rich.

Char Gen. Spatha tubulosa, monophylla, demum apice rupta, decidua. Stamina monadelphæ, unilateralia; duo sterilia lateralìa, medium bicrus, biantheriferum. Stigmata bina inæqualia. Capsula costata bilocularis bivalvis, placentâ demum liberâ septis adnatâ, valvis parallelâ. Semina extus mucilaginosâ.

Plantæ evasculares, vel frondosæ, habitu Hepaticarum vel Fucorum quorundam. Spathæ pedunculorum elongatione ruptæ; axes inflorescentiæ unifloræ. Flores inconspicui.

Ob. Ex caractere Mniopsi affinis videtur et ob structuram exteriorem seminum Lacistemæ.

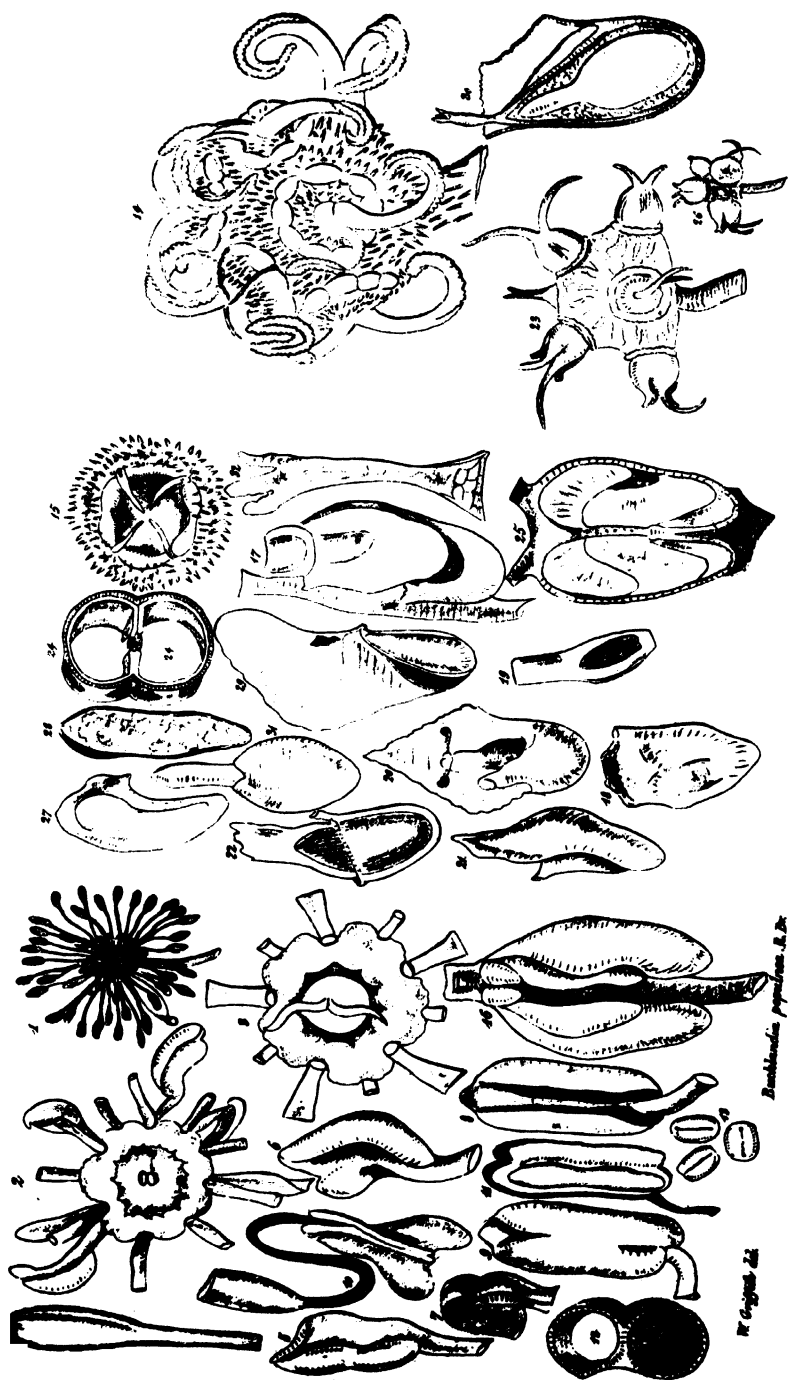
1. *PODOSTEMON WALLICHII*, R. Brown. Frondibus informibus ascendentibus sinuato-lobatis, floribus longe exsertis, ovariis sessilibus, stigmatibus conico-subulatis, capsulâ 8-costatâ.

*P. Wallichii*, R. Brown in Wall. Cat. no. 5225.

Hab. super saxis scopulisque rivorum et cataractarum *Churra Punjee* prope Moosmai et Mamloo. Legimus florentem fructiferamque mense Oc obris 1835.

Planta parvula, altitudine extremâ vix uncialis, facie Hepaticæ cujusdam, dilute viridescens. *Frons* informis, adscendens, coriaceo-cartilaginea, sinuato-lobata, præcurva venis rectis e centro radiantibus, subopposite remosis, ramo unico ad florem quemque excurrente, inferne hinc illinc, sed præsertim centrum versus, ope radicum rupibus inundatis vel semi-inundatis arcte adhærens, superne et fere semper ad lorum sinus flores exserens. *Radices* interdum solitariæ, sæpius plures, centrales disciformes, hinc illinc radículas proferentes, exteriores ob frondis lobos adscendentes elongati, sæpe cylindracei, apicibus sub discoideis. *Folia* vera nulla. *Axes inflorescentiæ* marginales, e sinubus, rarius e disco exsertæ,

solitariae, sublineales, vestitae squamis 5—7 alternantibus, arcte distichis subequitantibus, subsecundis, formâ irregulari, sæpius angulatis, basibus facie externâ plus minus inter se coalitis, texturâ fere frondis sed magis carnosâ coloreque magis herbaceo, venâ unicâ præcursoris, demum deciduis, inferioribus minoribus et tantum ex facie antica axis conspicuis, interioribus spatham semi-amplectentibus; superne in pedunculos continuatæ. *Spathæ* tubulosæ, celluloso-membranaceæ, aveniæ, apice dilatatæ, initio clausæ, ad anthesin apice irregulariter ruptæ, pedunculorum partes inferas obvolventes. *Pedunculi* cylindracei, crassiusculi, ante ruptionem spathæ flexuosi, ad anthesin fere subito exserti, maturitate longitudinem linearum 4 vix metientes, post anthesin peripheriâ cellulosâ deciduâ attenuati! filiformes, fere capillacei, indurati. *Flores* omnino nudi. *Stamina* unilateralia et semper externa quoad frondis centrum, ovario applicita, sæpius 4, interdum 5; lateralibus abortientia, cellulosa, plano-setacea, apicibus subspathulatis introrsum sæpe geniculatis, hinc imâ basi cum centrali columnari e duobus tribusve filamentis coalitis formato connata. Columna introrsum arcuata, ovario paullo longior, subteres, crassisucula, glabra, apicem versus bifurcata in filamenta duo antherarum circiter longitudine, dorso centraliter et paullo infra bifurcationem stamen abortivum lateralibus simile sæpe gerens. *Antheræ* 2, (furcæ cuilibet una) late ovatæ, basi affixæ, biloculares, fere didymæ, longitudinaliter et introrsum dehiscentes, loculis insertionem obliquis, ante dehiscentiam insigniter bilocellatis. *Endothecii* cellulae oblongæ rotundatæve, inconspicue fibrosæ. *Pollen* formæ fere horologii arenarii, compositum e sphaerulis binis lævibus conatis, aquâ immersis haud solubilibus. *Ovarium* semper internum, sessile, ovatum, glabrum, obsolete 8-sulcatum, biloculare, loculis anticis posticisque ○, septis tenuissimis facillime ruptis, placentâ centrali, carnosâ, septis adnatâ, ovulis undique tectâ. *Ovula* oo, adscendentia, minutissima, oblonga, viridescentia; tegumentum unicum, cellulosum, crassum, extus papulosum; foramen inconspicuum prope hilum; nucleus inversus, ovatus, apice obsolete mammillatus. *Stylus* subnullus. *Stigma* carnosum, sero deciduum,



Transformed on stone by F. H. Carter.

*Brachyotum papilionaceum*, B. Br.  
J. H. Burdett, 1888, from China

Dr. G. G. G. G.





profunde bilobum, lobis conico-subulatis inæqualibus per anthesin divaricatis, antea et postea incumbentibus, exteriore semper longiore et per anthesin inter crura columnæ recepto. *Capsula* lineam circiter longa, breviter stipitata pedunculo omnino denudato vel hinc reliquias parvas columnæ gerente, ovata, insigniter 8-sulcata (peripheriâ cellulosa et pedunculo continuatâ simul cum stigmatibus lapsâ) sulcis 6 in stipitem decurrentibus et basi e capsulæ parietibus liberis, his margines junctionis foliorum carpellarium indicantibus, geminatis et medio sulcatis; bilocularis, septidim bivalvis, valvis humectatis rectis, siccitate intus arcuatis! marginibus septorum reliquias gerentibus; endocarpio e cellulis minutis transverse dispositis formato. *Placenta* complanata, valvis parallela, demum libera, decidua, septis adnata et alato-marginata. *Semina* oo, minutissima, adscendentia, sæpius oblongo-ovata et utrinque attenuata, luteo-brunnescencia, exalbuminosa. *Raphe chalazaque* nullæ. *Testa* crassa, celluloso-rugosa, madefacta mucilaginosa et granulis minutissimis grumosa, immersione protractâ subsolubilis. *Tegumentum interius (nucleare)* celluloso-membraneum, inconspicue areolatum, brunneum, apice obsolete mammillatum. *Embryo* dicotyledoneus, orthotropus, albus, cellulosus. *Cotyledones* plano-convexiusculæ. *Radicula* infera, hilo approximata, obtusa, cotyledonibus duplo brevior. *Plumula* inconspicua.

## 2. *PODOSTEMON GRIFFITHII*, Wall. Mss.

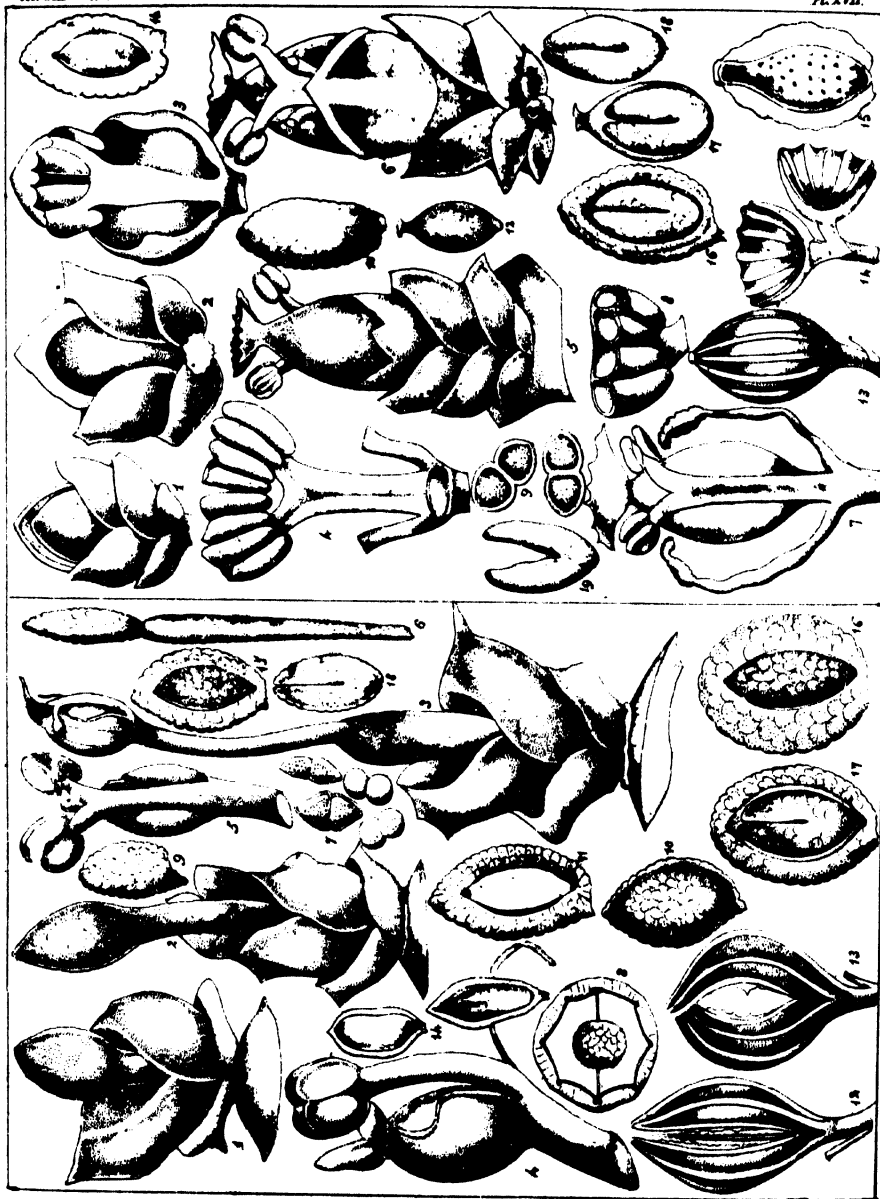
Fronde orbiculari depressâ, floribus semi-exsertis, ovariis stipitatis, stigmatibus cuneatis dentatis, capsulis 12—13-costatis.

*Hab.* Inveni florentem fructiferamque in saxis rupibusque semi-inundatis rivuli lente fluentis prope torrentem Bogapance dictum, collium Khasiyensium, Novembri 1835.

Plantula minima, aspectu omnino fucoideo, saxis ope discorum (radicum?) floribus oppositorum firmissime et inextricabiliter adhæsens. *Frons* orbicularis, omnino depressa et saxis arcte applicita, lobata, coriaceo-cornea, superficie subsiliceâ, viridis, lucida, paullo viscosa, avenia! e disco promiscue et sine ordine axes inflorescentiæ numerosas exserens, lobo-

rum sinus nudis. *Axes inflorescentiæ* super frondem depressæ, extrorsum inclinatæ, vix semi-lineales, supra in pedunculos continuatæ. *Squamæ* subsenæ, virides, distiche imbricatæ, equitantes, ambitu oblongæ, angulatæ, substantiâ coriaceæ et angulum externum versus corneæ, interiores spatham semi-amplectentes. *Spathæ* facie superiore fissæ, margine inferiore integro rotundato coriaceo-corneo; cæterum membranaceo-aveniæ, pedunculos excedentes. *Pedunculus* inclusus, brevissimus, ovario brevior ut in præcedente, demum denudatus. *Flores* omnino nudi. *Stamino* semper externa, lateralia abortiva, ovarium longitudine æquantia, apices versus geniculatim flexa, et apice imo recurvata. *Columna, antheræ* et *pollen* fere omnino ut in præcedente. *Endothecii* cellulæ vix fibrosæ. *Ovarium* breviter stipitatum, ambitu fere lanceolatum, compressiusculum, lineam circiter longum, biloculare, læviusculum, junius sessile rotundatum. *Ovula* oo, majora et angustiora quam in præcedente, cæterum omnino eadem. *Stylus* subnullus. *Stigmata* bina bilabiatim disposita, (antica posticaque) vix divaricata, cuneiformia, dentata, carnosa, rubra, celluloso-papulosa, exteriori majore et furcâ columnæ amplexo; æstivatione supra antheras equitancia, demum simul cum peripheria cellulosa pedunculi ovariique decidua. *Capsula* subexserta, pedunculum denudatum terminans, breviter stipitata (stipite ovarii immutato) forma ovarii, 12—13-costata, costâ superadditâ vel distinctâ vel sum alia confluentâ. bilocularis, septacidim bivalvis, valvis siccatione intus arcuatis, unâ demum deciduâ (an semper?) Structura et placentatio præcedentis. *Semina* oo, oblongo-ovata, minutissima, adscendentia, utrinque attenuata. *Testu* cellulosa, crassa, immersa peripheriâ hyalina et quasi mucilaginosâ, intus lutescenti-grumosa. *Tegumentum interius* inversum, brunneum, celluloso-membranaceum. *Embryo* dicolydoneus, orthotropus, cellulosus, albus. *Cotyledones* præcedentis. *Radiculæ* apex cum apice tegumenti interioris adhærens (ob immaturitatem). *Plumula* inconspicua.

**Observation.** In neither of the plants have I been able to ascertain the existence of any vascular tissue; the place of which appears





to be supplied by fibres of very small diameter packed very closely together, and, at least after maceration in spirit, filled with grumous matter. These fibres form the veins above described as existing in *P. WALLICHII*, which pass up along the centre of each axis of inflorescence, supplying in their course the scales, the column of stamina, and terminating by forming the costæ of the ovarium. But in *P. GRIFFITHII* these fibres are confined entirely to the axes of inflorescence; and although a branch appears to pass up along the staminal column, this appearance would seem to result rather from a discoloration of the tissue than from the presence of distinct fibres. The remainder of the fronds consist of dense cellular tissue, the cells varying considerably in shape and containing, particularly in *P. GRIFFITHII*, much granular amylaceous? matter. No stomata exist, although the distinctness of the cutis in the last mentioned species would lead one to suspect their existence. The spathæ appear to be the only entirely cellular parts. The roots of *P. WALLICHII* consist, like the peduncles of both species, of an outer cellular and a central fibrous portion.

In *P. GRIFFITHII* each axis of inflorescence is perfectly distinct; each arising from the parenchyma, the cells of which are there smaller and all converging towards the peduncle. Opposite to each of these points the fronds adhere so firmly to the bodies on which they grow, that it is almost impossible to detach them to any considerable extent. The adhesion is indeed so extraordinarily firm, that each disc on its detachment tears away with it a corresponding portion of the surface of the rock or stone on which the plant grew. On detaching the axes of inflorescence small round alveoli are left, penetrating or reaching to the disc of adhesion. This is very conspicuous in old plants, which appear like brownish, rather thick, frequently perforated films spread over the surface of the bodies to which they are attached.

The most remarkable points of structure are perhaps the composition of the pollen, and the deciduousness of the cellular portions of the peduncle and ovaria.

In describing these two species I have been guided by the fact that in some plants of the order the stamina are arranged all round the ovarium. But I am almost inclined to believe that the flowers are in reality unisexual.

The normal number of stamina is evidently five, the two intermediate ones being alone fully developed, and the central one often entirely wanting. The abortive stamina are entirely cellular, they are slightly constricted towards their points, the part above the constriction being obviously more cellular.

The plants of the order to which *PODOSTEMON* belongs, have such an anomalous structure that it is scarcely possible to assign to it any natural situation. The only points in which it agrees with some other dicotyledonous orders, are the absence of a perianth and the unilaterality of the stamina, which last character however does not seem to be of much importance. It is with much pleasure that I have been enabled to corroborate the accuracy of Dr. LINDLEY's inductions as to these plants being dicotyledonous; but it appears to me that they have no affinity with *PIPERACEÆ*. Dr. von MARTIUS has remarked at some length on the order in his *Nova Genera et Species Plant. Brasil.* 1, pag. 6, 7, and has touched upon its affinity with *LEMNA*; but his reasonings are founded upon the supposition of its being monocotyledonous. Putting this very strong objection aside, I think *PODOSTEMON* more allied to *PISTIACEÆ* than to any other known order.

#### *KAULFUSSIA.* Blüme.

Ord. Nat. Filices. *Marattiaceæ.* Kaulf.

Syst. Linn. *Cryptogamia, Filices.*

Char. Gen. Capsulæ sparsæ, exsertæ, orbiculari-cyathiformes. multiloculares. Indusium nullum.

Filices frondibus ternatis amplis, subtus stomatibus maximis apertis quasi perforatis, stipitibus basi bisquamatis, capsulis subsessilibus.

*KAULFUSSIA ASSAMICA.* Griff. Mssr.

Fronde triphylla, foliolis subsessilibus, stipitibus teretibus, capsulis sub-20-ocularibus, loculis per dimidiam longitudinem tantum dehiscentibus.

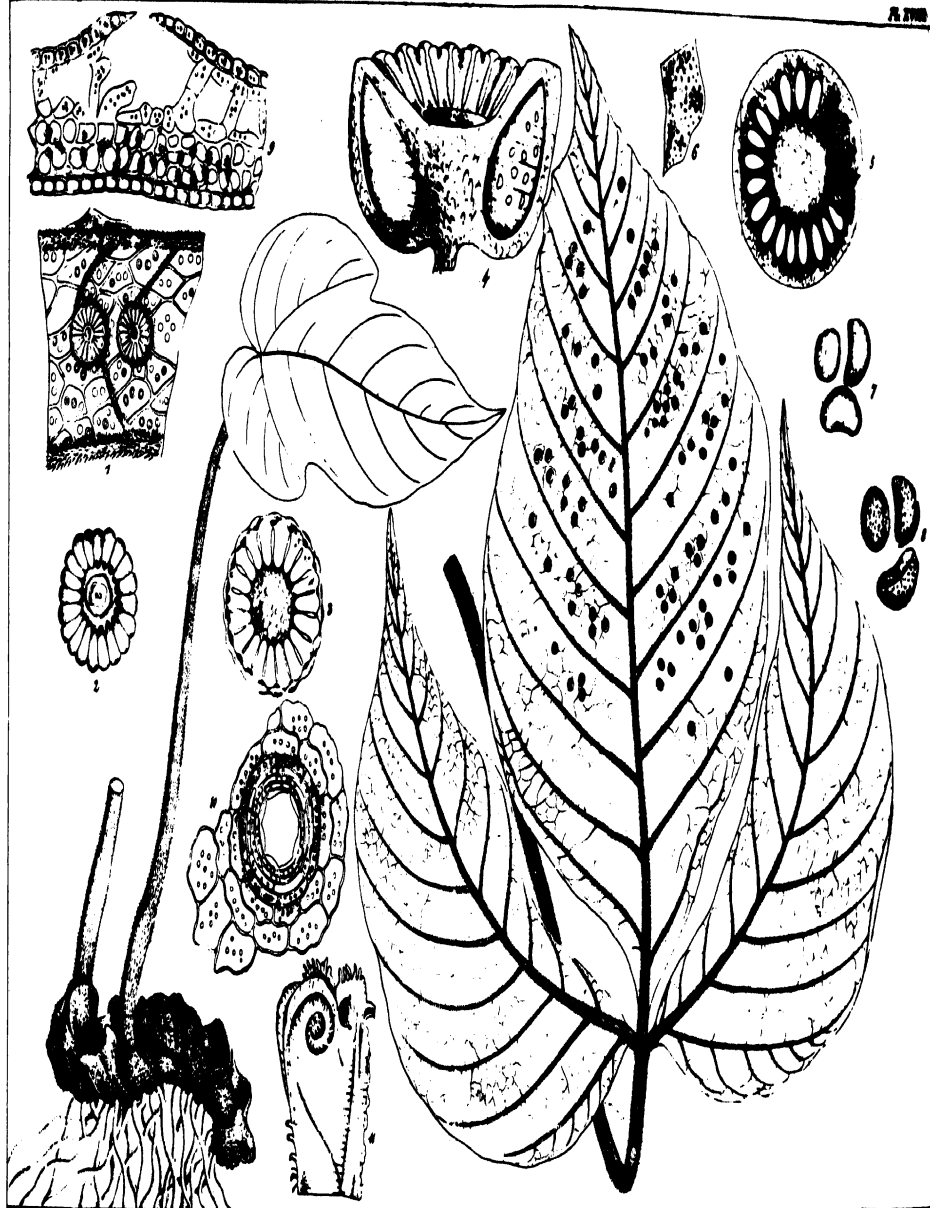
**Hab.** In rupibus arenosis solo alluviali tectis Assamiæ Superioris, ad basin collium Nagensium Gubroo Purbut propinquis, ubi copiose inveniente mense Martii 1836. Umbrosissima amat.

*Rhizoma* subterraneum, longe repens, crassum, carnosum, infra radículas teretes, tortuosas, simplices ramosasve proferens, supra ad basin cujusque stipitis in squamas duas persistentes, carnosas, quam maxime papillosas (junioribus imbricatim conniventibus et frondem nascentem obtinentibus) quasi ruptum. Superficies papillis conicis magnis pilisque cellulosi irregularibus septatis asperata. *Stipes* pedalis, aliquando sesquipedalis, teres, basi incrassatus, papillis pilisque supra descriptis valde scaber, pilis rarius stellatis, sæpe ramosis, squamis badiis minimis peltatis raro immixtis. *Frons* ampla, ternata, ambitu deltoidea, novellæ gyratæ intra frondis substantiam formatæ, demum erumpentes pilis ramentisve rubris hispidissimæ. *Foliola* subsessilia, oblongo-ovalia, acuminata, carnosæ, sub-integra, supra sordide viridia lævia et glabrata, infra albida, oribus magnis elevatis innumeris stomatum officio fungentibus quasi papulosa, et ad venas, ultimis exceptis, modo supra descripto scabra, lateralia margine superiori obliqua. *Venatio*: *Venæ primariæ* (costæ) crassæ; secundariæ apices versus arcuatæ et ope venularum mutuo nexæ, vel magis distinctæ, apice utriusque cum vena secundaria superiore confluyente; tertiariæ vix prominulæ; *intervenientia* cæterum varie irregulariterque reticulata; terminatio venularum ultimarum obscure clavata, vel intra-marginalis, vel intra areolas. *Capsula* (sori cel. Kaulf.) maximæ, sine ordine evidente per totam paginam dorsalem frondis sparsæ, irregulariter seriatae vel sub-biseriatae, sitæ in confluentia venularum tertiariarum et ultimarum, subsessiles, cyathiformes, superficie externâ tot exarata sulcis quot locula, margine paullo incurvato sub lente crenato, crenaturis fissuris dehiscentiæ oppositis: loculis viginti vel ultra, verticalibus, ovatis, a medio supra usque ad apicem rimâ introrsum dehiscentibus, extus lutescentes, intus luteo-badiæ, utrinque rubro-punctatæ, siccatione rugosæ. *Sporula* in acervulo lutescentia, rotundata vel subreniformia, sub lente centies augente minutissime scabrella.



*Anatomia.* Radices cellulose, fasciculo vasorum unico centrali fibris circumato. Rhizoma e maxima parte cellulosum; cellulæ rotundatæ, pressione angulatæ, plurimæ, parvæ, succo rubro-rosaceo turgidæ; lacunæ paucæ interjectæ sine ordine evidente. Fasciculi vasorum plures, sparsi, peripheriâ fibrosi, centro ductiferi; ductibus plurimis, vix solubilibus, simpliciter trabeculatis. Stipes etiam e maxima parte cellulosus; cellulæ laxæ, pressione angulatæ, minoribus succo rubro-rosaceo effertis paucis et præcipue peripheriam versus sitis; lacunæ plures, sparse. Fasciculi vasorum subnoni, versus basin stipitis irregulariter, versus apicem hujus circa centrum dispositi, sectione transversâ oblongi vel subreniformes. Dispositio fibrarum ac vasorum eadem ac in rhizomate, sed vasa majora, ductusque solubiles, pseudo-fissi, compositi. Foliolorum cuticula utraque et præsertim inferior, quæ stomatosa, crassiuscula, e cellulis sinuosis globulas paucas virides minutas continentibus formata. Stomata (vel potius perforationes) maxima, sine ordine sparsa, in areolis minutis solitaria, in mediocribus plura, rotundata, inæqualia, supra cuticulam elevata, oculis nudis facile conspicienda; oris margine e cellulis linearibus 3—4-seriatis annulatim dispositis formato, membranulâ marginali simplici? late crenatâ. Referunt omni sensu Hepaticarum quarundam stomata. Parenchymatis cellulæ ut plurimum rotundatæ, meatibus conspicuis interceptæ; cellulis cuticulæ stomatosæ propinquis laxissimis, quam maxime difformibus et lacunis amplis interceptis. Loculorum parietes proprii tenues, membranacei, moleculis minimis crebris interspersi.

Obs. For the knowledge of this plant being a *Kaulfussia*, I am indebted to my kind friend Dr. WALLICH. In my MSS. I had called its *Macrostoma* in allusion to its stomata, which so far as I know have hitherto been found only in the cuticulate genera of Hepaticæ; these organs M. KAULFUSS describes by the words "vesiculis pertusis." I have described the capsule with reference to its appearance only: but it is at once obvious that the fructification consists of as many capsules as there are cells, united together by cellular tissue, which is deficient along their inner faces, but in this species only from their middle upwards.



*W. Griffith analysis del.*

*Kaulfussia cuneata*

**Printed on Recycled 100% Post-Consumer Waste**

*Lebensweg eines Mannes*



The genus obviously belongs to the subtribe Marattiaceæ or Danæaceæ, in which M. KAULFUSS has placed it; the correctness of this is farther pointed out by the fact, that in Angiopteris the evolution of the young frond takes place in a similar manner, so far at least as may be judged from the universal presence of the two scales surrounding the base of the stipes in this latter genus.

M. BLUMES' species may be thus distinguished :

K. *ÆSCULIFOLIA* fronde ternatâ, foliolis petiolatis, laterali uno alterove geminato bipartitove, stipitibus hinc canaliculatis, capsulis subnovem-locularibus, loculis per totam longitudinem dehiscentibus.—K. *ÆSCULIFOLIA* Bl.—KAULFUSS in Hook. et Grev: Icon. Filicum vol. 2. Tab. 229.

---

## REFERENCES TO PLATES.

Plate XIII.\* Fruitbearing branch of *BUCKLANDIA POPULIFOLIA*; on the right side a branchlet with male flowers, both somewhat reduced; on the left a leaf, natural size.

Plate XIV. Analysis of the flower and fruit of *BUCKLANDIA POPULIFOLIA*.

Fig. 1. Hermaphrodite flower. Natural size.

2. Vertical view of a flower, most of the petals half transformed into stamina.
  3. Vertical view of a normally developed flower; such are of very rare occurrence.
  4. Petal.
  5. 6. Ditto half transformed into stamina.
  7. Ditto, transverse section.
  8. Anther with portion of filament, viewed from before.
  9. Ditto ditto behind.
  10. Ditto after dehiscence.
  11. Ditto representing the mutual approximation of the valves.
  12. Transverse section of anther.
  13. Pollen.
  14. Capitulum of female flowers.
- 

\* By mistake this plate and plate XV. have been marked W. Griffith del., instead of Lachmus Slag del.

**Fig. 15.** Female flower separate, ovarium removed.

16. Outer view of placenta removed from the ovaria, representing the situation of the ovula of one cell.
  17. Lateral view of three ovula of one side of the cell of the ovarium, removed with portion of the placenta.
  18. One of the middle ovula viewed on its inner face.
  19. Do. the second integument, enclosing the nucleus.
  20. One of the lowermost and perfect ovula, inner face.
  21. Do. viewed laterally.
  22. Do. upper part of outer integument cut away, exposing the upper part of the second coat, within which is seen the apex of the nucleus.
  23. Mature fruit, several times enlarged.
  24. Transverse section of a capsule.
  25. Longitudinal do. running through both cells, and exposing the situation of the lateral seeds of each, the base of the perfect ones alone visible.
  26. Fruit, natural size; more of the ovaria in this case are abortive than usually happens; one of the capsules has fallen off.
  27. Inner face of upper abortive seed.
  28. Long section of one of the middle do. shewing it to be solid.
  29. Inner face of perfect seed.
  30. Long section of do. wing removed almost entirely, apex of the second coat exposed.
  31. Embryo.
  32. Neck of the second integument, highly magnified.
- All with the exceptions of No. 1 and 26 magnified.

**Plate XV.** Fruit bearing branch of *BRDGWICKIA CERASIFOLIA*; natural size.

**Plate XVI.** Analysis of the fruit of *BRDGWICKIA CERASIFOLIA*.

**Fig. 1.** Fruit several times enlarged.

2. Ditto long section through the centre.
3. Longitudinal section of a capsule through both cells; seeds in one cell remaining in situ, of the other removed.
4. Transverse section of a capsule.
5. Seeds of one cell removed in situ, viewed on the outer face.
6. Capsule after dehiscence, removed.
7. Inner view of half the preceding, separated along the septa.
8. Ditto outer view.
9. 10. Sterile seeds.

**Fig. 11** Long section of a sterile seed towards the middle of the placenta, shown to be lined by a membrane.

12. Outer view of lowermost and perfect seed.

13. Inner of ditto.

14. Ditto ditto longitudinal section, neck of the second integument exposed.

15. Portion of the outer integument, highly magnified.

16. Embryo, one cotyledon removed.

17. One of the persistent anthers.

18. Ditto, transverse section.

All the above more or less magnified.

**Plate XVII. Left half. *PODOSTEMON WALLICHII*.**

**Fig. 1.** Axis of inflorescence in a young state with a portion of the frond.

2. Ditto more advanced.

3. Ditto ditto after the dehiscence of the anthers.

4. Flower viewed laterally; one of the abortive stamina in situ, the other displaced.

5. Ditto viewed on the outer face.

6. Abortive anther.

7. Pollen; the lowermost represent two after immersion in water.

8. Transverse section of ovarium.

9. Young ovule.

10. Ditto a little more advanced.

11. Mature ovule; outer coat half cut away longitudinally, exposing the nucleus.

12. Capsule at the period of dehiscence.

13. Ditto after dehiscence in the dry state.

14. Seeds.

15. Seed moistened.

16. Ditto after immersion in water.

17. Ditto immersed in water and slightly pressed.

18. Embryo.

**Plate XVII. Right half. *PODOSTEMON GRIFFITHII*.**

**Fig. 1.** Axis of inflorescence in a young state, upper or inner face.

2. Ditto ditto outer or under face.

3. Flower of ditto detached, outer view.

4. Column of ditto with portions of the two lateral stamina, inner view.

5. Upper view of axis of inflorescence during flowering.

6. Ditto-ditto, under view.

7. Outer view of perfect flower, lateral and abortive stamina displaced.

8. Transverse section of anther before dehiscence.

9. Pollen.

**Fig. 10. Ovulum.**

11. Ditto, longitudinal section exposing the nucleus.
12. Nucleus detached.
13. Capsule viewed laterally.
14. Ditto dehiscent, in the dry state and one of the valves nearly separated.
15. Placenta.
16. Seed.
17. Inner integument enclosing the embryo.
18. Embryo.
19. Ditto, cotyledons displaced.

**Plate XIX. KAULFUSSIA ASSAMICA.**

The figure on the left exhibits the fern, reduced; the detached frond on the right is of the largest natural size.

- Fig.**
1. Portion of the frond viewed on its inferior or dorsal face.
  2. Capsule viewed vertically and on its lower face.
  3. Ditto ditto upper face.
  4. Ditto longitudinal and central section.
  5. Ditto transverse section towards the middle.
  6. Portion of the membrane of the cells.
  7. Sporules viewed as opaque bodies.
  8. Ditto immersed in water.
  9. Long section of a portion of the frond carried through one of the stomata.
  10. Stoma viewed vertically and exteriorly.
  11. Long section of the apex of a rhizoma.

X.

---

NOTE

ON THE

F O S S I L C A M E L

OF THE

SIVÁLIK HILLS.

---

By HUGH FALCONER., M. D.,

*Superintendent, Botanical Garden, Scháranpur,*

AND

CAPTAIN P. T. CAUTLEY,

*Superintendent, Doáb Canal.*

---

AMONGST the most interesting of the Fossil remains of Mammalia, which have been found in the Siválik strata, the Camel may undoubtedly take up a high position. Independently of the speculations which the remains of this genus would lead to, relatively to the form and features of the country previously to their entombment, the circumstance of the Camel having been up to this period a desideratum in Fossil Zoology adds very considerably to the interest of the present discovery.

The only\* remain which we find noted is in CUVIER's *Ossements Fossiles*, where a reference is made to the *Merycotherium Sibericum* of M. BOJANUS,

---

\* *Ossements Fossiles* tom 5, part ii., page 507. Besides the *Merycotherium*, CUVIER also notices in the same article a fossil femur, of which he says "qui ressemble aussi beaucoup, dans ce qui en reste, à celui d'un chameau." A drawing of the specimen, which was found near Montpellier was sent by M. MARCEL DE SERRE to CUVIER. Our information does not extend later than the third edition of the *Ossements Fossiles* in 1825.



which CUVIER decides to be an undoubted species of Dromedary : this remain consists of three teeth brought by a merchant from Siberia : the place or stratum in which it was found is unknown, and CUVIER's remark—" Si les trois dents que M. BOJANUS vient de publier sont effectivement fossiles," throws an uncertainty even on its antiquity.

In the identification of the Siválik fossil there can be no doubt ; and although we should have preferred delaying this paper until we had procured a perfect skull, we may perhaps be excused for entering upon the description, since the portions of the skeleton we already possess, including parts of the skull, are sufficiently marked to remove all doubts on the animal to which they belonged.

The Camel is placed in systematic arrangements at the head of the Ruminantia. In common with the rest of the family it has a compound stomach. Its molars have the form characteristic of Ruminants, and its skeleton generally is constructed on the same plan. But the skull differs very materially in form from that of the horned Ruminants ; and we see in the less complete ankylosis of the metacarpal and metatarsal bones, and in the greater division of the carpus and tarsus, an approach to a higher family among the Mammalia. The anomalous character of the pseudo canines, the presence of incisors in the upper jaw, the thickness of skin and horny soles of the feet, shew a strong affinity with the Pachydermata. This affinity is greatest with the Solidungula which the Camels approach by their more divided carpus and tarsus ; while the former approximate to the Camels by their soldered metacarpals and metatarsals.

In drawing a comparison between the skull of a Camel, and that of a horned Ruminant, the peculiarities of the former are exhibited in the great width and massiveness of the cranial portion, contrasted with that of the muzzle, which is slender ; the position of the orbit is more central and its edges more prominent, owing to the elongation of the cranium and to the greater development of the temporal fossa.

We cannot do better however than follow CUVIER in his observations on the same subject; who, in drawing his comparison with the separate bones of the head, remarks—"In the true Camels the occipital crest is more elevated, and the temporal fossæ more hollowed than in the Lamas; this development being nearly as great in the Camel as in the Carnivora, the occipito-temporal suture is considerably in front of this crest; the nasal bones are narrower at their bases, and a much larger space intervenes between the small membranous portion situated at the angle of the nasals, and the lacrymal bone, a very small portion of which is exposed, and which does not even extend to the internal sub-orbitary foramen in the orbit." These remarks are applicable to the Ruminants generally as well as to the Lamas, although the passage from which we have made the quotation is intended for the latter: we may add two other points in which a marked difference exists between the skull of the Camel and the horned Ruminants. 1st, in a greater depth of maxillary bone, and a consequent elevation of the nasals. 2d, in the external nasal aperture being provided with three pairs of bones, the nasals and intermaxillaries being separated; this intervening space is a general feature in the Camel, although subject to great variations in extent. We have seen specimens with the nasals and intermaxillaries separated by a space of two inches; and others again with only one quarter of an inch of the maxillary bone appearing on the nasal aperture. In the horned Ruminantia this peculiarity is only observable in the Yak and Auroch.

We have considered the above observations applicable in pointing out the differences that exist in the osteology of the Camel's head and that of other Ruminants, previous to entering upon the teeth; as with these two points fully explained, the identification of our fossil is placed beyond all doubt, and it will only remain then for us to shew the differences which it exhibits.

It has been before noted that the anomalous character of the teeth is one of the points connecting the Camel with a higher family. The molars

*however are, as is normal in Ruminants, in number twenty-four; six on each side in the upper, and the same in the lower jaw. The first molar, which from having the simple and pointed form of a canine tooth has by some Naturalists been termed a second canine, is one of the chief peculiarities of the Camel. It is situated at some distance from the remaining molars, which, in number five, are in a continuous series; in the lower jaw the 2d molar or that which may be considered the first of the series, is described by CUVIER as falling out at an early age: and not being replaced, it leaves a series of four teeth only.*

We have examined a number of skulls of the common or Arabian Camel, and have only found one example of the existence of this 2d molar in the lower jaw; the series in all other cases consisting of four, with a wide intervening space between the 1st and 3d. That it is a part of the true series is undoubted from its existence in the specimen above alluded to. It is exceedingly small and rudimentary. Its position is central on the space between the 1st and 3d of the whole series.

The skull in which we have observed this small and deciduous tooth is from a fine specimen of the Camel procured at Hissar. The animal to which it belonged was full grown, we should say somewhat passed the adult state, judging from the bones of the cranium being ankylosed and a consequent absence of sutures. There is a greater development of all the distinctive characters in this specimen in depth of maxillaries; comparative dimensions of the cranial and facial portions, &c. arising from the superior growth to which the animal has attained, and to the superior class of animal from which it was selected; and the space occupied by the maxillary bone in the external nasal opening is also smaller than we have observed in any other specimen.

In the upper jaw the line of molars consists of one sharp pointed tooth similar to a canine, and situated at some distance in front of the others, which are in a continuous series; the two first being single barrel'd, and the three last, or the three true molars, double barrel'd.

In the lower jaw a sharp pointed tooth, corresponding with that in the upper jaw, is situated in the same way; and takes the place of the first in the series. The intervening space between this and the continuous line contains the second or small deciduous molar. The remaining four teeth are placed together, the first of these (or third of the whole series) consisting of a similar cylinder, and the three permanent molars as is usual with the Ruminants, being double barrel'd with the exception of the last which is triple barrel'd. Finally, as in the Sheep and Antelopes, the cylinders are well defined, and without any approach to accessory pillars.

There are two canines in the upper jaw, as we find in another section of the Ruminantia.

The presence of incisive teeth in the upper jaw is peculiar to the Camel as a Ruminant. Of these teeth there are two, corresponding in position to the outer incisors, and similar in form to the canines. In taking a lateral view of the skull this similarity of form in the incisor, canine, and first molar, gives the appearance of three canines in the upper jaw.

In the lower jaw there are, as is normal in the family, eight incisors, differing in form from those of other genera;—the outer ones taking the simple and pointed form as described above, and the six intermediate ones being more regular in proportions than is usual in Ruminants, and having on each side a nick or hollow on the grinding surface.

The teeth of the Camel then are as follows :

*Upper Jaw*—2 Incisors.

2 Canines.

12 Molars, two of which are pointed and have been termed second canines.

*Lower Jaw*—8 Incisors, two of which are pointed.

12 Molars, two of which are pointed, and two deciduous at an early age.

The chief peculiarities of the skull are—

1. Narrowness of muzzle.

2. Advanced position and prominence of orbits.
3. Elevation of sagittal and occipital crests and development of temporal fossæ.
4. Narrowness of nasal bones at the posterior extremity.
5. Extreme depth of maxillary, producing an arched appearance in the nose of the animal.
6. Form of sphenoid and basillary portion.
7. Number of bones on the external nasal aperture.

This summary brings us at once to the comparison of our fossil species with the existing Camelidæ.

In pursuance of the rule that we have proposed to follow in naming the new species so as to ally them at once to the mountain series, whence their remains have been obtained, we propose calling the largest and that nearly approaching the Indian species, *Camelus Sivalensis*: to the second or a smaller species, the description of which we shall enter upon more fully hereafter, and which may perhaps have been more closely allied to the Lama, we propose the name of *Camelus Antiquus*.

#### CAMELUS SIVALENSIS.

Of the *Camelus Sivalensis* we draw our description from the remains both of the skull and of the bony structure of the animal generally. We have at present only portions of the skull to guide us. The remains of the lower jaw however are perfect, including the coronoid processes. The articulating ends of bones are in sufficient abundance, and in a sufficient state of preservation, to enable us to form a very tolerable idea of the size and height to which the animal must have attained.

To commence with a comparison between the fossil skull and that of the *Dromedarius* or common Camel in use in the Bengal Provinces. From the imperfection of our fossil fragments, and the sutures not being distinctly traceable in most cases, we must be satisfied with a view, limited more

to the general character than to the detailed boundaries of the bones ; yet it is fortunate, that in some cases where these boundaries are especially required as a distinctive character, as in the naso-frontal and naso-maxillary suture ; our fragments, imperfect as they are, have been provided with them.

The form of the skull, position of sutures (as far as our fossil fragments exhibit), and the teeth both in number and character, very closely resemble the existing species above referred to. We draw our comparison from a fragment consisting of the posterior portion of the nasals and maxillary bones with the frontal to the posterior border of the orbits. This fragment would alone establish the generic position of the animal, and in the absence of a perfect skull we could not have possessed a specimen more applicable to our present purpose. This fragment in fact contains three of the most prominent points in which the Camel differs from all other Ruminants : here we have the contrasted breadth of the frontal and facial bones, the extreme narrowness of the posterior extremity of the nasals, and the great distance between that point and the anterior border of the orbit, distinctly shewn. In the fossil there is a strong resemblance in all these points to the species now existing ; the swelling of the frontal is as highly developed, and the deep superciliary notch as well defined. The narrowness of the nasal bones on their approach to the frontals is well marked, as also that space occupied by the membranous portion in rear of the nasal bones, and the superciliary foramina correspond in size and position, being placed as remote from the orbit as in the living animal. In viewing this fragment laterally we observe that the orbit has an excess of length on its antero-posterior diameter, the orbit of the existing Camel being either a perfect circle, or having the excess of length in its vertical dimension. The mutilated state of this fragment—(see Figs. 1 and 2, giving an upper and a lateral representation of the fossil) does not admit of remark or comparison further than that the animal to which it belonged was far advanced in age, and had

arrived at that period and state of dentition when the obliteration of the crescentic lines was complete, and when the grinding surface consisted of ivory with an imperfect margin of enamel. The second and third false molars, or those with a single cylinder, are here in position; exhibiting a remarkable affinity to those in the existing Camel both in form and in the contrasted obliquity of wear (to front and rear respectively in the first and second teeth,) which is such a peculiar feature in the old animal.

Fig. 3, is a representation of another fragment; both jaws locked together, but the anterior and posterior extremities, with the upper surface of the skull, wanting. The animal from which this remain originated, was young—its ultimate permanent tooth not completely developed, and the third milk molar still in position. The general character is that of the present Camel, the form of maxillaries, thickness of lower jaw and external appearance of teeth corresponding as closely as two skulls of one species would do in the animal now existing. The position of the sub-orbitary foramen, however, is rather higher up on the maxillary, and the diminution in depth or tapering of the lower jaw is not so considerable as we observe to be the case in the existing Camel.

Fig. 4, gives us a still further insight into the form of the head of the fossil Camel. The lower jaw (with the exception of the upper portion of the ascending branches including the condyle and coronoid processes) is quite perfect; and the lines of molars of the upper jaw are also in position. Here we may express a regret on the want of careful superintendence in excavating and removing these fossils from the stratum. It is possible in the present case that the whole of the upper portion of this specimen might have been obtained had proper care been taken in removing the circumjacent matrix. It will be seen that the upper portion has been as it were cut off on a line with the alveoli of the upper molars, leaving not only them but also the upper canines in position.

Fig. 5, represents the lower jaw of the existing Camel, and placed in juxtaposition with the fossil will convey a tolerable idea of the form and character of both. The measurements of the lower jaws are annexed.

| DIMENSIONS, LOWER JAW.  | FOSSIL. |        | EXISTING FROM HISSAR. |        | EXISTING FROM SEHARANPUR. |        |
|---|---------|--------|-----------------------|--------|---------------------------|--------|
|   | Inch.   | Metre. | Inch.                 | Metre. | Inch.                     | Metre. |
| 1. Extreme length from alveolus of incisors to rear of ramus, .....             | 16.8    | .428   | 15.0                  | .382   | 15.2                      | .387   |
| 2. Ditto expanse of alæ to the rear, .....                                      | 8.1     | .25    | 6.4                   | .162   | 6.2                       | .157   |
| 3. Ditto length of symphysis, .....   | 5.4     | .116   | 5.325                 | .135   | 4.95                      | .125   |
| 4. Width of jaw over 1st or pointed molar, ..                                   | 2.1     | .052   | 1.95                  | .050   | 2.0                       | .050   |
| 5. Length of molars in series, .....  | 5.9     | .15    | 5.4                   | .137   | 5.2                       | .132   |
| 6. Distance between 1st or pointed molar and the 3d or 1st of the series, ..... | 2.95    | .075   | 2.575                 | .065   | 2.6                       | .066   |
| 7. Extreme depth of ramus at the ascending angle, .....                         | 4.25    | .108   | —                     | —      | 4.0                       | .101   |

This fossil is the remain of a very old animal ; the canines and pointed teeth are worn down to a flat surface, and the molars which can be partially examined, from the circumstance of the two jaws having been fossilized obliquely on each other, appear to have lost all their enamel excepting the exterior border. We before stated that, although the cranium and facial bones were entirely removed, the lines of molars on both jaws were in position ; the animal had partly from age and partly from accident, lost the first molar from the right side of the upper jaw. This tooth must have dropped out at an earlier period than nature had ever intended, and the coronal surface of the corresponding tooth in the lower jaw for want of the wear which it ought to have had under the natural course of detrition is distinctly marked with its crescentic lines of enamel. The fall of the tooth has further led to a tendency on the part of the rear teeth to incline forwards and partially occupy its place ; this inclination had so far advanced, as to prevent the posterior cylinder of the tooth in the lower jaw from undergoing any change, the front and foremost cylinder only of this



penultimate tooth having undergone this singular alteration and arrived at this diseased form.

In referring to the table of measurements above given, the excess in size of the fossil is the most prominent feature, but the relative dimensions of the different parts, with one exception, bear a close affinity to those of the existing Camel. In the jaw of the latter there appears to be a greater depth at the alveolus of the ultimate molar on the commencement of the ascending branch, which may possibly result in some degree from age, and the more perfect development of the teeth; but in other respects the resemblance is striking. The exception to which we refer is in the second measurement, shewing the breadth between the rami or ascending branches to the rear, a difference of some importance, as it involves in the structure of the cranial portion of the skull an increase of width, and a greater distance between the articulating or glenoid surfaces for the condyles of the lower jaw. We are borne out in the correctness of this inference, by the remains of our second species of Camel, which fortunately is very perfect in the cranium, and where the breadth and form of this region in comparison with that of the existing Camel are very different. To this, however, we shall refer in its proper place, satisfying ourselves with the conclusion that the *Camelus Sivalensis* and the *Camelus Antiquus* corresponded in this respect, and that the former differed from the existing Camel in the form and excess of width of the cranium. In comparing the teeth of the fossil represented in Fig. 4, with those of the *Camelus Dromedarius* we observe no difference excepting that which may have arisen from their difference in age. That of the fossil must have been considerable, as may be observed in the wear, and flattened surface of the fourth or pointed incisor. The intermediate incisive teeth have been slightly disarranged in the matrix; and it will be observed in the drawing that one of these teeth has been displaced and is now situated above, imbedded in the rock. The grinding surfaces of all the incisors are much worn, and all marks of the lateral nick completely obliterated. On the opposite side to that represented in the plate the canine

tooth of the upper jaw is situated in position with its point downwards, imbedded in the mass of matrix, which it may be observed reposes on the anterior parts of the fossil. This canine is much worn both on the point and on the anterior side; and its resemblance to that of the Camel of the present day is sufficiently close to make any further comparison unnecessary.

Figs. 6 and 7 are portions of the lower jaw of the skull, a fragment of which is represented in Figs. 1 and 2. The mass from which these remains were recovered was carefully broken up by ourselves, and the broken pieces united afterwards. A great portion of the cranium appears to have been disintegrated and so mixed up with the matrix, as to make all attempts at a separation ineffectual. The anterior part of the lower jaw has suffered in this way, but the extreme good fortune of rescuing that portion represented in the figures above alluded to, consisting of the rami of both the right and left side with the condyles and coronoid processes entire, is ample compensation for the loss, more especially as the incisive extremity was already in our possession, and we were only in want of the articulating and coronoid processes to complete the jaw. The difference in form of the fossil will be observed on a reference to Fig. 5, which is a representation of the lower jaw of the existing Camel. In giving the measurements we place in juxta position those of the Hissar and Seharanpur Camels before referred to, and to facilitate reference have defined the boundaries of our lines of measurement by capital letters.

|  | FOSSIL. |        | EXISTING<br>HISSAR. |        | EXISTING<br>SEHARAN-<br>PUR. |        |
|--|---------|--------|---------------------|--------|------------------------------|--------|
|  | Inch.   | Metre. | Inch.               | Metre. | Inch.                        | Metre. |
| Total depth from top of coronoid process to lower border of jaw, or from A. to D.,.....            | 8.3     | .211   | 9.2                 | .233   | 7.9                          | .20    |
| Ditto from surface of articulating condyle to lower border of jaw, or from B. to D.,.....          | 5.45    | .138   | 8.1                 | .205   | 6.4                          | .102   |
| Ditto from heel to lower border of jaw, or from C. to D.,.....                                     | 3.6     | .091   | 6.0                 | .152   | 4.7                          | .119   |
| Depth from A. to B. or from top of coronoid process to upper margin of articulating condyle, ..... | 2.65    | .072   | 1.1                 | .028   | 1.5                          | .038   |
| Breadth of condyle on transverse measurement,  | 1.7     | .044   | 1.65                | .042   | 1.6                          | .041   |

The fossil ramus has more the form of that of the Ox than of the Camel ; the slenderness of its proportions resembles that of the Cervidæ more than of the Camelidæ to which it belongs : and were it not for the heel or step on the posterior ascending margin which as the generic mark establishes its position, we should have been at some loss in recognizing as the remain of a Camel, a fragment bearing in its external appearance so strong a resemblance to the Ox, Deer or Antelope. Independent of the heel, the Camel now existing, is rather peculiarly formed in this part in comparison with other Ruminants. The Buffalo is that which has the nearest approach to it. In the existing Camel, the ascending branch rises at nearly a right angle from the line of jaw ; it has considerable breadth on its antero-posterior dimension, and its coronoid process is short, straight and massive. In the fossil Camel the ascending branch is as oblique as in the Ox ; it has no excess of breadth on its antero-posterior dimension, and its coronoid process is long, slightly curved back, and slender. Here are points of difference sufficiently striking—but there is a still further difference in the form of the condyle—that of the fossil having a much longer transverse diameter than in the existing Camel ;—its proportions are much more slender, and the depression on its upper margin much deeper. We may remark however that the slenderness of the fossil condyle is only comparative, with reference to that of the same genus now existing, and that it bears no resemblance whatever to the condyle of either the Buffalo, Ox, or other Ruminants. The condyles of the two former are much slighter and the upper articulating surface much narrower than in the Camel.

On the peculiarity of form above described as appertaining to the ramus of the lower jaw, we are naturally struck by the close resemblance it bears to that of the horned Ruminants, and its marked variation from the same bone belonging to the Camel of the present day : and we should be inclined to refer to the extreme length of the coronoid process as a point tending in all probability to unravel the mystery, were we not struck with the discre-

pancies that appear even amongst animals of the same species, in the length and dimensions of this process.

The length and breadth of the coronoid process appear to be distinguishing features in all animals where there is a great depth of the temporal fossa and great elevation of the zygomatic arch ; and also in those animals possessing the power of great lateral motion of the condyle in the glenoid cavity. Amongst the former may be included all the Carnivora and predatory animals : amongst the latter the Ruminantia, to which only we shall at present refer, although there appears to be considerable obscurity on the changes that modification of form of this process entails upon the physical economy of the animal.

The Capridæ, including Antelopes, appear to have the coronoid process more developed than the Bos ; the Bos more than the Camel. We observe that this process in the common Goat, *C. Hircus*, is long and broad, and in the *A. Chikarra* long but narrow, in the *A. Tetracornis* it is short. In two specimens of the male and the female of the Nilgai (*A. Picta*, PALLAS), we observe that the female has exceedingly a long coronoid process, much curved to the rear ; whereas that of the male is short, straight and pointed. We could give additional instances were it necessary for a want of any rule of uniformity, in fact the inferences of the value of this process in establishing any peculiarity in the organization of the masticatory faculties, appear to us, as we before noted, to be clothed in considerable obscurity.

With these remarks on the osteology of the head, we will after the following Table, shewing the comparative sizes of the ultimate tooth in the upper jaw of a number of fossils compared with that of the Camel now existing, proceed to the rest of the bony structure, which, from the strong resemblance that exists between the fossil and modern types, will occupy but a small space.

*Comparative dimensions of the ultimate or third permanent molar in the upper jaw of the Fossil and of the existing Camel.*

| DIMENSION.   | EXISTING<br>HISSAR. |        | FOSSIL 1ST. |        | FOSSIL 2D. |        | FOSSIL 3D. |        |
|--|---------------------|--------|-------------|--------|------------|--------|------------|--------|
|  | Inch.               | Metre. | Inch.       | Metre. | Inch.      | Metre. | Inch.      | Metre. |
| Length on its antero-posterior }<br>measurement, ..... } | 1.75                | .044   | 1.90        | .049   | 2.00       | .050   | 2.00       | .050   |
| Breadth on its greatest lateral }<br>bulge, ..... }      | 1.00                | .025   | 1.35        | .034   | 1.25       | .032   | 1.30       | .030   |

Of the vertebral column we possess a very perfect atlas with part of the axis attached to it.—The form is precisely that of the corresponding vertebra of the existing Camel, with the exception of an increased development to the ridge on the lower side, and a consequent increase of depression of the lateral surfaces in which the arterial foramina are situated. The shortness of the wings and the conical form of the atlas correspond with that of the existing Camel.

Of the axis, we have only a mutilated specimen, the posterior portion is altogether wanting, but the remainder is similar to that of the present Camel.

We possess a number of the lower extremities of both the humerus, and the radius and ulna ; some of them in connected joints, others separate ; but we have not been able to detect amongst the numerous fragments in our possession, the connecting pieces by which the bone in its whole length could be established. We see no difference whatever in these fragments, and in their articulating ends from those of the existing animal. The ankylosis of the radius and ulna is as complete ; the surfaces for the articulation of the scaphoid and cuneiform bones as flat and unmarked by a hollow ; and the lower extremity of the ulna is as destitute of an

external process for embracing the cuneiform bone of the carpus as the existing Camel.

The carpal bones are equally correspondent both in form and number—the small bone in rear of the os magnum and connected bone having the same marked and spherical headed articulation with the scaphoid.

We now come to the metacarpal bone, of which we have a very perfect specimen attached to the end of the radius and ulna by the intermediate carpal bones. We see no difference in form and no peculiarity requiring remark. We derive data however from this for establishing the comparative size to which the Sivalik Camel arrived—our dimensions are placed in juxta-position with those of a full grown and common sized Camel of the present day :

|  | FOSSIL.        |                | EXISTING.      |                |
|--|----------------|----------------|----------------|----------------|
|  | <i>Inches.</i> | <i>Metres.</i> | <i>Inches.</i> | <i>Metres.</i> |
| Extreme length of metacarpal bone from its articulation with the carpals to articulation with the phalanges,.... } | 18.85          | .479           | 15.85          | .403           |

The extent of non-anchylosis, and the form of the pulleys for articulation with the phalanges, and the phalanges themselves, appear to correspond, and to be equally characteristic in both the fossil and the living Camel.

With the posterior extremities we are not so well provided, and shall content ourselves with a reference to the femur only, of the lower end of which bone we possess a variety of specimens ; of the largest of these we annex the dimensions :

|  | FOSSIL.        |                | EXISTING.      |                |
|--|----------------|----------------|----------------|----------------|
|  | <i>Inches.</i> | <i>Metres.</i> | <i>Inches.</i> | <i>Metres.</i> |
| Extreme transverse breadth in condyles,..... | 4.9            | .124           | 4.7            | .118           |
| Ditto breadth from front to rear, .....      | 5.4            | .137           | 5.1            | .130           |
| Ditto breadth between condyles, .....        | 0.875          | .0165          | 1.075          | .027           |

With the exception of the proximity of the condyles to each other in the fossil, there is no marked difference; all the hollows and protuberances on the bone of the existing animal have their corresponding ones on the fossil. The femur in its length also appears to have had as great a curve forward as we observe in that of the Camel of the present day.

This brings us to a conclusion on the comparative differences between the *Camelus Sivalensis* and the *Camelus Dromedarius* now existing. Although the fossil fragments from which this comparison has been derived are not either so perfect or so numerous as we could have wished, they are still sufficiently so for every purpose of comparison, and in some cases we have been even struck with the remarkable perfection of the fossil, considering its soft and in many cases imperfectly indurated quality, added to the intimate combination with, as well as adhesion to, the matrix, which consists of a light colored clay with a small admixture of sand.

In recapitulation of our above remarks, therefore, we will note that independent of the peculiarities described as existing in the cranium of the *Camelus Sivalensis*, upon which peculiarities we rest its specific character, there must have been others in its external form. These differences however could not have extended far: its general character must have borne a close affinity to that of the same animal of the present day, and although we have proofs of its size having exceeded our existing Camel in a proportion equalling at least one-seventh of its height, we are unfortunately ignorant of the effects that domestication may have caused in the deterioration or otherwise of the *Camelus Dromedarius*; especially in a country and amongst a race of people who pay little attention to the improvement whilst the natural increase is sufficient to supply their wants and add to their comfort. The *Camelus Dromedarius* from which our comparison has been drawn must not be confounded with the *Camelus Bactrianus* or Camel used by the Arabs.

For the Camel in all its perfection we must seek the shores of the Caspian, to the hordes and wandering tribes who from generation to generation have looked upon this animal as the only means by which they

could exist, as the only means by which communication could be maintained over oceans of sand and miles of desert. If any care be given to the breed of the Camel in its domestic state, we should expect to find it in this quarter; but among the people of India who use the animal merely as a beast of burthen, and carry on the breed much in the same way as they do with their other domesticated animals, we have no reason to expect any improvement. In the Government stud we have no doubt that all feasible means are exerted to improve the breed, or at least to prevent deterioration by maintaining a stock from the largest and finest grown animals. It will be noted that one of the skulls referred to in this paper is from the stud, and the person to whom we are indebted for its use as a means of comparison described it as having belonged to a very large male Camel: but here also we see no great difference in size, although there are differences in the greater development of the bones of the head and face. The constant influx of Camels in the whole sweep of the Indus and its branches from *Ludiana* to *Shikārpur*, or even to the Indian ocean, most undoubtedly keeps up the supply, but does not add anything to the improvement of the species. Indeed, we are inclined to consider that the Camel has deteriorated in size from that to which it attained in its wild and natural character, and should our inference be correct, the dimensions obtained from the comparative measurement of the bones of our fossil species, may lead to a very tolerable idea of the size to which the Camel reached, when unshackled by the trammels of man, and leading its existence in the wilds of its own native region.

We regret our inability, from want of specimens, of adding to this comparative statement, the dimensions and peculiarities of form of the Bactrian or true Camel with two humps, *Camelus Bactrianus* of authors. The *Camelus Dromedarius* or the Dromedary with one hump is the animal from which we have drawn our description. In STARK'S Natural History the former is stated to be the *longest* of the two—*Camelus Bactrianus* being described as "about 10 feet long," and *Camelus Dromedarius* as "nearly 8 feet long." We are not aware of the limits upon which the above measurements are



drawn; but in taking those of a perfect vertebral column from the atlas to the last caudal vertebra of the common sized *Camelus Dromedarius*—we obtain a measurement of 9 feet 10 inches, including the head. The total length of the *Camelus Dromedarius* is 11 feet 4 inches, and this must be considered as under the full measurement, from the absence of inter-vertebral cartilages which connect the vertebræ in the living animal. STARK'S specific character evidently leaves an impression of a superiority of size in the *Camelus Bactrianus*. We learn from ELPHINSTONE, in his history of Caubul, that the height of the latter animal is considerably less; that it is shorter and stouter; well adapted for rocky and hilly countries; and from its shortness of limb, less liable to accident, than its tall and slenderly formed congener.

On the Camels in *Afghánistán*, the author above mentioned, remarks—“The Dromedary is found in all the plain country, but most in sandy and dry parts; this is the tall long-legged animal common in India. The Bactrian Camel (which I understand is called Uzhree in Toorkee,) is much more rare, and I believe is brought from the Kuzzauk country beyond the Jaxartes. He is lower by a third at least than the other, is very stout, and covered with shaggy black hair, and has two distinct humps, instead of the one bunch as the Dromedary. The Boghdee Camel, in the south-west of Khorasan, is shaped like the last mentioned, but is as tall as the Dromedary. Even this last varies; the Dromedaries of Khorasan, being lower and stouter than those of India.”\* Again—“Many Dromedaries are bred here, or at least by the tribes whose residence is partly in Damaun. They are much darker in color than the common Camel, have shorter and stronger limbs, and are far better calculated for work among hills.”†

It would appear from ELPHINSTONE'S remarks that there are three species of Camel—

1st.—That which has obtained the specific denomination of *Camelus Dromedarius*—tall, slender, with one bunch, and common to India.

\* ELPHINSTONE'S Caubul, 2d edition, 1819, vol. 1, p. 280.

† Ditto ditto, ditto, vol. 2, p. 72.

2d.—*Camelus Bactrianus*, or the Bactrian Camel, which is one-third less in height than the former one, stout, covered with black hair, and with two distinct humps.

3d.—The *Boghdî Camel* resembling in shape the Bactrian. but with the height of the Dromedary or *Camelus Dromedarius*.

The Khorasan Dromedary may be considered as a variety of the 1st species or *Camelus Dromedarius*, with less height but stouter proportions.

In GRIFFITH'S Translation of the *Régne Animal*, notice is drawn to a third species distinct from the Bactrian and Arabian Camels in the possession of RUGIERE; of this third species however the characters are not given. HAMILTON SMITH in GRIFFITH'S CUVIER\* divides the genus into the two species, *Bactrianus* and *Dromedarius*; considering these as the parent stocks from which a number of breeds and varieties have sprung, "all nevertheless "depending on the very trivial distinctions of color, size and form:" but the specific characters of these parent stocks differ very materially from those derived from ELPHINSTONE'S work before alluded to, most especially with reference to the *Camelus Bactrianus* described by that author as one-third lower in height than the Arabian Camel. HAMILTON SMITH† says in describing the *Camelus Bactrianus*, "his height may be considered superior to the Arabian, and the bulk of his body more considerable. The "large breed of this species attains seven feet and a half from the top of "the hunches to the ground, the legs are proportionately short, and the "body long." The height of the Arabian Camel, according to the same authority, does not exceed seven feet, "those of Turkey are the strongest and the best suited for burthen, those of Arabia and Barbary the "lightest; and those of India, where there are breeds for both purposes "constantly supplied by fresh importations from the North West, yet "probably inferior in their class to those more in the vicinity of their "original climate."

---

\* Vol. 5, p. 296, Synopsis Mammalia.

† Vol. 4., p. 48.

We have been desirous of ascertaining the excess of height to which the existing Camel arrives, to form a correct opinion of the proportionate size of our fossil species, and for this purpose have consulted those authorities from whom it was most likely to draw accurate information. The accounts are sufficiently conflicting, but that of GRIFFITH, as an authority on a point of natural history, may be considered as the best, and the most properly to be depended upon : assuming therefore that the comparative heights and proportions of the *Camelus Bactrianus* and *Camelus Dromedarius* as shewn by GRIFFITH are the true ones, and that the latter is of a smaller size than the Bactrian Camel, we are still borne out in our conclusions with regard to the excess of dimensions of the fossil or *Camelus Sivalensis*, and that this excess applies generally towards all the species of Camel now existing.

*Northern Doób, July 15, 1836.*

---

#### REFERENCES TO PLATES XX, XXI, OF CAMELUS SIVALENSIS.

- |   |      |     |  |
|---|------|-----|--|
| Appertaining to the skull figured in 1 and 2. } | Fig. | 1.  | View of portion of skull of <i>Camelus Sivalensis</i> from above.  |
|   |      | 2.  | Ditto ditto lateral view of Fig. 1.  |
|   |      | 3.  | Side view of another portion of skull of <i>Camelus Sivalensis</i> with lower jaw attached.  |
|   |      | 4.  | Side view of lower jaw of ditto with the molars of the upper jaw in position.  |
|   |      | 5.  | Side view of lower jaw of existing Camel ; <i>Camelus Dromedarius</i> .  |
|   |      | 6.  | Side view of ditto of <i>Camelus Sivalensis</i> right side, exhibiting the peculiarities in form of the ascending branch and the coronoid process. |
|   |      | 7.  | Side view of ditto ditto left side.  |
|   |      | 8.  | Portion of lower jaw <i>Camelus Sivalensis</i> right side inner view.  |
|   |      | 9.  | Ditto ditto left side outer view.  |
|   |      | 10. | Ditto ditto ditto inner view of No. 9.   |
|   |      | 11. | Ditto ditto right side outer view.   |
|   |      | 12. | Fragment of upper jaw <i>Camelus Sivalensis</i> , shewing the ultimate and penultimate molar of the left side.                                     |
|   |      | 13. | View of No. 12, exhibiting the inner side and coronal surfaces of the molars.  |
-

# XI.

---

## NOTE

ON THE

FELIS CRISTATA,

A NEW FOSSIL TIGER,

FROM THE

SIVALIK HILLS.

---

BY HUGH FALCONER, M. D.,

*Superintendent Botanical Garden, Shéránpur,*

AND

CAPTAIN P. T. CAUTLEY,

*Superintendent Doáb Canal.*

---

TO the large fossil species of the genus *Felis* hitherto described, we are now enabled to add another from the Tertiary Strata of the Sivalik Hills, differing alike from the *F. Spelæa* and *F. Antiqua* of the "Ossements Fossiles;" and, (so far as our means for comparison enable us to judge) from every known member of the genus.

The specimen from which we take our description, is one of the most perfect that has up to this time been exhumed from the fossil tract. It was found at the foot of a sandstone cliff, partly encased in a hard stone matrix. It consists of a nearly entire head; deficient only in the temporal apophysis of the left zygomatic arch, and in a small portion of the sagittal crest. The incisors had dropped out, but the alveoli are sufficiently distinct to indicate their number and relative size. The cheek teeth are

nearly entire but the canines are broken off at their bases. The fragility of the specimen has deterred us from removing a portion of hard stony matrix which fills up the right zygomatic fossa, and conceals the base of the skull from the anterior margin of the occipital foramen on to the posterior border of the palatine bones.

(Plate XXI. Fig. 1.) Represents the head in profile and shews the peculiarities of the fossil in the most striking light :

1st. The relative shortness of the facial portion of the head, from the post-orbitary apophyses of the frontal (*a*) to the border of the incisives; and the length of the cranial portion from the same point (*a*) to the occipital crest (*b*); the dimensions being as 124 to 153. In this respect it differs from all existing species, in which, as exhibited by CUVIER,\* the facial portion of the head exceeds the cranial, generally, to a considerable extent.

2d. The outline of the upper surface of the cranium and face. The facial line (*c a*) runs with a gentle curve, slight convexity and nowise serpentine, to the rear of the post-orbitary apophyses of the frontal. The cranial line meets it without angularity, and runs back horizontally to the occipital crest: so that when the head is seated on the occipital condyles and carnassier teeth, the plane of the base of the cranium is parallel to that of the vertex. In this respect it differs remarkably from all known large species of *Felis*, in which the cranial line descends more or less either in a curve or slope, from the post-orbitary apophyses to the occipital crest.

3d. The saliency of the sagittal crest which greatly exceeds that of all known *Felineæ*. It is partly broken off in the original, but the dotted line marks its direction.

4th. The height of the occipital, which is relatively greater than in any other known species of the genus.

5th. The elevated position of the zygomatic arches, and the strongly arched outline of their inferior margin.

---

\* *Ossemens Fossiles*, Vol. 4, p. 147.

Viewed from above (Fig. 2.) the contrasted proportions of the cranium and face are well exhibited. The muzzle is short. The canine region of the maxillaries swells greatly out in the bulge of the alveoli, and between it and the malars, the infra-orbitary hollow is more abrupt and deeper than generally holds in the large *Felina*. The nasals are short and broad. The brow is wide. The intra-orbitary region of the frontal is marked by a deep longitudinal hollow. The post-orbitary processes of the frontal and malars are blunt and little projecting. The post-orbitary ridges of the frontal meet at a very acute angle, leaving between them a well defined and narrow furrow. The length and prominence of the sagittal crest and the height of the occipital crest are strongly apparent. The parietals are seen to bulge out little towards their upper margin, but considerably towards the temporals.

Our means for comparison of the fossil with most of the large *Felina* are restricted to the figures in the Ossements Fossiles, which however are so perfect and characteristic, as to admit of the chief marks of distinction being very readily seized. Of all the large species, the specimen most closely resembles the Tiger, although considerably smaller in size and perfectly distinct otherwise. The chief points of resemblance in both, are the great developement of the sagittal and occipital crests; the considerable surface of the occipital; the moderate convexity of the brow and face; and the elevated position of the zygomatic arches and the outline of their inferior margin. To exhibit the peculiarities of the fossil we shall now give its dimensions in juxta-position with those of two of the largest sized Tigers, killed in the forests near *Sháranpúr*, and of a younger animal almost exactly of the size of the fossil. The amount of wearing in the cheek teeth,

and the condition of the sutures prove that the fossil was full grown although not aged.

|  | FOSSIL TIGER.   |               | LARGEST TIGER No. 1. |               | LARGE TIGER No. 2. |               |
|--|-----------------|---------------|----------------------|---------------|--------------------|---------------|
|  | English Inches. | French Metre. | English Inches.      | French Metre. | English Inches.    | French Metre. |
| 1. Extreme length from occipital crest to alveoli of the incisors, .....   | 10.9            | .278          | 14.1                 | .358          | 13.1               | .333          |
| 2. Ditto from anterior margin occipital foramen to ditto, .....            | 9.0             | .228          | 11.7                 | .298          | 10.8               | .274          |
| 3. Extreme breadth of head at zygomatic arches, .....                      | 8.0             | .203          | 9.55                 | .242          | 10.0               | .253          |
| 4. From posterior border of palate to the alveoli of the incisors, .....   | —               | —             | 6.3                  | .180          | 5.9                | .149          |
| 5. From anterior margin of nasals to occipital crest, .....                | 9.2             | .233          | 12.4                 | .314          | 11.88              | .300          |
| 6. From border of post-orbitary process to ditto, .....                    | 6.0             | .153          | 7.5                  | .191          | 7.0                | .179          |
| 7. From ditto to the alveoli of incisors, .....                            | 4.9             | .124          | 6.6                  | .168          | 6.1                | .156          |
| 8. Extreme height from base of occipital foramen to occipital crest, ..... | 4.1             | .103          | 4.2                  | .106          | 4.2                | .106          |
| 9. Width between outer surfaces of occipital condyles, .....               | 2.2             | .055          | 2.3                  | .058          | 2.45               | .062          |
| 10. Ditto of occipital foramen, .....                                      | —               | —             | 1.15                 | .029          | 1.25               | .031          |
| 11. Height of ditto, .....   | —               | —             | 0.8                  | .020          | 0.8                | .020          |
| 12. Ditto of cranium from middle of frontal to the palatine arch, .....    | —               | —             | 4.6                  | .117          | 4.25               | .108          |
| 13. Breadth on maxillaries between the canines and molars, .....           | 3.0             | .076          | 3.7                  | .093          | 3.5                | .088          |
| 14. Extreme length of 2d and 3d molar, .....                               | 2.2             | .055          | 2.32                 | .059          | 2.2                | .056          |
| 15. Breadth of maxillaries to rear of carnassier, .....                    | 4.5             | .114          | 5.4                  | .138          | 5.6                | .142          |
| 16. Depth of infra-orbitary foramen, .....                                 | 0.75            | .018          | 0.7                  | .017          | 0.7                | .017          |
| 17. Width of ditto, .....  | 0.3             | .007          | 0.4                  | .010          | 0.375              | .0094         |
| 18. Length of the nasal bones, .....                                       | 2.8             | .071          | 4.2                  | .106          | 4.1                | .104          |
| 19. Length of carnassier tooth, .....                                      | 1.5             | .038          | 1.4                  | .035          | 1.375              | .034          |
| 20. Width of frontal between the post-orbitary apophysis, .....            | 3.1             | .078          | 4.2                  | .106          | 3.65               | .092          |
| 21. Length from frontal angle to base of the nasals, .....                 | 2.9             | .073          | 3.6                  | .090          | 2.9                | .073          |

We shall now make a comparison of the peculiarities of the individual bones of the head with those of the Tiger. This will make the points of difference in the fossil more apparent.

The dentition of the fossil is as is normal in the genus. There are six alveoli for the incisors—the two outer of which are greatly larger than the intermediate which are equal in size. The canines are broken off at their

base; and the section is seen to be the same as in the Tiger. The cheek teeth had consisted of two false molars, a carnassier and a tuberculous tooth on either side. The tuberculous and the first false molar had dropped out. The socket of the tuberculous tooth is distinct on one side. Those of the first false molars are more ambiguous. In all the specimens of the *F. Spelæa* observed by M. GOLDRUSS,\* this false molar was invariably wanting, and he was induced to consider it as a specific distinction of the fossil. But CUVIER attributes its absence to dropping out at an early period.

In our fossil we were at first led to think that there was no small false molar, from the very contracted space between the canine and the large false molar not admitting of room for it. In the fossil the space is 0.3 inch whereas in the Tiger it is 0.7 inch. But on carefully clearing the interval we have detected on the left side an alveolar cavity. In this respect therefore the fossil does not differ from the existing large species.† The great false molar and the carnassier tooth resemble in form, those of the Tiger exactly. But they differ considerably in two respects which we consider as distinctive marks of the fossil. 1st, The length of the two teeth in the fossil is exactly equal to that of the full grown Tiger No. 2, although it measures 10.9 inches in length of head, while the Tiger is 13.1 inches; 2d, the large false molar is directed inwards, so that its long axis makes a considerable angle with that of the carnassier. This position of the false molar holds in a slight degree in the genus *Felis* generally, but it is very marked in the fossil.

The obscurity of the sutures, and the extent to which the fossil is still enveloped in stone, do not admit of our determining precisely the limits of many of the bones of the cranium and face.

---

\* Quoted in CUVIER Oss. Fossil. Vol. 4, p. 452.

† The presence or absence both of the tuberculous and the first false molar, appears to be very uncertain in aged *Felines*. In a very old Tiger, No. 1, of the measurements, with the canines and all the teeth much worn, both the tuberculous teeth, and the small false molar of one side are present. Upon the opposite side all trace of alveolus has disappeared. Whereas in younger animals with unworn teeth, we find the tuberculous, and first molars, less complete.



The *frontal* is considerably shorter than in the Tiger of the same size No. 3, and broader; so that it has more squareness of form, at the same time that the ridges stretching from the post-orbitary processes by their prominence and greater convexity inwards, give it an appearance of more sharpness to the rear. These processes are more obtuse and less salient than in the Tiger, and the outline of the frontal portion of the orbit is less curved. The separate halves of the bone are convex across leaving a deep longitudinal hollow between.

The *parietals* are longer than in the Tiger. They are sunk towards their commissure, giving greater appearance of saliency to the sagittal crest. They bulge out, at their junction with the *temporals* in conjunction with these bones. The sagittal crest, as noticed above, from its great prominence, is one of the most distinctive characters about the fossil. It is nearly twice as much raised, as in the largest sized Tiger. Its anterior extremity for a short way divides in two, from running in continuity with the post-orbitary ridges of the *frontal*.

The *occipital* is large in all its dimensions. It greatly exceeds that of the Tiger of the same size in height, and equals that of the large Tiger No. 2. Its margins expand greatly, laterally, in conjunction with the ridge, ascending from the petrous portion of the *temporal* bones.

The *temporal* on the right side is mostly concealed by stony matrix. On the left it is broken at the zygomatic process. The petrous is comparatively larger than in the Tiger. The zygomatic arch is elevated and its lower margin is arched more decidedly than in the Tiger. (In this respect it resembles the "Black Jaguar."\*) The posterior angle is more acute.

The corresponding process of the malar differs chiefly from that of the Tiger in the post-orbitary apophysis being blunt and very slightly prominent.

The *nasal* bones are considerably shorter than in the Tiger, and they taper less upwards towards their frontal insertion.

---

\* Oss. Fossil. Vol. 4, Plate H. W., Fig. 7.

The *maxillaries* chiefly differ from those of the Tiger, in their greater prominence along the alveoli of the canines, and the more decided hollow which occupies the infra-orbital region. From the elevated direction of the zygomatic arches, the posterior margin of the maxillaries, descending from the malars is higher than in the Tiger. The infra-orbital foramina agree in form and position with those of the Tiger.

The ascending apophysis of the incisive bones, runs higher up between the nasals and maxillaries, giving thus a stronger insertion to the bone.

We do not observe any very appreciable difference in the palate, except that the bulge of the canines, and the inward direction of the large false molars, appear to contrast it in width between this teeth.

The orbit is smaller than in the Tiger; the post-orbital processes of the malars and frontal are more apart, and the osseous ring consequently less complete.

Regarding the relations of the fossil with respect to other species.—

The fossil Lion of GAYLENREATH, *F. spelæa*, differs from it, in the great size, equalling that of the Lion in the outline of the head; breadth of forehead; depth of zygomatic arches; position of the infra-orbital foramina, and inconsiderable sagittal crest.

The fossil *F. Antiqua*, differs in being greatly smaller. The existing Lion is much larger, differing also in its rectilinear profile, shortness of head, and want of prominence in the sagittal crest and occipital.

The points of distinction and resemblance with the Tiger have been noticed in detail.

The Panther somewhat resembles the fossil in the moderate convexity of the head, but differs in size and in the little prominence of the sagittal crest. The Jaguar has the same elevated direction of the zygomatic arch, as the fossil, but differs greatly in the outline and form of the head.

The Cougar has one character peculiar to it and the fossil in the genus; in the face being shorter than the cranium. But it differs in size and form.

The other species of the genus differ at once in size.

We have named the fossil, the *Felis Cristata*, from its most prominent character, the elevation of the sagittal crest.

Its position in the genus will probably be after the Tiger. Its size is intermediate to that species and the Jaguar.

We are indebted to WALTER EWER, Esq. of the Civil Service, for an examination of the fossil, which was found by collectors employed by that gentleman under the direction of Captain CAUTLEY.

*Northern Doab, April 15, 1836.*

---

## XII.

---

### NOTICES

OF

## THE ORNITHOLOGY OF NÉPÁL.

---

BY B. H. HODGSON, Esq.,

*Resident at Katmandu.*

---

### I.—EIGHT NEW SPECIES OF CINCLOSOMA,

WITH SOME REMARKS ON THE GENUS,

*Order* INSESSORES. *Tribe* DENTIROSTRES.

*Family* MERULIDÆ. *Genus* CINCLOSOMA.

THE elegant and philosophical VIGORS has lately characterised a new Genus of Meruline birds to which he has given the name of *Cinclosoma*. Mr. VIGORS justly observes that this genus is clearly separated from *Turdus* by rounder, feebler wings; a longer, laxer, and graduated tail; and higher and stouter tarsi. Without pausing at present to enquire whether the group (which is certainly a just and natural one) belong rather to the Meruline or Corvine family, or, whether it has been characterised with sufficient precision, at once, and latitude, I shall merely observe that according to my experience the *minutely* exact form of the tarsi, the nostrils, and wings cannot be relied on;\* and that the group, considered as contrasted

---

\* That is, tarsi more or less smooth or rough: the precise relation of length between some dozen of the wing feathers: and the precise form of the nasal aperture. But perhaps the real explanation of these differences is, that the value of the group has been underrated.

with that of the true Thrushes, is as distinctly marked by the stomach, the bill, and the frontal zone, as by the wings, tail, and feet. The stomach has double the muscular power of the same organ in *Turdus*, approaching to a true gizzard: the straight compressed bill, inclining to a tetragonal form, has the tomæ nearly in contact with the palate in both mandibles; and the nares are partially or wholly concealed by a setaceous frontal zone, analogous to that of the *Corvidæ*.

The birds composing the group or genus are gregarious, noisy and alert. They frequent the deep and dank forests and groves exclusively; procure the greater part of their food on the ground; use the trees but for security when disturbed, for nidification, and for occasionally eking out their repasts with berries, pulpy fruits or caterpillars; and are, for the most part, incapable of a sustained flight. Their habitat is very extensive, since they are almost equally common in the southern, central, and northern regions of these hills; and in the valleys alike, as on the tops of the mountains. In all situations, however, wood-lands are indispensable to them, both for food and shelter; especially the latter, their retreat being a mere succession of hops from tree to tree, after the manner of the Magpies. Most of them have a good deal of the mixt weariness and familiarity, as well as of the noisiness and congregational habits, of the *Corvidæ*; and, though they never quit the deep wood-lands, those persons who pass through such places, perpetually encounter them on the roads and pathways, to which these birds are attracted by the dung of cattle, for the grain, larvæ and insects it affords them. They are on the whole, rather insectivorous than frugivorous, baccivorous, or graminivorous: but they eat a deal of grain and hard seeds, with gravel to digest it; and must, from the universality of their regimen, be classed among the omnivores. They are distinguished from the Thrushes by their avoidance of rills and swamps;

---

SWAINSON, justly perhaps, classes the Cinclosomæ with the Crateropodinae. But he unjustly reduces them to a sub-genus. This paper was penned before I had seen SWAINSON's casual allusion to the group in the birds of America. That able writer is most correct in stating that the characters of Cinclosoma and of Pomatorhinus stand in grievous want of revision.

and they are more capable of a graminivorous diet than that group. They scrape the earth with their bill, and sometimes also with their feet, in the manner of the *Rasores*. Many of the species are caged and tamed with facility; and they are more often turned loose into walled gardens; whence they seldom attempt to escape, if there be a considerable number of trees, and where they are of great service in destroying pupæ, larvæ and perfect insects, especially those which are generated, or feed, in manure.

In the Minister's garden at Cathmandu there are always several scores of *Leucolopha* (*Corvus Leucolophus* of Hardwicke;) and in that of his nephew, many individuals of each of following species—*Ocellata*, *Albigula*, *Nufimenta*, *Monilegera*, and *Erythrocephala*. But this enumeration reminds me that I am anticipating by the mention of several species as yet undescribed, and to the summary description of which I now proceed, premising only that the newly described species are *Leucolopha*, *Erythrocephala*, *Variegata*, *Ocellata*, *Capistrata*, and *Lineata*. To these I now purpose to add *Nipalensis*, *Albigula*, *Monilegera*, *Rufimenta*, *Grisauris*, *Melanoura*, *Cærulatus*, and *Setafer*, arranging them in a series indicative of the gradually diminishing power of the wing.

1st. *Species*, CINCLOSOMA? NIPALENSIS Nobis, SIBIA? NIPALENSIS Nobis.

Above, with the flanks, thighs, vent and under tail coverts, rufescent sub-olive brown. Below, and the cheeks, sordid blue grey, with a yellowish tint: wings and tail castaneous with numerous cross bars of black: entire top of the head full pure brown, streaked down the shafts with hoary: a broad black moustache, bounding the ear coverts below. Remiges and rectrices, internally blackish, and apertly so towards the tips: the tips themselves of the tail feathers white: head with a full soft garruline crest: legs flesh-coloured: bill dusky: iris brown: orbits clad: sexes alike, as in all the subsequent species.

N. B. In defining the Genus *Sibia* (Nobis) I have enumerated the above as one of the species. It has, though in a less degree, the brushed tongue of that genus: its wings are rather feebler: and its bill is more straight. The tomæ are scarped, and the notch and bend of the upper mandible are

palpably developed. The lunated, unplumed, nares, with a large adpressed membranous tect, are those of *Sibia*. So are the feet ; which latter, however, agree sufficiently well with those of *Cinclosoma*.\*

The species is, in fact, osculant between *Cinclosoma* and *Sibia*. Size, 8 inches long by 10 wide, and  $1\frac{1}{2}$  to  $1\frac{3}{4}$  oz. in weight. Tarsus  $1\frac{1}{2}$  ; central toe  $\frac{1}{4}$  ; hind toe  $\frac{1}{4}$  ; wings not bowed ; 5 and 6 quills longest : tail firm but graduated,  $1\frac{1}{4}$  inch in the extreme laterals.

*Species 2nd.* CINC. ALBIGULA, white throated *Cinclosoma*, Mihi.

Above, and the breast, dull olive : belly, vent and under tail-coverts, rusty : chin to breast, inferiorly, and terminal  $\frac{1}{3}$  of the lateral rectrices, pure white ; bill dusky : iris glaucous : orbital skin green : legs plumbeous grey, 12 inches long by 15 broad ; and  $3\frac{3}{4}$  oz. in weight.

N. B. This species, like *Leucolopha*, has much the appearance of a Jay : but it possesses in a high degree, all the characteristics of *Cinclosoma*, of which more is said in the sequel.

Nares ovoid or elliptic, and frequently quite hidden by the frontal zone.

*Species 3rd.* CINC. GRISAURIS, grey-eared *Cinclosoma*, Mihi.

Above, save the neck, olive, with a rusty smear : neck, throat and flanks, pale rusty ; rest of body below, white : cheeks, ears and lores grey, enclosed by two narrow black lines which originate at the bill, and circling round the eyes and ears, unite into a broad band on the sides of the neck, and thence form a gorget on the *top* of the breast : terminal  $\frac{1}{3}$  of the lateral rectrices doubly banded with black and white, as in *Ocellata*, but the bands broader : bill, dull horn : legs plumbeous : iris brown : orbital skin, greenish yellow : 13 by 17 inches, weight 6 oz.

\* Exaggerated mention has been made of the feet of *Cinclosoma*, and some species have been again separated, propter hanc causam, from *Cinclosoma*. But in truth, the feet agree most expressly with those of *Pica Erythrocephala*, *Vagabunda*, &c. It were much more wise to amend the definition of *Cinclosoma* than thus to divide it. In no species is the thumb nearly so large as the central fore digit ! The *Cinclosoma* are a half Corvine, half Meruline group, united by their manners even when partially separated by their structure. They compose a genus with sundry subgenera. B. H. H. July.

**N. B.** The upper mandible is sometimes produced, bent, and notched at the tip, even more than in *Turdus*.

Nares ovoid, partially hid by setæ from the frontal zone.

*Species 4th.* CINC. MONILEGERA, black-necklaced Cinclosoma, Mihi.

Extremely like the last in colours. Above, pale olive brown ; whole neck, with the throat, breast and flanks, rusty ; and rest of the body below, white : a broad superciliary white line from the bill to the occiput : below it a black line proceeding from the bill through the eyes and ears (which latter are black,) and thence sweeping round the *bottom* of the breast like a necklace : iris orange : bill dusky with horn coloured tip and base below, and plumbeous grey feet : orbital skin evanescent :  $11\frac{1}{2}$  by  $14\frac{1}{2}$  inches, weight  $3\frac{1}{4}$  oz.

Nares as in the last ; and all the three last named species closely assimilating with *Leucolopha*.

*Species 5th.* CINC. MELANURA, black-tailed Cinclosoma, Mihi.

Head, neck, and body, olive brown, lunated with black : brows and chin, black : wings black internally, visibly so in the tertiaries : edge of the primaries cerulean ; of the other quills and of the coverts, castaneous : rump immaculate : tail black with a complete terminal band of rusty : feet fleshy brown : bill black : iris marine blue : length of the bird  $10\frac{1}{2}$  inches : breadth 12 : weight  $3\frac{1}{2}$  oz.

**N. B.** The maxilla of this species has usually the meruline bend and notch : the nares are ovoid somewhat indented above by the membrane, and free from the frontal zone. The wings are rather rounder than in the three preceding species.

*Species 6th.* CINC. CÆRULATUS, blue-sided Cinclosoma, Mihi.

Above, rich olive brown, with a chesnut tinge : cap, wings and tail, chesnut ; the first, lunated with black. Below, white : the flanks and tibiæ, blue : a black frontal zone from the eyes : body, wings, and tail, immaculate : bill dusky with a purplish fleshy base : orbital skin purpurescent : iris brown : legs fleshy white : 11 inches by  $12\frac{1}{2}$  ; weight  $2\frac{3}{4}$  to 3 oz.



N. B. In this species the shorter and more rounded nares are *wholly* hidden by the setaceous frontal zone ; and all the remiges, save the 5 first and 5 last, are nearly equal. The mandibles of the bill are exactly equal and entire, eminently typical.

*Species 7th. CINC. RUFIMENTA*, rusty-chined Cinclosoma, Mihi.

Above, olive brown, broadly lunated with black : entire cap black : tail immaculate, but furnished towards the tip with a double band of black and rusty, prevailing throughout : chin and vent rusty : throat white : breast and belly smokygray with black drops : lower part of the flanks and thighs, olive brown ; bastard-wing, and external edges of primaries, subcerulean : the former and the long coverts, apt with black bar-wise : a pale roundish spot before the eyes : broad longitudinal black patch behind the gape : bill horn yellow : orbital skin splendid blue : iris sanguine-brown : legs fleshy brown : 10 inches by  $10\frac{1}{4}$  ; weight  $2\frac{1}{2}$  oz.

N. B. In this species the nares are not wholly hidden, but they are even less elongated than is the last : the wings are very feeble and perfectly round : bill, as in the preceding species, but shorter.

*Species 8th. CINC. SETAFER*. Spiny Cinclosoma, Mihi.

Slaty blue, overlaid with ruddy brown, which is clearer and paler below, and richer and almost castaneous on the wings and tail-feathers. Lateral rectrices broadly banded with black towards the tips : the tips themselves bluish grey : shafts of the feathers on the head and neck, rigid, spicuous and black : elsewhere, albescent and soft :  $8\frac{1}{2}$  inches by 9 ; weight  $1\frac{1}{4}$  oz.

N. B. In this somewhat anomalous species the tomæ are scarped internally as well as less near to the palate or more locked than in any of the preceding species, and the upper mandible, rather longer than the lower, has *always* the meruline bend and notch. The nares are short and ovoid, free from the frontal zone, and more shaded above by the membrane. The stomach, which is gradually more muscular in the two last species, in this reaches the form of a true gizzard almost.

The rotundity and feebleness of the wings are carried to the extreme limit.

In the four first species the wing, though rounded, has yet something like acumination in the prime quills. That character begins to disappear in the 5th and 6th; and is wholly lost in the 7th and 8th species. *Quoad hoc*, the four first assimilate with *Leucolopha*, and the two last with *Erythro-nota*; the 5th and 6th being transitional. The whole eight have points of difference among themselves which perhaps may be best explained by the assumption that the group (already loaded with species recent as is its institution) is really of more extent than a genus, or at least forms a genus with several subgenera. Certainly, the Pie-like and Thrush-like species form a bold and decided contrast. *Leucolopha*, *Albigula*, *Grisauris* and *Mouilegera* belonging to the former division. The essential characters of the genus appear to me to be as follows: An elongate conic bill, framed as to length and thickness upon the Meruline model, but distinguished from that of *Turdus* by its straightness, by the pent roof, rather than convex, shape of its maxilla; by the tendency to equality and entireness in both its mandibles, and, above all, by the palate being produced almost to the cutting edges which yet are trenchant throughout; fossed and membraned nares, the apertures of which are almost or wholly hid by a setaceous frontal zone: nude orbits: soft, rounded, and feeble wings: a longish, gradated, bowed, and feeble tail: high, stout, corvine, legs and feet, the thumbs of which are large and partially flat-soled, as in *Corvus*, *Pica*, *Garrulus*, &c., but *not* in *Turdus*. In the general form of the wings, tail, and feet, there is a much closer connexion with *Pica* and *Garrulus* than with *Turdus*. And this corvine analogy is strengthened by the anteal development and setaceous character of the frontal zone of feathers; by the partial nudity of the orbits; by the similarity of the sexes; by the manners, the voices, and the soft discomposed plumage of the *Cinclosomæ*; and, lastly, by the considerable muscular power of their stomachs and omnivorous regimen. But, on the other hand, the thick

massive bill, notched and bent in both mandibles ; the unfossed nares ; and the short, half-fleshy tongue of the *Garruli* and *Picæ*, no way consort with the structure of the same parts in the *Cinclosomæ*, which, in each of these respects, bear a distinct affinity with *Turdus*, and, more generally, with the *Merulidæ*.

June 1836.

---

## II.—NEW SPECIES OF THE THICK BILLED FINCHES.

FRINGILLIDÆ—COCCOTHTRAUSTINÆ.

Genus COCCOTHTRAUSTES ?

Species, new. COC. MELANOZANTHOS, Black and yellow Finch, nobis.

*Form* : bill exceedingly gross, as high as long ; tips of both mandibles compressed, mutually bent and notched ; upper mandible arched along the culminal and rictal lines, strangulated and furnished with a large tooth at the base ; lower mandible wider at the base than the upper, and flattened beneath. Nares remote, ovoid, opened laterally at the lower end of a basaj transverse membranous groove ; their aperture hid by hairs. Wings long and firm, reaching to middle of tail : 2d quill usually longest : primaries nearly twice as long as tertiaries, and very firm. Tail distinctly forked. Tarsi low, stout, heavily scaled, longer than any toe : toes medial, unequal, stout ; fores compressed ; hind depressed ; external fore basally connected : nails stout, falcate, moderately acute.

*Colour and size* :—Male.—Above, with the entire head and neck, slaty black ; below, bright yellow : long coverts of the wings tipped broadly with yellow, and a broad stripe of the same on the outer edge of the secondaries and tertiaries : a white speculum on the primaries, next to the false wing : bill and legs, plumbeous : iris, brown. Female,—much more variegated : wings and tail as in the male : top of the head and dorsal neck,

dark like the male, but entirely enclosed by a yellow band proceeding from the brows over the eyes and down the neck to the back, where the opposite lines are blended and form yellow margins to the dorsal plumes : a broad dark line from the nostrils through the eyes to the scapulars, which are immaculate. Below this line all the inferior surface is yellow ; but there is a dark line from the gape and another from the lateral angle of the lower jaw, on each side, enclosing an immaculate chin. Below the chin the yellow ground is varied with longitudinal drops of the dark hue of the upper surface, save on the centre of the lower belly, vent, and under tail coverts, which are immaculate yellow as in the male : bill, legs and iris, as in the male, but duller. Size of the male, 9 inches long by 15 wide, and 3 oz. in weight : female, rather less.

The young till after the second moult resemble the female, taking the full adult plumage gradually.

These birds belong to the northern region, whence however they wander into the central, even in summer, in search of ripe stony fruits.

Their structure is by no means typical, and I have noted them as the type of a new Genus under the revived name of *Stobilophaga*.

*Species 2nd*—CARNIPES. Fleshy-grey footed Finch, nobis.

Head, neck and breast dusky slaty, striped on the lower half with hoary : upper back, wings and tail dusky ; the first smeared all over, and the two last edged, with greenish yellow : a white speculum on the primaries, as in the last : lower back, belly and vent, greenish yellow : under tail coverts the same, dashed with dusky : legs and bill fleshy grey : iris brown. Sexes alike ; size rather less than the last.

*Genus* CORYTHUS ?

*Species 1st*—C. SIPAHI, nobis. Seapoy Corythus, nobis.

*Form* : bill less gross sharper, the mandibles nearly equal and nearly intire : culmen and rictus arcuated : a salient tomial angle near the middle of the lower mandible : sometimes wanting ; wings shorter, scarcely exceeding the base of the tail : 3 and 4 quills longest and equal.

Tail even inclining to divaricate : tarsi smoother : toes shorter and more depressed ; lateral toes equal ; the anteriors basally, though trivially connected : nares more approximated, sunk, subvertical, opened centrally in the transverse lunated fosse, hid.

*Colour of the Male* : brilliant scarlet, with black remiges and rectrices broadly edged with scarlet : large coverts of the wings, black with scarlet edge and tip : tibial plumes black : under tail coverts dashed with dusky : bill, yellow ; legs, fleshy brown : iris, hoary brown.

Female : head, neck, upper back, wings and tail, dusky, broadly margined all round, or in the remiges and rectrices, on the outer vane, with dull greenish yellow : quills and tail blackish internally : rump bright yellow : breast and body below, dirty white picked out largely with dusky, sometimes in the form of subterminal cross bars : bill, legs and iris, as in the male, but duller. Size of the male,  $7\frac{1}{2}$  inches by  $12\frac{1}{4}$ , and  $1\frac{3}{4}$  oz. in weight. Female, rather smaller.

*Species 2nd.* SUBHIMACHALUS, Subhimalayan Finch, nobis.

Form differing somewhat from the last : the bill more pyrrhuline ; the anterior toes slenderer with unequal laterals, and straighter and more acute nails : wings with 3rd quill usually longest.

*Colour of the Male* : brilliant roseate red, largely picked out, with blackish on the top of the head, dorsal neck, and upper back : quills and tail feathers blackish, with broad roseate edges on the outer vanes. Breast and body below, plumbeous grey : bill and legs, brown flesh-colour, with a rosy tinge : iris, brown. Female : forehead and a large gorget on the top of the breast, bright yellow : rest of the head, the whole neck, and body below, plumbeous : the vent and under tail coverts, paler and albescent : body above, dull greenish yellow, picked out on the upper back with dusky : wings and tail dusky black, with greenish yellow edges to the outer webs : bill, legs and iris, as in the male, but duller. Size of the male,  $8\frac{1}{4}$  inches by  $12\frac{1}{4}$  ; wt.  $1\frac{3}{4}$  oz. : of female, something less. Habitat ; the northern region : in winter, found in the central.

**Remark.** I have classed the two above species with *Corythus* because the expert at home seen to consider them as of that genus, and because till the generic characters of the whole of *Coccothraustinae* vel *Loxianae* have been revised, they may as well be *Corythi* as anything else.\* Their fore toes, however, are not wholly cleft; nor their tails, properly speaking, forked; nor their wings longer than in *Pyrrhula*.

*Family COCCOTHAUSTINÆ, genus new, MUNIA, nobis,*

**Character.** Bill as gross as in *Coccothraustes*, with the ridge line subarched; the mandibles equal, pointed and entire; upper mandible flattened on the ridge towards the base and spread like a plate over the forehead. Gape strongly angulated but without salient process in either mandible.

Nares round, vertical, sunk, free. Tarsi stout, scaled, longer than the central toes: toes long, slender, unequal compressed—outer fore basally connected—hind large: nails slender, acute and straightish. Wings short and feeble; primaries scarcely exceeding the tertiaries; 3 first quills subequal and longest. Tail medial, wedged and pointed.

*Species 1st. M. RUBRONIGER, black and red Munia, nobis.*

Head, neck, and breast, glossy black: centre of the belly, vent and under tail coverts, the same, but tinged with red: rest of the body and wings, pure cinnamon: rump darker, with lake tinge: rectrices brighter, with an orange chesnut hue: bill and legs soft plumbeous: iris black brown. Sexes exactly alike: young, brown, above; dirty rufous of a pale tinge, below; and the bill and legs darker and duller. Size of the species,  $4\frac{1}{2}$  to 5 inches by  $6\frac{1}{2}$  to 7, and weight  $\frac{1}{2}$  oz.

*Species 2nd. M. ACUTICAUDA, sharp-tailed nobis.*

Remarkable, even among its congeners, for the perfectly cuneate and acute form of the tail, just like a Woodpecker's but not rigid. Head, neck, breast, most part of the back, wings, rump, thighs and upper and under tail

---

\* It appears to me not impossible that CUVIER would have considered the two first described species as *Corythi*, and these two as *Coccothraustes*! *Subhemachalus* inclines much to *Pyrrhula*; and none of the four species are typical. Hence the difficulty in classing them.

coverts, saturate rich brown, with whitish shafts to each plume : lower back and body below, white with narrow hastate marks on each plume of a dusky hue : lining of wings and inner edge of the quills towards their bases, immaculate buff : tail pure black : bill and legs, slaty blue ; pure and plumbeous in lower mandible of bill : iris brown : sexes alike : size of the last.

*Species 3rd.* M. LINEOVENTER, bar bellied, nobis.

Head, neck, body above, wings and tail, ruddy brown—more saturate on the head and neck ; and paled nearly to white brown on the rump and tail : breast and belly white with frequent zigzag cross bars of black : vent and under tail coverts, whitish and unmarked : bills and legs, plumbeous : iris red : sexes alike : size of the two last.

Remarks. These singular little birds cannot with propriety be ranged under the genus *Coccothraustes*, nor yet under that of *Ploceus* ; for, as CUVIER, the institutor of the latter genus, justly affirms, the *Plocei* are distinguished by the straightness of the commissure of their bills.\* But the fact is, CUVIER's subgeneric characters are too vague to be of much practical utility ; and the specific descriptions of most general works so summary as to be nearly worthless.

If species are worth describing and transcribing, they should be described and transcribed adequately ; and if genera and subgenera are to be characterised by three words, families and subfamilies should *first* be more fully and exactly defined, the former characters being always understood with strict reference to the latter. Amongst the thick-billed Finches, there are some observable differences of structure both in the osseous frame work of the body and in the chylopoetic viscera—differences which, taken in conjunction with those of the whole external organs, might serve to separate these birds much more naturally than has yet been done ; especially if the indications

---

\* *Baya* is a typical Indian species of *Ploceus*, common in the *tardi* but never seen in the *Hills*. *Coccothraustes* belongs to the cold regions : *Ploceus* to the hot ; *Munia* is intermediate.

of internal structure (in the larger divisions) were eked out by those of *habit* and *manner*. But to return :—*Munia*, the name we have assigned to our new genus, is well known to the *taraī* and to the Hills as the generic appellation of several species of tiny gross-bills, distinguished for their familiarity with man, their gregarious habits, their depredations upon the rice crops, and their ingenious nests.

The species are solitary in regard to nidification ; but, *after* the breeding season they are all gregarious in a greater or less degree. They are exclusively graminivorous, feeding on hard grass, seeds or cerealia, according as one or the other are procurable ; and they fix their large globular nests either among the spiny leaves of the palm trees or the thick interlaced branches of the lesser bamboos.

But there is no weaving or sewing employed in the structure of the nest. It is merely a large ball, laid against or upon naturally blended branches or stiff leaves, and having a small round entrance either on the side or at top. The eggs are many, and in *Rubroniger* of a bluish white colour. These birds are easily tamed and caged, but they have no song.

The whole three species are migratory, appearing in June and departing in November. Many of them breed in the Residency grounds, and solitarily so far as I have observed. The nest is composed of grass fibres, or leaves of the *Pinus Longifolia*, and is usually constructed in the midst of the small Chinese bamboo or of the dog-rose. The male and female labour at the work with equal assiduity, and share equally the task of rearing the young. In winter and spring they resort to the lower region, returning to us to breed just as the rains set in, and departing with their young so soon as the rice crop has been got in ; after which the open cultivated country is perfectly bare for some months.

PYRRHULINÆ. Genus PYRRFULA.

1st species. P. NIPALENSIS, nobis.

Form as in *Erythrocephala* ; but the bill grosser with the tomial line of its upper mandible less even, and the tail still more conspicuously



forked and gradated. Colour and size—male, brown-smeared slaty blue, (like common slate stone) with black rump, wings and tails all reflecting a brilliant purplish blue gloss; cap picked out with dusky, and a band of the same hue round the base of the bill; a white spot under the eye; band across the rump, lower belly, vent, and under tail coverts white; outer web of the last tertiaries fiery red; bill greenish horn, with black tip; legs fleshy brown; iris brown;  $8\frac{1}{2}$  to 9 inches long by 10 to 11 wide, and  $1\frac{1}{2}$  to  $1\frac{1}{2}$  oz. in weight.

Female rather less, exactly like the male, save only that the outer web of the last quill towards the body is invariably yellow, and not fiery red as in the male. The young, at first, want this distinctive sexual mark. Habitat northern and central regions.

**PYRRHULA? EPAULETTA.** Epauletted Pyrrhula, nobis.

Form somewhat anomalous, uniting the wings, tail and feet of *Fringilla* with the bill of *Pyrrhula*. Bill strictly *Pyrrhuline*, but rather longer and less gibbous than in *Vulgaris*, with a sharp tooth on the tomial margin of the lower mandible, near its base; wings scarcely exceeding the base of the tail. 3 and 4 sub-equal and longest; 1 and 2 distinctly gradated. Tail medial, firm, even; the quills divaricating and pointed at their tips; tarsi rather elevate and nearly smooth: toes medial, compressed; laterals and hind sub-equal; outer fore connected to the joint: nails acute. Colour and size. Male—black with the occiput bright silken yellow: a ruddy yellow tuft at the bend of the wings (unde nomen); the tertiaries white, partially or wholly, on the inner web; vent more or less concolorous with the epaulettes; bill black; legs fleshy gray; iris brown: size  $6\frac{1}{2}$  inches by 9, and  $\frac{3}{4}$  oz.

Female, of the size of the male: top of the head and ears greenish yellow; dorsal neck and top of the back dull slaty blue; rest of the body, with the wing coverts and tertiaries, ruddy brown; remiges and rectrices dusky black: tertiaries whitened on the inner web, as in the male; and bill, legs and iris, colored like his. Habitat the northern and central regions: shy, adhering to the forests.

CARDUELINÆ. *Genus* CARDUELIS.*Species new.* C. NIPALENSIS, nobis.

Form of the bill as in *Carduelis Caniceps* and in the common Goldfinch: but the tarsi higher, and wings and tail apparently longer and stronger; wings to the middle of the tail, decidedly acuminate with the 3rd quill clearly longest; rectrices strong, broad, divaricating, acutely pointed; the whole slightly gradated from above, and the tail consequently, distinctly though trivially forked; tarsi elevate, finely scaled; toes long, slender, and compressed, with slender and very acute nails.

Colour and size of the male:—above, and the neck and breast entirely sooty black, or dusky strongly tinted with a dark sanguineous blossom red; forehead, a line over the eye to the occiput, the chin and throat, breast and belly, pure blossom red; under tail coverts paler and picked out with dusky; remiges and rectrices pure sooty brown, more or less touched on the outer margins with the red hue of the upper surface; bill and legs fleshy brown; iris red brown: size  $6\frac{1}{2}$  to 7 inches by  $10\frac{1}{2}$  to 11, and  $\frac{3}{4}$  oz.

Female rather less above olive brown; below, from chin to breast, dirty yellowish; from breast to tail, white; wings and tail dusky brown; the coverts of the former, with the tertiaries, externally margined or tipped with dirty yellowish; bill, legs and iris, as in the male but obscurer. Habitat central and northern regions.

ALAUDINO, *Genus* EMBERIZA.*Species New.* NIPALENSIS, nobis.

Form, typical in the main: \* bill elongate-conic, compressed, intire; culmen raised and subcarinated between the nares which are oval, lateral, shaded above and behind by membrane, and hid by tiny hairs; wings rather short; 3, 4 equal and longest; 1 and 2 distinctly gradated; tail even; tarsi and toes simple, ambulatory.

Colour and size. Male—blue glossed black with cinnamomeous wings and tail, which are both dusky towards the tips; tail-coverts mixed black

---

\* That is, with the gape strongly angulated and the palate furnished with a large obtuse knob.

and cinnamon ; tertiaries darkened on the inner web ; forehead furnished with an elongated, slender, mobile, crest ; bill and legs fleshy brown ; iris dark brown :  $6\frac{1}{2}$  inches by 10, and 1 oz in weight.

Female has the crest smaller and the bill and feet duller hued : above she is dusky brown edged with grey ; below, rufescent white, streaked lengthwise with dusky ; quills and tail feathers dusky-brown, more or less edged externally with dull cinnamon, and showing that hue internally and basally on the quills almost as clearly as in the male : size nearly equal to his. The species is gregarious in small flocks ; feeds on small hard seeds and grains solely, and chiefly frequents the hedge rows and brushwood of the upland downs and meadows. In Winter, common in the central region : in Summer, resorts to the northern.

*Genus new.* FRINGALANDA, Lark Finch, nobis.

Bill as in *Fringilla* but smaller ; perfectly conic, intire, straight and pointed ; tomice of the lower mandible inflexed and scarpt towards the gape, but without angulation or salient process ; palate well scooped out and smooth ; wings very long, passing the center of the tail ; 2nd longest ; 1st and 3rd subequal ; tertiaries truncated and square ; much short of primaries ; tail longish, firm, slightly but distinctly forked.

Tarsi submedial, finely scaled ; toes compressed and slender ; the laterals and hind subequal ; outer connected to the joint.

Nails long, slender, acute, straightish ; hind largest, less the toe.

Nares oval, lateral, shaded above by membrane and hid by small hairs.

*Species new.* F. NEMORICOLA. Forest-haunting Lark Finch, nobis.

Form has been detailed above.

Colour and size :—above dusky brown, edged with rufous, as in so many of the Larks ; below, sordid earthly grey ; or grey brown, paler as you descend the body ; long tail coverts, above blackish with white tips, below, white with dusky centres ; remiges and rectrices dusky ; the long wing coverts and the tertiaries, with broad edging of rufous or white colour ; bill and legs fleshy brown ; iris red brown ; sexes exactly alike : size  $6\frac{1}{2}$  by  $11\frac{1}{2}$ , and 1 ounce in weight.

**Remarks.** These birds are confined to the central and northern regions, and never quit the skirts of the forest. Their habits are very like those of the arboreal Larks, but they never come into the open country. Their stomach is a powerful gizzard; and their food, kernels and hard seeds, which they digest by means of trituration with gravel. They seem to me eminently singular birds, and I regret I do not know more of their manners. They have sundry points of contact with the genus *Plectrophanes*; but are separated essentially therefrom by their smooth hollow palate; as noted in the generic character expressly to prevent such confusion.

The following detail of the dimensions of a fine male may help a just conception of the characters of the genus :

|                            | <i>Inches.</i> |
|----------------------------|----------------|
| Tip bill to tip tail,..... | 6½             |
| Bill, length of, .....     | 0.8½           |
| —, basal height of, .....  | 0.4½           |
| —, ditto breadth of, ..... | 0.4½           |
| Tail, .....                | 2½             |
| Expanse of wings,.....     | 11½            |
| Tarsus, .....              | 0.4½           |
| Central Toe, .....         | 0.2½           |
| Hind toe, .....            | 0.4½           |
| Nail, .....                | 0.2½           |
| A closed wing, .....       | 3½             |
| Weight, .....              | 1 oz.          |

### III.—NEW GENERA OF THE COLUMBIDÆ.

The Pigeons are usually and usefully divided into the terrestrial, the arboreal and the ordinary; the last uniting the attributes of the other two, and being the most perfectly organised of the family. The above form the genera *Goura*, *Vinago* and *Columba*; and, though I am aware that there

are other genera recently instituted, such as *Ptilinopus*, *Peristera* and *Ectopistes*, it will not be necessary for me to take more notice of them on the present occasion than by this mere allusion, made only to show that I have not overlooked them.

The remarkable bird which I am now about to introduce to the notice of Zoologists, unites the bill and wings of *Goura* with the feet of *Vinago*. This, as its general description, is strictly accurate; and therefore I presume it will be allowed that the species could not be introduced without violence into any existing genus.\* I shall therefore consider it as the type of a new one, to be reduced to a sub-genus, or wholly rejected, according to the discretion of the learned. All persons must allow with Mr. SWAINSON that this manner of introducing new species, at least insures an unusually accurate acquaintance with them *as species*. For the rest, until it has been decided, whether the Pigeons constitute an order, a family, or a genus, I suppose we may not look for very intelligible (so called) generic characters. As to the objection to a genus founded on one species, it appears to me that any person who carefully distinguishes a striking modification of form, may reasonably anticipate that *very many recorded* species will be found to belong to it, so soon as our knowledge of the (in this case) vast and promiscuous heap of them, comes to exceed a faint notion of their mere colours and size.

*Sub-family.*—VINAGINÆ OR TREE PIGEONS.

*Genus or Sub-genus*—*DUCULA nobis*.—DUKUL OF THE NIPALESE. (genericé)

Character of the genus:—bill equal to the head, straight, cylindric, very feeble; both mandibles membranous for three-fourths from the gape; tip of the upper mandible gently inclined—of the lower, strongly compressed; nares broad, linear, obliquely transverse, central; their groove faint; their tect subtumid.

\* If the *Columbidae* be regarded as a family, divided into the three sub-families *Gourinæ*, *Vinaginæ*, and *Columbinæ*, I place this bird at the entrance of the second from the first of these sub-families.

Wings short, not rounded, 3, 4, 5 quills sub-equal and longest ; central primaries with their tips wavily truncated.

Tail 14, long, strong and square ; tarsi very low,\* and plumed nearly to the toes laterally, less in front ; toes depressed with broad flat soles ;\* lateral toes sub-equal, hind large ; nails strong, arched and acuminate ;\* central and hind equal, lateral toes equal, less ; orbits nude ; plumage simple. The above is a tedious character, but it is a distinct one. Those who love more summary proceedings may perhaps approve the following :

“ Bill and wings as in *Goura* ; legs and feet as in *Vinago*.” But the fact is that the bill of our bird, nearly as it resembles that of *Goura*, is clearly distinguishable therefrom, by less compression, a fainter grooving, and a more tumid nasal tect. The wings, again, with the same general character, are strikingly marked by the singular truncate angulation or curve at the points of the central primaries.

In like manner, the feet, though exclusively adapted for perching, and consequently framed strictly upon the model of the same organs in *Vinago*,† (and *Ptilinopus*), differ therefrom by the subequality of the lateral fore toes, and by the absence of that extreme and sudden acuminations of the nails which distinguishes them in that genus. The wings of our birds differ entirely from those of *Vinago* ; the latter being longer, conspicuously acuminate, with sharp narrow primaries (3) analogous to those of the lesser Indian Bustard. In our bird there is no acuminations of the wings : the

\* These characters, I admit, belong rather to the sub-family than to any genus or sub-genus of it (see note in the sequel) : but, so long as the sub-family continues to be vaguely defined, its genera must be defined diffusely. On this principle I might add, that the toes of our genus are cleft : but the fact is, this is a character co-extensive with the whole family ; and reiteration must have some limits.

† It is a strange misinterpretation of the language of CUVIER, (I suppose,) which led STEVENS to assign toes connected by membrane to *Vinago*. They are cleft though bordered ; that is, the edges are spread laterally by the depression of the soles. There is something so decided and necessarily influential in the exclusively perching feet of the *Vinaginae*, that I consider this character the diagnosis of the sub-family ; and I class our bird with the *Vinaginae*, notwithstanding the extreme feebleness of its bill, because its feet are utterly unsuited to walking.

webs of all the quills are broad: and the peculiarity of structure is confined to the points and begins with the 3rd or 4th primary, extending thence as far as the secondaries. In *Vinago*, too, the membranous and soft part of the bill scarcely reaches forward to its centre, the organ having double the strength which it possesses in our bird. In *Vinago*, the tumid tect of the nares is nearly evanescent: in our bird it is distinct, though less conspicuous than in the Pigeons proper. Lastly, though *Ducula*, like *Vinago*, be exclusively arboreal and fruit-eating; the latter is eminently gregarious—the former, almost a solitary.

*Species new.* DUCULA INSIGNIS. Great Ducula, nobis.

Habitat central and lower hilly regions.

*Colour and size*:—head, neck, body below, and lining of the wings, soft blue-grey or grey blue; paler and albescent on the chin, and richly tinted with vinous on the back of the head and of the neck; lower tail coverts, soft buff; quills and tail slaty black; terminal 1-3rd of the latter, and lower back, slaty blue; upper back, shoulders, and wing-coverts, saturate slaty, internally, but merged in a brilliant vinous hue on the whole surface; bill and legs intense sanguine; terminal hard portion of the former, and the nails, dusky horn; orbit skin slaty, merging in purple; iris hoary or blue grey: 20 inches long by 30 wide:  $1\frac{1}{2}$  lbs. in weight.

Female, a-fourth less than her mate; wants almost wholly the rich vinous tint of the male; and is, generally, more obscurely coloured.

The following are the dimensions of a fine male:—

|                             | Ft. Inches. |                    |
|-----------------------------|-------------|--------------------|
| Tip bill to tip tail, ..... | 1           | 8                  |
| Bill, .....                 | 0           | $1\frac{1}{2}$     |
| Tail, .....                 | 0           | 8                  |
| Expanse of wings, ....      | 2           | 6                  |
| Tarsus, .....               | 0           | $1\frac{7}{16}$    |
| Central toe, .....          | 0           | $1\frac{7}{16}$    |
| Outer fore toe, .....       | 0           | 1                  |
| Inner ditto, .....          | 0           | $0\frac{3}{4}$     |
| Hind ditto, .....           | 0           | $0\frac{1}{2}$     |
| Weight, .....               | 1 lb.       | $8\frac{1}{2}$ oz. |

[For sketch of the foot and bill see accompanying plate.]

*Genus or Sub-genus*—*TORIA nobis*.—*THORYA*. (quasi *Rostratus*) of the Nipalese Character.

Bill shorter than the head, compressed very strong with the tip heavily bent and membrane at the base nearly obsolete; nares longitudinal, linear, simple;\* wings sub-medial; 2d longest, 3d lunately emarginated on the inner web; the rest simple;† tail 14, short, even; orbits and lores nude; tarsi equal to the central toe, nude; knees clad; acrotarsial scales nearly perfect; paratarsus smooth.

Toes unequal; the two exterior fores compressed and slender; the inner fore and hind somewhat depressed and bordered; hind stout; outer toe longer than the inner; nails falcate and acute; hind largest; plumage simple. If the bird previously described appeared to be placed on the confines of the arboreal and ground Pigeons, belonging to the former, so this seems to possess a similarly-osculant character. Its aberration, however, from the sub-family type consists chiefly in the structure of its feet; not in that of its bill as in the preceding genus.

Its wings are longer than in *Goura*, shorter than in *Columba* or *Vinago*. The quills offer no peculiarity save that noted above, and the firm primaries exceed the tertiaries by  $1\frac{1}{2}$  inch. The bill possesses more strength and a stronger bend than in any species of the whole family I ever met with. The nares longitudinally developed, and neither fossed nor provided with a tumid tect, are quite unique. The feet have, upon the whole, a perching character; but they are, at the same time, by no means so utterly unsuited for walking as those of the typical arboreal Pigeons. With reference to the doubtful attributes of the feet and wings of our bird I have been induced to range it with hesitation amongst the *Vinagine* owing to the extreme power of the bill—certainly a decided, though not, I think, the most decided character of that sub-family. The habits of the species are very similar to those

---

\* Nares simple, that is, neither fossed as in *Goura*, not swollenly membraned as in *Columba*, and in a less degree, in *Vinago* also.

† 2, 3, 4 are slightly sinuated on the outer web; but the mark is too common to be characteristic.



of the small ordinary Doves. It is however, much rarer and more shy than any of them. It is not very gregarious ; adheres to the forests ; feeds chiefly on soft fruits, and prefers the trees to the ground ; but without absolute exclusiveness of habit in that respect. Its habitat is the central and lower hilly regions.

*Species new*, TORIA NIPALENSIS, Nipalese Toria, nobis.

*Colour and Size.* Top of the head plumbeous ; cheeks, with the intire neck and body below, lower back, upper tail coverts and central rectrices, medial grass green, paler and yellower below than above ; thighs, vent, and lateral inferior tail coverts picked out or tipt with white ; rest of the inferior tail coverts deep buff : upper coverts of the wings, top of the back and scapulars, rich maroon red ; wings black ; the great coverts and tertiaries, broadly tipt and margined on the outer side with brilliant yellow ; rectrices, except the 4 central ones, plumbeous above, with a sub-terminal dusky bar ; below, paler especially at the tips ; lining of the wings, and the quills on the lower surface, plumbeous ; base of the bill and the legs deep sanguine ; bill before the nares and the nails bluish yellow horn colour ; outer circle of the iris orange red, inner circle blue ; orbital skin bright green.

The female is nearly of the same size, but she wants the rich maroon mantle of the male, being green on the upper back ; and her inferior tail coverts are all green, picked out with white, like the thigh coverts : size, 10 to 11 inches by 16 to 17, and weight 6 to 7 oz.

The full dimensions of a fine male are as follows:—

|                             | Feet. | Inches.             |
|-----------------------------|-------|---------------------|
| Tip bill to tip tail, ..... | 0     | 10 $\frac{1}{2}$    |
| Bill, .....                 | 0     | 0 $\frac{1}{2}$     |
| Tail, .....                 | 0     | 2 $\frac{1}{2}$     |
| Expansion of wings, .....   | 1     | 5                   |
| Tarsus, .....               | 0     | 1                   |
| Centre toe, .....           | 0     | 0 $\frac{1}{2}$     |
| Outer, .....                | 0     | 0 $\frac{1}{2}$     |
| Inner, .....                | 0     | 0 $\frac{1}{2}$     |
| Hind, .....                 | 0     | 0 $\frac{1}{2}$     |
| Weight, .....               |       | 6 $\frac{1}{2}$ oz. |

[For sketch of the bill and foot see accompanying plate.]

## IV.—NEW GENUS AND 3 NEW SPECIES OF THE SILVIADÆ.

**Sylviadæ.** Genus new, YUHINA, nobis; *Yuhin* of the Nipalese.

Bill equal to the head, slender, acute, depressed as far as the nares, gradually compressed beyond; maxilla cut out to centre by nasal fossæ, convex beyond, subarcuated throughout, and gently inclined at tip, with 2 or 3 sharp teeth on either side; mandibula straight, equal to maxilla, pointed; toniæ of both, trenchant, erect, scarped and locked throughout; nares large, the aperture lunated and lineated by a nude, incumbent, soft, membrane.

Tongue subequal to bill, cartilaginous, deeply forked, and the prongs filamentous and convolved; wings sub-medial, round-acuminate, firm; 1st quill small, 5th usually longest; tail short, firm, square; tarsi stout, finely scaled, longer than any toe; toes simple; exterior connected to the joint; laterals and hind subequal; last very stout and depressed: nails falcate, acute; anteriors subequal; hind much the largest; head crested; rictus slightly bristled.\*

Habitat, central and northern regions. Food, viscid stony berries and small scaly insects, such as harbour among foliage. It is the opinion of Mr. VIGORS that these singular little birds serve to connect the *Silviadæ* with the *Certhiadæ*. In the structure of the bill and tongue, and even of the feet and wings, they remind me of the genus *Sibia* (nobis) and of others of the Philedonian Thrushes of CUVIER—a group the contents of which have been referred at random to the Tenuirostral *Meliphagidæ*, and (in part at least) to the long-legged division of the Thrushes. These are high matters of classification, which may perchance be settled with an approach to accuracy some 50 years hence, provided our investigations meanwhile be carried into the general structure and prevalent habits of species,—and be not confined, as now, to closet dissertations on dried skins.

---

\* If family and sub-family characters had the requisite precision, and our genus could be now safely referred to a given family and sub-family, half of the tedious particulars of the generic character might have been omitted, as they will be hereafter.

The genus I now propose, as well as its location, are both provisional—my knowledge of the structure and habits of the species being confessedly incomplete ; and the directions of the books within my reach being better calculated to misguide than to guide.

These little birds, so far as I have yet ascertained, adhere exclusively to the great forests : prefer the lower and more umbrageous to the higher and barer trees ; and seem to procure no portion of their food from the ground though their feet are sufficiently adapted for walking. They are usually found in small flocks ; and have a monotonous feeble monosyllabic note.

Their intestines are about the length of their body (from the tip of the bill to the tip of the tail) furnished with grain-like cæca, near the lower end, and of nearly uniform diameter. Their stomach has the muscular coat of very moderate, subequal, thickness, and the lining is neither very tough nor much grooved.

Three species are known to me, in all of which the sexes resemble each other. I now proceed to a summary description of them, premising that the two first are typical—the last, much less so.

*Species 1st.* YUHINA GULARIS ; Spotted Throated Yuhin, nobis.

Above, with the tertiaries and tail feathers, obscure olive brown ; cap, darker and purer brown ; ears, chin, throat and breast obscure rufous wood brown ; the chin and throat spotted blackish, and bounded laterally by a longitudinal stripe of the same hue ; rest of body below, bright orange-rusty ; primaries and secondaries black, the former with a narrow edging of hoary, and the latter, with a broad one of orange ; lining of the wings and inner margin of the quills towards their bases, albescent ; tail dusky internally ; legs deep orange ; bill fleshy brown with dusky culmen ; iris brown ; head with a full soft mobile and subrecurved crest : size  $6\frac{1}{2}$  by  $8\frac{3}{4}$  inches and  $\frac{3}{4}$  oz : bill,  $\frac{11}{16}$  inch ; tarsus  $\frac{11}{16}$  ; central toe  $\frac{9}{16}$  ; hind toe  $\frac{5}{16}$ .

*Species 2d.* YUHINA OCCIPITALES ; Rusty-naped Yuhin, nobis.

Above with the whole tertiaries and outer webs of the larger remiges and of all the rectrices, dull obscure olive brown ; top of the head and back of neck dull slaty with hoary stripes ; the nape bright rusty ; ears, chin,

abdominal neck and the breast vinous buff, a blackish stripe like a moustache behind the gape; belly, rump and under tail coverts deep rusty; remiges and rectrices internally dusky; inner basal margins of the quills pale buff; lining of wings white; legs orange; bill fleshy red; iris brown; head with a full soft crest, as in the preceding: size  $5\frac{1}{2}$  by  $7\frac{1}{2}$  inches and  $\frac{1}{2}$  oz. in weight; bill  $\frac{1}{8}$  inch; tarsus  $\frac{1}{8}$ ; central toe  $\frac{1}{8}$ ; hind  $\frac{5}{8}$ .

*Species 3d.* YUHINA? FLAVICOLLIS; Yellow-necked Yuhin, nobis.

Above obscure brown, with a slaty tinge; cap pure rich brown; cheeks and nape paler; back of the neck rusty yellow, continued in a collar round the sides and front of the neck, and thence spread over the lower surface of the body and diluted often to white; chin and throat white; moustache dark brown; remiges and rectrices internally dusky; the primaries edged externally with white on the outer webs, and all paler internally on the inner, as in both the preceding species; lining of wings white; sides of body shaded with brownish; legs yellowish fleshy grey; bill fleshy brown; iris brown; head crested as in both the preceding species; bill shorter, less acuminate, and furnished with only one salient process on each side the tip of the upper mandible of the bill: size  $5\frac{1}{4}$  by  $7\frac{1}{4}$  inches, and less than  $\frac{1}{2}$  an oz. in weight.

The following is a detail of the dimensions of a fine male specimen of *Yuhina Gularis*, and which may serve to indicate the proportions of all the three species:

|                             | Inches.       | Frac.          |
|-----------------------------|---------------|----------------|
| Tip bill to tip tail, ..... | 6             | $\frac{1}{2}$  |
| Bill length of, .....       | 0             | $\frac{1}{16}$ |
| — basal height of, .....    | 0             | $\frac{3}{16}$ |
| — ditto breadth of, .....   | 0             | $\frac{1}{8}$  |
| Tail, .....                 | 2             | $\frac{1}{2}$  |
| Expanse of wings, .....     | 8             | $\frac{3}{4}$  |
| Tarsus, .....               | 0             | $\frac{1}{8}$  |
| Central toe, .....          | 0             | $\frac{3}{8}$  |
| and nail, .....             | 0             | $\frac{3}{8}$  |
| Hind toe, .....             | 0             | $\frac{5}{8}$  |
| and nail, .....             | 0             | $\frac{1}{8}$  |
| Weight, .....               | $\frac{3}{4}$ | oz.            |

[For sketch of the bill and foot see plate.]

## V.—NEW SPECIES OF THE STRIGINE FAMILY.

*Genus* ULULA? *Species* new, NEWARENSIS, Newār\* Owl, nobis.

*Form.* Bill shorter than the head, but of considerable length and somewhat straightened towards the base, moderately compressed, strong, at base as high as broad; tomice, plane and scarcely locked; tip of the lower mandible notched and truncated.

Nares large, ovoid, sub-transverse, opened chiefly towards the front and placed high on anteal edge of the cere which is somewhat tumid and soft behind them, though far less so than in *Noctua*. Cere rather large and, as well as the nares, concealed by bristles. Disc medial, complete, decidedly less than in *Otus*. Corch medial, elliptic valved, with the auditory canal opened basally. Tarsi and toes medial, longer than in *Bubo*, moderately stout, thickly plumed with one or two scales next each talon. Talons acute, moderately unequal, somewhat squared and channelled below, inner fore and central equal; hind least. Tail longish, squared, firm, sub-bowed. Wings medial,  $2\frac{1}{2}$  to 3 inches less the tail; 5 and 6 quills longest and equal; 4 first considerably and sub-equally gradated; 1st  $3\frac{3}{4}$  inches less the longest; all the great quills considerably emarginated remotely from their tips and on both webs, save the 1st which has the outer web entire. Outer webs of all these quills more or less pectinated; of the 1st entirely so. Scapulars five inches, and tertiaries two inches, shorter than the longest primary. Egrets none.

*Colour and Size.* Head, dorsal neck, outer soft zone of the disc, back, scapulars, and wing coverts, saturate rich brown and immaculate; remiges and rectrices the same, but crossed by many (10 to 12) narrow bars of a whitish-brown hue, and the tips of both slightly but clearly blanched. Entire body below, as well as the legs and feet, the lining of the wings, the disc

---

\* Name of the indigenous people of Nepal proper.

and the inner and concealed scapulary feathers, pale sordid rusty, with very many (12 to 14 per plume) transverse narrow bands of a bright brown, darkened on the lower edge; brows rufous-hoary; margin round the eye and space between eyes and nostrils black, a white transverse zone on the throat below the disc; breast darker than the body; quills internally towards their bases, bright buff and many of the upper wing coverts, barred internally; iris dark brown; bill bluish towards base; greenish horn yellow towards tip; talons horn grey with blackish tips: 20 to 21 inches by 48 to 50 between the wings. Weight  $2\frac{1}{2}$  to  $2\frac{3}{4}$  lbs. Sexes alike both as to size and colours.

*Remark.* These birds are entirely nocturnal: they tenant the interior of woods and never approach houses. They are commonest in the central region—rare in the northern—unknown to the southern.

In the present state of Strigine classification it is impossible to say to what genus or subgenus our birds should be referred. They may be *Nyctea*, or *Ulu*, or a *tertium quid*: and at all events, the bill is neither short nor arched from the base, as (for example) in *Otus*, in *Scops*, and in *Noctua*. I have set them down in my note book as the type of a new genus or subgenus under the Newar generic title of *Bulaca*, with the more significant of the characters above given in detail.

*Genus* BUBO? *Species* new. CAVEARIUS nobis.—Hole-haunting Owl nobis.

*Form.* Bill and nostrils as in the last. Disc smaller and incomplete over the eye, but still of considerable size. Opening of the ears ovoid, not valved, smaller rather than in the last, but still large: the auditory canal opened subcentrally on the postear side and crossed by a membranous band couch,  $1\frac{2}{3}$  inch long. Feet as in the last, but the tarsi rather higher and slenderer, and the talons not channeled below, but merely squared. Wings longer and less gradated;  $1\frac{1}{2}$  to 2 inches less the tail; tertiaries and scapulars both long, subequal, and falling within 2 inches of the ends of the great primaries; the latter not bowed though soft and broad webbed; 3d and 4th quills subequal and longest; 1st, scarcely  $1\frac{1}{2}$  inch less than the 3d,

which is usually the longest of all ; 3 first strongly emarginate on the inner web near the tips—on the outer webs entire or nearly so. Pecten of the outer web complete on the 1st quill—extending over only half of the second. Egrets large, consisting of 6 to 10 gradated plumes rising from the postal and superior angle of the orbits. Tail longish, not bowed, firm, very slightly rounded.

*Colour and size.* Brilliant rufous yellow, merging, as the ground colour, into deep brown upon the cap, shoulders, tertiaries and scapulars where the darker hue preponderates, mottled barwise and otherwise variegated by the paler colour. Neck, upper back and breast, broadly striped down the shafts with saturate brown ; downy plumage of the belly, vent, and thighs, immaculate ; long plumes falling over the belly, tibial tufts, and lining of the wings, minutely zigzagged crosswise with brown, there being 8 to 10 lines on each plume which frequently, owing to its dark shaft, exhibits the herring-bone marking : tarsi lunated with brown : toes immaculate : remiges and rectrices with 6 or 7 mottled bars—dark upon a pale ground in the prime quills and lateral tail feathers—pale upon a dark ground in the central caudal, and lesser wing, feathers ; disc concentrically rayed with brown lines, and zoned postally by black brown, counterminously with the limits of the external ear. Egrets brown like the cap, and picked out with that brilliant ruddy yellow which, amid all the transitions of the plumage, clearly constitutes the *ground colour* of it : iris golden : bill dusky : talons dusky horn : size 22 inches by 55 to 58 inches : weight  $3\frac{1}{2}$  lbs. : female somewhat larger : male somewhat darker : but both distinctions trivial.

*Remarks.* These birds, when disturbed, fly freely and strongly in the broad glare of day, as (by the way) *Otus Europæus* et *Brachyotus* do ; and though neither the former nor the latter be properly diurnal questers, yet they are alike distinguished by commencing operations long before dark, and by carrying them on in the open country. Our species have their habitation sometimes in a hole or burrow in a bank side, (in which they always breed) and sometimes their domicile consists merely of a perch upon

the stunted trees growing from rocky declivities. Our birds breed in March, and seem to be confined to the central and northern regions; for I have never procured one from the southern tract. The young, as soon as fledged, resemble their parents; and the brood consists invariably of two of them.

*Both* the preceding species have eminently medial characters, being alike remote from *Strix* and *Otus*, on the one hand, and from *Scops* and *Noctua* on the other.

The bill has neither the length nor straightness of *Strix*, nor the shortness and arcuation of *Otus*.\* In strength, it is greatly superior to the bill of the former genus—by no means inferior to that of the latter. It resembles generally the same organ in our *Cultrunguis*, but is shorter somewhat, and the base is more beset with bristles than in *Cultrunguis*.

Another noble bird, *Huhua Nipalensis*, presently to be noticed, carries the elongation and straightness of the bill, accompanied by great depth, breadth and power, to a yet further degree. So that we have here a complete new series of Strigine Birds, typifying in their own circle, the Aquiline sub-family of the *Falconidæ*;—or, CUVIER's assertion (followed without question by all other writers) that the genus *Strix* alone exhibits either elongation or straightness in the bill, is wholly unfounded.

The tarsi, toes and talons of both the preceding species are framed upon the Otine model; whereas in our *Huhua Nipalensis*, there is a diminution of length with proportionate accession of power in the tarsi, analogous to the characteristic form in *Bubo*.†

\* *Noctua* and *Scops* have a bill similar to that of *Otus*; but their small round nares with a very swollen tect, sometimes even salient and tubular (in *Noctua* at least) are contradictory: so also their unplumed toes. The toes of *Noctua* agree with those of *Strix*, saving only the pecten of the central talon in the latter genus. The wings of both *Noctua* and *Scops* are usually short; but those of the former are of a firmer texture; as is, indeed, their whole plumage.

† In defining *Cultrunguis* I omitted to state the length and nervousness of the toes, which, with the extreme roughness of the soles, are characters almost as significant as the cultrated talons, and obviously subservient to the same end of clutching successfully the slippery bodies of fish.



In the form and size of the ear conch our two species just described exhibit two distinct links in the chain of passage from *Strix* and *Otus* to *Scops* and *Noctua*; so also in the medial length of their wings; though this latter character would seem to be, in the Strigine family, less important and influential than amongst the *Falconidæ*. Why else have *Strix* and *Otus* the true Falcon's wing in common, whilst the beaks of the two are diametrically opposite in character? In *Strix*, however, the wings considerably exceed the tail—in *Otus* are only equal, or scarcely superior to it in length. Is, then, *Strix* the representative of *Milvus*? and *Otus* of *Falco*? Or must not the long and feeble legs and toes of the former, added to its straight powerless beak and long wings, induce us rather to seek its analogue in the Buteonine genus *Circus*? Our *Huhua* and *Cultrunguis* are evidently representatives amongst the Strigidæ of the *Aquiline* branch of the diurnal Raptores; the latter being distinctly, the analogue of the fishing genera of this branch. To the same branch must be referred, analogically, the two species now described; and which, by the combined straightness and power of their beak would also appear to be types of new genera in their own family—*unless* there be something very unsound indeed, in the entire existing classification of the *Strigidæ*, which admits no straight-billed Owls but *Strix*—a genus as remarkable for the *feebleness*, as for the straightness, of its bill.

*Genus* BUBO. Species new. NIPALENSIS mihi.

This remarkable bird, the largest of the family yet discovered, is 28 to 30 inches long and 65 to 68 inches between the wings,\* with muscular power in the legs far exceeding that of the Eagles, and with talons capable of giving that power the utmost effect in the destruction of life.

It has most of the influential characters of the Genus *Bubo*, but differs strikingly therefrom by the comparative length and straightness of the bill, and also, perhaps by the partial nudity of the toes, and by wings more nearly equal to the tail as well as differently gradated. Should these differences seem to warrant the establishment of a new Genus or Subgenus,

---

\* The bill is  $2\frac{1}{2}$  inches; the tarsus, 3; the central toe,  $2\frac{1}{2}$ ; inner talon (along the curve)  $2\frac{1}{2}$ .

I beg to propose for it the name *Huhua*, latinised from *Huhu*, which is the common appellative of all Strigine birds in Nepal. At present I mean to consider it as a species of *Bubo* and to name it specifically *Nipalensis*, it being found in all parts of the Kingdom.

It tenants the interior of umbrageous woods, and by reason of the feeble light penetrating them even at noon-day, it is enabled to quest subdiurnally in such situations. It preys on pheasants, hares, rats, snakes, and sometimes on the fawns of the *Ratwa* and *Ghoral*. The sexes nearly resemble each other ; but the young every where, and the old too in the Northern region, are more blanched than in maturity. The bill is equal to the head, straightened beyond the cere, abruptly and largely hooked, very strong, and furnished with an accipitrine festoon ; its lower mandible deeply notched and vertically truncated at the tip ; the tomixæ, obtuse and free towards the gape—trenchant, deeply locked, and internally scarped, towards the point.

The nares are placed high up and near to the anteal edge of the cere ; their aperture a broad ellipse, simple, transverse, with an aspect obliquely to the front.

Wings  $1\frac{1}{2}$  to 2 inches less than the tail ; 5th quill longest ; 4th nearly equal to it ; the three first considerably and equally gradated ; 1st,  $3\frac{1}{2}$  to 4 inches less the longest ; the four first strongly emarginated on the inner web, and 2nd to 5th inclusive, on the outer web also, remotely from the tips ; primaries two inches and more longer than the tertiaries : the last, as well as the scapulars, long and firm. Pecten complete on the 1st quill—clearly traceable on 2nd, 3rd and 4th, below the emargination. Tail medial bowed, square ; the extreme laterals subgradate. Legs immensely stout, short, and plumed nearly to the talons : exterior fore toe antagonising with the others, but not reversile ; outer four and central, subequal in length, but the former much the stouter : terminal third of all the toes, denuded of plumes and furnished with three or four heavy scales to each toe : remainder of the toes, hirsutely plumose. Talons, acute and large : inner fore

much the largest ; next the central ; then the outer fore and the hind, which are subequal ; all flat beneath, and the process of the inner edge of central, entire. Tongue fleshy and entire. Intestines 30 to 44 inches long ; very thick coated ; considerably wider above and gradually diminishing in diameter downwards : at 6 to 9 inches from anal end two cæcæ of from 4 to 4½ inches in length, each of them. Stomach spheroidal ; of considerable subequal thickness in the coats, which are two—an exterior thin one of muscular fibre, and a thicker one constituting the body of the stomach, of granular structure and gland like : the lining membrane, softish, sub-plicated, and easily separable. Head not small : facial disc, very small and incomplete : opening of the ears, very small, simple, elliptic ; 4 to 5 eighths of an inch long. Egrets 3 to 3½ inches long, composed of 15 to 20 plumes, rising from the postea and upper angle of the orbits, erigible, usually drooped.

The following description exhibits the external aspect of this bird. Above, saturate brown transversely barred and emarginated with rich rufous yellow ; the bars and points of the greater feathers mottled with brown ; a clear longitudinal line of rufous yellow down the lower or anteal edge of the scapulars ; the disc hoary, more or less smeared with brown ; great wing and tail plumes apertly quadrannulated. Below white, buff smeared on the breast, sometimes all over, and each plume cordated or barred heartwise with saturate brown ; thighs lunated with the same. Bill and nude part of the toes full yellow ; edge of the eyelid yellow, dappled with brown ; talons horn yellow with dusky points, iris brown. I have in my note book provisionally characterised this bird, as the type of a new genus : thus—

Bill equal to the head, straightened beyond the cere, suddenly hooked, very strong, festooned ; wings medial, sub-equal to the tail ; 5th longest ; 3 first considerably gradated ; 1st pectinated. Legs, as in *Bubo* ; but the toes more hirsute and denuded, and the outer fore antagonising, not reversile.

Talons very unequal, large, and acute. Egrets as in *Bubo*. Disc and ears smaller. Tail medial, square.

To the above account of a bird which I fancy is the largest known species of the family. I shall add a brief description of another, that I suspect is the least.

*Genus* NOCTUA. *Species new*. NOCTUA TUBIGER. Tube-nostrilled  
Noctua, mihi.

Coloured exactly like *N. Cuculoides*, but with a buff patch, inclosing a black triangle, on either side the neck : nostrils furnished with prominent tubes and opened laterally at the ends of them. Length  $5\frac{1}{2}$  inches ; breadth 11 to  $11\frac{1}{2}$  ; weight  $1\frac{3}{4}$  oz. Such is the distinct specific character of this singular little bird, which would scarcely form a mouthful for its noble congener, just described.

*Genus* NOCTUA. *Species new* ; TARAYENSIS, nobis. *Turai Noctua*, nobis.

Form and size as in the *Noctua Cuculoides*, of which species our bird is the palpable representative in its own region—the former being peculiar to the hills—the latter to the forest at their base. I notice this fact, because I have proof of the very same identity of form and size, with great diminution of intensity in the colour, in two species of *Accipiter*,\* which in like manner are exclusively confined to the lowlands and highlands respectively ; the dark bird being, in this instance also the mountaineer.

*Colour*. Above earthy grey brown, each plume exhibiting two white spots disposed opposite each other and barwise. Below white broadly barred or cordated barwise, with pale ruddy brown. Tarsi immaculate, tail with 3 or 4, and wings with 5 or 6, white bars ; disc white for the most part, confined by dark brown on the outer and soft zone ; but the ear coverts distinctly barred transversely or vertically ; iris straw yellow ; feet obscure yellow ; bill greenish horn.

*Genus* SCOPS of Savigny.† *Species new* ; SUNIA or golden Scops, nobis. *Sunya Cusyal* of Nepal.

\* *Accipiter Scutarius* and *Accipiter Affinis*, nobis.

† Apud SHAW XIII. 51, for CUVIER gives no egretta to this group, and does not specify the naked toes.

**Form.** Bill short and wholly arched; nares small, round, with a swollen softish tect, and hid, as well as nearly the whole bill by bristles; disc small and imperfect; but larger than in *Noctua*; conch of ears  $\frac{3}{4}$  of an inch long, very small, oval, simple, protected by a double cross row of setaceous plumes; egrets distinct and rather large; tarsi medial, plumed; toes longish, the inner and central fores sub-equal, all quite nude, reticulate with 3 or 4 scales next each talon; talons sub-equal, acute, the inner fore subpectinated or subcultrated below; grasp of the foot oblique; tail medial, soft, square, not bowed; wings longish, reaching within  $\frac{1}{2}$  to  $\frac{3}{4}$  inch of the end of the tail; 4th quill usually longest; 3 first moderately and sub-equally gradated up to it; scapulars and tertials long; most of the prime quills emarginated remotely from the tips, and their edges frayed or discomposed, but the first only distinctly pectinated; plumage characteristically soft, (a strong distinction as compared with *Noctua*); eye and head larger than in *Noctua*; lives in the interior of woods.

Habits nocturnal. **Colour and Size.** Above, with the whole head and neck, golden red, narrowly striped with black down the shafts of the plumes. Below; white, touched irregularly with the colour of the upper parts, and finely herring-boned with black; disc between the eye and bill often white, and its soft outer zone nearly black; outer edge of the scapulars, white with black lunules; quills and tail quadricinctate; the bands mottled and blackish; bill dusky; legs obscure fleshy grey, iris straw colour;  $7\frac{1}{2}$  to 8 inches long by 18 to 19 wide. Weight  $2\frac{1}{2}$  to 3 oz.; sexes alike; young, duller hued and vaguely marked.

**Species 2d.** LETTIA, nobis. The *Lattya Cusyal* of Nèpál.

**Form and Size.** As in the last and habits the same. **Colour.** Above a tawny medial brown, striped lengthwise, blotched and vermiculated ad infinitum with black; below rufous yellow, or refuscent white, herring-boned with blackish; tarsi transversely lunated or barred with the same; quills and tail with 6 to 8 mottled bands of buff upon a brown ground, or of brown upon a buff one; disc hoary or buff, vaguely lineated in circles with brown; egrets rather smaller than in the last, black variegated with buff;

legs fleshy grey ; bill blueish horn, iris variable, yellow in the young, brown in the old birds ; sexes alike. Habitat central and northern hills.

P. S. All the above species have the inner edge of the central talon produced like a comb, but without teeth. The mark is obviously too general to be significant except in *Strix* where it is toothed.

27th August.

---

## VII.—TWO NEW SPECIES OF THE PARROT TRIBE.

PALEORNINA, Vigors *Genus*. PALÆORNIS? *Species* new ; NIPALENSIS, nobis.

*Form.* Bill large, very conspicuously arched along the ridge, at base much higher than long, moderately compressed with subconvex sides and broad round back. Tomial line of maxilla, untoothed and unfeathered : hook crenulated within. Mandibula rather short ; its tomial line unnotched and straight ; its tips strongly bent up and squared.

Cere, very small, entire, and, with the round nares, almost or quite hid. Wings long ; 2nd longest ; 3rd plus the first ; all three narrowed and sharpened towards their points. Tail very long, typical ; the two central plumes  $4\frac{1}{2}$  to 5 inches plus the rest. Feet as in *Palæornis*. Orbits plumose.

*Colour and Size.* Very brilliant green, somewhat shaded with verditer blue on the nape, belly and lining of the wings. Tail paler than the body and shaded externally with yellow ; below, and the tips and inner vanes, yellow ; throat and a broad half collar, black ; the collar completed dorsally with rosy red ; a large longitudinal bar of sanguine lake color down the shoulders, just outside of the scapulars : bill intense coral red ; iris pale straw ; legs greenish grey ; talons dusky, size large, 22 inches long by 26 wide, and 9 to 10 oz. in weight.

Female rather less, and without any red mark on the wing. Young, at first, wholly green with a yellowish bill. Inhabits the Saul Forest exclusively, and is not known to the Parrot-tamers.

*Remarks.* This species differs from *Palaornis* by a heavier and more entire bill, as well as by the narrowing and pointedness of the three prime quills, in the manner of *Vinago Militaris*

*2nd Species.* SCHISTICERS slaty headed, nobis.

*Form.* Entirely typical, (*Palaornis*) except that I do not perceive any widening of the outer vanes of the 2d, 3d, and 4th quills towards their middle. The 1st is longer than the 3d; the former being but  $\frac{1}{8}$ , and the latter above  $\frac{3}{8}$  of an inch less the 2d; and all three have obtuse points. The central rectrices are  $3\frac{1}{2}$  to 4 inches longer than the next pair. The tomixæ are very scarpt, trenchant, and, as well as the hook, crenulated internally.

*Colour and Size.* Brilliant green, paler and flavescent below; entire cap saturate slaty blue, confined below by a narrow band of black, which widens as it approaches the black throat; two central rectrices green at the base, blue in the middle, and yellow at the points; the rest, green on the outer vane, bright yellow on the inner, and at the tips; wholly yellow on the inferior surface; a narrow subtransverse dark blood bar on the shoulders. Bill, above, coral red; its cutting edge, hook and the whole of the lower mandible, yellow. Iris, straw; orbital skin, slaty; legs, dusky green. Size, 15 to 16 inches long by 18 to 19 wide; and  $4\frac{1}{2}$  oz. in weight.

Female rather less; her tail less gradated; no blood spot on her shoulders. Young, at first, wholly green, and taking the colours of maturity slowly and gradually.

*Remark.* This species inhabits the central, as well as lower, region; and is constantly tamed.

The other Psitticine Birds of Nepal are, *Rodocephalus*, *Mystaceus* and *Alexandri*; all belonging to the Genus *Palaornis* and confined, for the most part, to the lower region, where (by the way) the tiny *Latkan* is also found. *Mystaceus* is distinguished for the flatness of the ridge of its bill, and for the shortness of its tail. Two or three species have been manufactured out of this one.

August 29th, 1836.

## VIII.—NEW SPECIES OF POMATORHINUS, AND ITS ALLIES,

## WITH REMARKS ON THE GENUS.

Whoever will attempt to classify half a dozen of the familiar Sub-Himalayan species, known to the people themselves by the generic titles *Gánrá* and *Bhiácurá*, will be, I think, forcibly struck with the profound truth of the adage that, "Practise often creeps where Philosophy cannot soar."

The people generalize and unite upon the strong ground of similar habits and manners, joined to a certain family likeness in external aspect; the Philosophers specialize and divide upon the feebler basis of distinctive formation in the details of *some one or two external organs*. I admit the validity of the distinctions so far as they go, but I think they are, in these cases, more than counterbalanced by prevalent uniformity of *general structure, and by similarity of manners*; in other words, that the *Gánrás* and *Bhiácurás* constitute two, and but two distinct though closely allied\* genera, each exhibiting several subordinate but well defined modifications of form, or sub-genera. I have already remarked upon the general resemblance and particular differences of the *Gánrás* or *Cinclosomæ*. Upon those of the *Bhiácurás* or *Pomatorhini*, I shall now make a few observations.

The essential characters of *Pomatorhinus* appear to me to be as follows:

A bill considerably elongated and arched throughout, perfectly entire, slender, strong, obtuse, cylindrico-compressed, with broad convex ridges and plane vertical sides; its tomæ somewhat scarpt and locked towards the centre of the bill, simply opposed towards the *solid* tips of both mandibles,

Short basal nares free from plumes, and closed above by a hard, arched, and porrect scale. Stout, ambulatory, sub-corvine legs and feet; and feeble

---

\* Of this alliance it is a striking proof that one of my species (of *Timalia*) was marked by an eminent authority in England, as being "new and closely related to *Cinclosoma*."—See Remarks in the Sequel.



bowed wings and tail—the former short and rounded—the latter more or less elongated and gradated on the sides.

*Timalia* and *Prinia* seem to be obviously sub-genera of *Pomatorhinus*, both distinguished from the generic type by a shorter and less arched bill, and by the rigid spinous character of the shafts of the plumage, more especially on the head and neck. In both sub-genera the legs and tail are rather longer, and the tarsi more heavily scaled than in the generic type. The last member or tail consists, in *Timalia*, of twelve rectrices, as in *Cinclosoma*. But in *Timalia* they are broader and more gradated to the sides; in *Prinia* narrower, 10 only in number, and strongly gradated *throughout*, with yet greater accession of length.

The most typical species of *Pomatorhinus* I consider to be *Erythrogenys Gouldii* (1831), *Ferrugilatus*, nobis. (MS. 1826.)

The following is a detail of its form and colours :

CRATEROPODINÆ. SW. POMATORHINUS. Horsf.

*Species* 1st. ERYTHROGENYS GOULDII.—FERRUGILATUS, or Rusty-sided, nobis.

*Form.* Bill a third longer than the head, perfectly entire, conspicuously arched throughout, strong, hard, slender, much compressed with broad convex ridges and plane vertical sides; upper mandible nearly solid, especially towards the point, lower somewhat scooped; tomixæ before the nares trenchant erect, scarpt and sub-locked, free and level with the palate towards the tips, which last are obtuse and rather unequal in length; carination of the culmen restricted but distinct. Plumes of the forehead and head soft; those of the lares and chin subsetaceous. Tongue somewhat elongated, simple, narrow, cartilaginous; its tip bifid or jagged. Wings not exceeding the base of the tail, perfectly rounded, bowed; 5 first quills regularly gradated in a diminishing ratio; 6th usually longest, the rest insensibly decreasing; the vanes of all, broad and entire. Tail sub-elongated, not equal to the body and neck, consisting of twelve sub-bowed, moderately broad plumes, of which the 6 centrals are even, and the 6 laterals gradated, but

scarcely an inch in the extreme ones. Tarsi sub-elevate, stout, anteally vaguely scaled, posteally, smooth and sharp. Toes medial, unequal, central fore medially elongated; laterals and hind sub-equal; last shortest but stoutest and sub-depressed basally, sometimes equal to the inner fore. Nails rather large, compressed, somewhat straightened and obtuse; lateral fores equal; central larger; hind largest; orbits nude as in *Cinclosoma*.

*Colour and Size.* Above olive brown, laterally together with a narrow band round the brows, the lining of the wings, the thighs, and entire undertail coverts, bright rusty. Below, white, dashed on the top of the breast with dusky: a hoary spot before the eye: a short dusky moustache from below the gape: remiges and rectrices internally dusky brown: tail transversely rayed with deeper toned lines—seemingly a generic mark: legs fleshy grey: bill horn colour with the ridge darkened basally: iris hoary: orbital skin smooth and deep blue: size  $10\frac{1}{2}$  inches by  $11\frac{1}{2}$ , and  $2\frac{1}{2}$  oz.: bill (in straight line)  $1\frac{1}{2}$ : tarsus  $1\frac{1}{2}$ : central toe  $\frac{1}{4}$ : hind toe  $\frac{1}{8}$ .

N. B. The sexes are alike in colour, save that the female has no moustache. She is rather less, too, than her mate.

*2d Species*, new; SCHISTICEPS or slaty pate, nobis.

Form, as in the preceding, but the bill rather shorter and somewhat more compressed; and the wings and tail slightly but sensibly more elongated.

*Colour and Size.* Above, together with the lower flanks, vent, thighs and undertail coverts, dark olive green: crown, nape and ear coverts, saturate slaty: lores black: from the ear coverts to the midflanks, the sides of the neck and the body are intense ochreous red: a long superciliary white stripe from the nares to the shoulders: below, from chin to belly, pure white: remiges and rectrices, internally dusky: tail, rayed as before: bill bright orange yellow with a blackish base above: iris hoary: orbital skin smooth and slaty: legs fleshy brown with yellowish horn nails: size of the last, but measuring rather more in extent owing to the cause above mentioned: 11 inches long by  $12\frac{1}{4}$  wide, and  $2\frac{1}{2}$  oz.: bill  $1\frac{3}{4}$ : tarsus  $1\frac{1}{2}$ : sexes alike.

*3d Species*, new ; *RUFICOLLIS*, rusty naped, nobis.

Form less typical, the bill being shorter and straighter than in either of the foregone, obviously leading towards *Timalia*. Colour and size, olive green, paler and shaded with white on the breast and belly, and merging in pure white on the chin and throat : a broad rusty band round the back of the neck : lores and ear coverts confluent blackish : a superciliary white line from the brows to the nape : no transverse rays on the unbowed tail : bill, sub-orange with a blackish base : legs plumbeous : iris variable, sanguine, brown, or hoary : size small :  $8\frac{1}{4}$  by  $9\frac{1}{2}$  inches, and 1 oz. : bill 1 : tarsus  $1\frac{1}{4}$  : central toe  $\frac{3}{4}$  : hind toe  $\frac{1}{2}$  : sexes alike, but female rather less.

*Sub-genus*, *TIMALIA*. *4th Species*, new ; *NIPALENSIS*, nobis. *Nipalese Timalia*, nobis.

*Form*. Bill assimilating closely with the last named species, but stronger and straighter ; equal merely to the head in length, subarcuated only, but distinctly so, and perfectly entire. Culmen rather more carinated between the nares, the tect of which is less hard and less arched than in the typical *Pomatorhini*. Rictus more strongly bristled. Shafts of the head and neck-plumes, spinous, as in *Cinclosoma setafer* (nobis). Legs stronger with more distinct scales ; another approximation to *Cinclosoma*. Tail equal to the whole body and bill, consisting of 12 broad, and straight, but frayed, feathers, the extreme laterals of which are gradated by half the entire length of the tail, or doubly as much as in the foregone species.

*Colour and Size*. Above, with the flanks, thighs and under tail coverts, brown ; paler and more olive beneath than superiorly. Below, from chin to breast, rufescent ; from breast to vent, albescent ; and both shaded with a tinge of the colour above. Entire cheeks, pure white : iris, hoary blue : bill and legs, dull dark plumbeous : the whole plumage black shafted : the outer vanes of the prime quills paled : sexes alike : size 10 inches by 10, and  $2\frac{1}{4}$  oz : bill 1 : tail 5 : tarsus  $1\frac{1}{4}$  : central toe  $\frac{1}{2}$  : hind  $\frac{1}{4}$ .

*5th Species* ; *PELLOTIS*, brown ear, nobis.

Characters, extremely similar to those of the last, but returning towards the typical *Pomatorhini* by its shorter and rayed tail.

*Colour and Size.* Above, dull olive green, inclining towards brown : thighs, vent and under tail coverts, the same but paler : cheeks, concolorous with the body : ear coverts, darker and brown : below, white, tinted with rufous towards the head, and shaded with the colour of the thighs and vent, towards them. Bill above and towards the tip, blackish : below, pure plumbeous : legs, pure plumbeous grey : iris, hoary : whole plumage black shafted, as in the last, and similarly spinous : tail closely rayed across : size of the last but not measuring so much in length, owing to the shorter tail, 9 inches by 10, and  $2\frac{1}{2}$  oz. : bill  $1\frac{1}{8}$  : tarsus  $1\frac{3}{8}$  : central toe  $\frac{1}{16}$  : hind toe  $\frac{5}{16}$  : tail 4 : sexes alike.

*6th Species.* *Subgenus*, PRINIA ? SUYA, nobis.

*Character.* Bill scarcely equal to the head, perfectly entire, strong, obtuse, inclining to an arcuate form, subdepressed as far as the nares, cylindrico-compressed beyond them. Culmen carinated half way, acutely convex ; tips of both mandibles obtuse ; that of the upper longer and inclining over the lower. Tomiæ erect, trenchant, remote from the palate, and interlocked throughout.

Nares medial, half way from gape to tip, lunato-elliptic, and shaded above by a small nude subarched scale. Rictus rather wide and strongly bristled. Plumes of the forehead rigid. Nape furnished with several long slender hairs. Tongue cartilaginous, simple, its tip bifid or jagged. Wings rounded, rather feeble, not bowed, 5th and 6th quills usually longest and exceeding the tertiaries by  $\frac{1}{2}$  an inch.

Tarsi elevated, stout, crossed by three or four scales. Toes medial, compressed, outer connected to the joint, laterals and hind subequal ; last stoutest but not depressed ; nails rather acute, hind one much the strongest. Tail very long and wedged, consisting of 10 narrow, feeble plumes which are greatly and equally gradated throughout.

*Type and species new ?* PRINIA ? CRINIGER, nobis. SUYA CRINIGER, nobis.

*Suya* of the Nipalese.

*Form*, has been detailed above. *Colour and Size.* Above, dusky brown, darker on the cap, paler on the tail. Below, rufescent yellow,

shaded on the breast and flanks with the colour of the superior surface ; lining of wings, and quills internally towards their bases, buff. Bill dusky or black ; legs fleshy grey ; iris brown : sexes alike ; female smaller, and her tail shorter : size of the male, 8 inches by 7 : tail  $4\frac{1}{2}$  : bill  $\frac{5}{8}$  : tarsus  $1\frac{1}{8}$  : central toe  $\frac{5}{8}$  : hind toe, plus  $\frac{3}{8}$ .

*General Remarks.* The whole of the above species are distinguished, in common, by hard, entire, compressed bills, feeble wings, gradated tails, and stout ambulatory legs and feet. The structure of their stomachs, intestines and tongues, too, is similar, as are their food and customary haunts. Comparing the *Pomatorhini* proper with the *Cinclosomæ*, I can perceive no essential difference of structure except in the bill ; which however, is marked ; nor any in the manners of the two, except that the former take somewhat more vegetable food and adhere to the forests ; whilst the latter scarcely ever touch berries, never grain, and adhere to the bushy downs and *skirts* of the forests. In searching for their food, the *Cinclosomæ* make a free use of their legs, like the *Rusores* ; the *Pomatorhini* proper and the *Timaliæ*, as free a use of their bills, in the fashion of *Upupa*.\* The *Cinclosomæ* are more gregarious than the *Pomatorhini* ; the *Pomatorhini* than the *Timaliæ* ; and the *Timaliæ* than the *Priniæ* vel *Sýyæ* ; which last are solitary and silent. The others are almost equally noisy ; and all of them more or less gregarious. All save the *Sýyæ* have a wide range throughout the hills, which, however, they never quit. The *Sýyæ* seem almost confined to the central region.

Of the *Sýyæ* the favourite site is those upland downs which are scattered with brushwood. Owing to the feebleness of their wings, they need the shelter of low trees and shrubs. But they are almost perpetually on

---

\* It seems to me singular that Dr. HORSFIELD did not compare his *Pomatorhinus* with *Upupa* or *Promerops* rather than with *Cinnyris*. The bill of *Pomatorhinus*, like that of *Upupa*, is a common coarse instrument, fitted for digging ; whilst that of *Cinnyris* is exquisitely delicate in all its details ; and, like the bill of *Trochilus*, is remarkable for the deep interlocking of the tomæ. The *very opposite* is the characteristic of the bill of *Pomatorhinus*.

the ground, seeking their food there exclusively. Small scaled insects are their favourite food, with larvæ and their eggs; next, grubs and caterpillars.\* Berries they seldom touch; never grain, nor hard seeds, nor consequently, gravel. The *Pomatorhini* and *Timaliæ* have, essentially, the same habits; both being distinguished from their *Cinclosomæ* by their non-graminivorous diet, and avoidance of the deep forests; unless the characters of *Prinia*, as of *Cinclosoma*, *Pomatorhinus* and *Timalia*, want emendation, our *Sýæ* can scarcely belong to the sub-genus *Prinia*. But I entertain a confident expectation that the alleged *notch* in the bill of *Prinia*, as well as the stated *feebleness* of its tarsi, will be found to be the exception and not the rule. The *Sýæ* are calculated to remind the student, in various ways, of *Malurus*, *Megalurus* and *Synallaxis*, as well as of *Prinia*. Their strong entire bills, elevated powerful legs, and terrestrial habits, are, however, their preponderant characteristics, and those which induce me, with the subordinate peculiarities above detailed, to consider them as a subgenus of *Pomatorhinus*, having first referred the latter to the *Crateropodinaë*.

The more general characteristics of the whole of our birds are exceedingly well given by Mr. SWAINSON (Northern Zoology. Aves. p. 156) as those of the Crateropodine or long-legged Thrushes—a very natural and useful aggregation of birds in my judgment. Dr. HORSFIELD was disposed to refer *Pomatorhinus* to the Tenuirostral *Cinnyridæ*; and it has been actually disposed among the *Meliphagidæ*! Yet it is one of the *most terrestrial* of the *whole order of Insectores*; feeding exclusively on ground insects; and bearing a very close relationship, both in the structure of its bill and in the manner of using it to procure food, to the Genus *Upupa*;† which latter, all terrestrial as it is, has been classed with the *Certhiadaë*! Compression, entireness, and solidity, in a slender rostrum are carried to the climax in *Upupa*: but the gradual accession of these attributes may

---

\* The species which frequent the grass and low vegetation: *not* the arborial kinds.

† The common *Hoopoe* is a familiar tenant of our lawn from September till May; but is never seen in Nepal proper during the hot and rainy months.

be distinctly traced through *Cinclosoma* and *Pomatorhinus*. *Timalia*, again, has been removed by systematists, *toto cælo*, from *Pomatorhinus* and from *Prinia*: and yet there can hardly be a question that *Timalia* forms a sub-generic link, uniting the two, and also connecting the genus *Pomatorhinus* with the genus *Cinclosoma*. I possess a series of *Pomatorhini*, *Timaliæ*, and *Cinclosomæ*, which blend insensibly with each other, at the same time that they collectively exhibit, in a striking manner, the general attributes of Mr. SWAINSON'S *Crateropodina*.

Nèpal. August 29th.

---

#### IX.—NEW SPECIES OF MOTACILLINÆ.

WITH INDICATION OF A NEW GENUS BELONGING TO THIS SUB-FAMILY.

SYLVIADÆ. MOTACILLINÆ. *Sub-Genus*, new; DAHILA nobis.

*Type*, DAHILA DOCILIS, nobis.

No. 439 of the new series of Specimens and Drawings in possession of the Zoological Society of London.

The birds of this genus in both structure and habits are a perfect compound of *Turdus* and *Motacilla*.\* The bill in all its details, and the feet are *Merulo-motacilline*, but with a more decided leaning to the Thrush than to the Wagtail. The tarsi are stronger and more elevated than in either genus, the thumbs broader and the nails more acute. The wings are shorter than in either genus, and exhibit the form and proportion seen in *Enicurus*: that is, the 5th quill is longest; the 1st and 2d abruptly; the 3d and 4th slightly gradated up to it; and the tertials (not† scapulars) are short, broad and fine. The tail composed of 12 feathers, is shorter than in *Motacilla*, longer than in *Turdus*; its six lateral plumes are considerably gradated from

---

\* Regarding the two genera in the large sense, or as emblematic of the respective sub-families, and not merely as genera.

† It is the tertials, not the scapulars of *Motacilla* which are elongated, notwithstanding the general doctrine of books.

below ; its six centrals even, and its form sub-cuneate. The general structure of these birds is robust and nearer to *Turdus* than to *Motacilla* ; but the pied plumage and habit of flirting the tail, are borrowed from the latter genus.

The song is the Thrush's : the murary and arboreal nesting, rather Meruline than Motacilline. And so, too, the non-migratory habits ; for the Wagtails proper leave us at their " appointed season," whilst the Thrushes, (like the *Enicuri*) are permanent. Many of the Wagtails, so long as they stay, familiarly occupy our gardens and lawns, seeking their food exclusively on the ground, and using the bushes only for shelter, but without perching. These, excepting the last peculiarity, are the manners of our *Dahila* which, like *Motacilla*, has an almost exclusively animal diet, seldom and only from necessity eating berries or unripe vetches and such comparatively soft vegetable substances. So far, then, there is a greater leaning to *Motacilla* than to *Turdus*, which latter is freely baccivorous : Nor do the Dahils wholly avoid the open banks of streamlets ; for I have seen them there in company with the Wagtails. But their usual protected and arboreal site, with their free habit of perching, are decidedly more Turdine than Motacilline. The Dahils, however, dislike and avoid the *interior* of woods, to which the Thrushes are partial ; and the former are less permanently, or (to speak nicely) more fitfully upon the ground than the latter. The usual food of the Dahils is grubs, worms, beetles, grasshoppers, crickets and their consimilars, tenants of the surface or subsurface of the Earth. Rarely, in winter, they take unripe vetches and such like ; but never gravel, nor sand, nor the hard seeds which the former help the digestion of. The Dahils, if found in the wilds, tenant meadows and grass land, provided with brush-wood ; but they are no where so common as in gardens and on lawns, which they enliven, in spring, by their song, and, at all times, by their vivacity and familiarity. They move quickly on the ground, yet perch firmly and readily, frequently watching for their prey on a low twig to which they return as soon as they have beaten it to death on the ground. They never seize on the wing.



When cattle pass their way they will partially attend on the herd descending occasionally from their perch to snap up the insects and grubs brought to light by the act of grazing. The Dahils are perpetually in motion, and raise and depress the body with flirtation of the tail, exactly in the Wagtail manner. Their habits of society, in respect to their own kind, are solitary or nearly so; except in the breeding season when these monogamous and attached birds steadily unite to rear and defend their young. The female usually lays 5 spotted eggs, bringing up from 3 to 4 young ones; and but once a year, unless the first brood has failed or been rifled from her. The nest is carelessly made of grass, but is always placed in a secure and sheltered position, commonly a hole in a wall, sometimes the interior of a low thick prickly plant. The Dahil is one of the boldest and most docile of birds; and is perpetually caged both for his song and his pugnacity. Few of the Thrushes have a finer note; nor is it degraded by apish tricks of imitation, though this intelligent bird will lend its courage for the profit or amusement of its keeper. In the spring the male Dahils are perpetually challenging each other, and no sooner is the defiance of one uttered than it is answered by another.

The professional bird keeper, availing himself of this propensity, takes out his tame male on his fist, and proceeds to the nearest garden or grove. The bird, at his bidding, presently challenges: the wild one immediately answers: the former is then slipt, and a desperate contest ensues between the two, during which the fowler readily secures the wild bird, with the tame one's assistance; for, the latter will deliberately aid his owner's purpose, seizing the wild bird, at the critical moment, with both claws and bill and retaining it till his master come up, in case it has not been so much exhausted by the previous contest as to be disabled from flying away upon the man's approach. Fighting the tame birds is a favourite amusement of the rich; nor can any race of game cocks contend with more energy and resolution than do these singular Motacillo-Meruline species.

*Indication of generic character.* Bill, feet, and habit of body, Meruline; tip of the lower mandible, vaguely recurved and notched: tarsi high,

stout, and nearly smooth ; the thumb, nearly equal to the inner fore toe and sub-depressed : the nails acute.

Wings, round-acuminate ; 5th longest : 1st and 2nd greatly, 3rd and 4th trivially, gradated : the tertials, short, firm and composed.

Tail, 12, subelongate, firm, erigible, considerably gradated on the sides.

Nape frequently furnished with a few slender hairs.

The above character has been composed with special reference to the two genera *Turdus* and *Motacilla* ; and upon the assumption that our Genus be referred to the Motacilline Sub-family of the *Sylviadæ*.

1st Species, new ; *DOCILIS*, nobis.

*Colour and Size.* Head, neck and breast, with the body above and the wings, blue glossed black : a broad central stripe throughout the whole length of the wing : the body below and the 8 lateral tail feathers, pure white : bill and legs, black : iris dusky brown :  $8\frac{1}{2}$  to 9 inches long by  $11\frac{1}{2}$  wide, and  $1\frac{1}{2}$  to  $1\frac{3}{4}$  oz. in weight : tarsus  $1\frac{1}{8}$  : central toe  $\frac{1}{16}$  : hind toe  $\frac{1}{16}$  : its nail  $\frac{1}{16}$  : tail  $3\frac{1}{2}$ .

Sexes alike. The young have the breast ruddy and the glossed black parts of the upper plumage : at first, olive brown, then blackish, slaty and un-glossed, including the breast : their feet are slaty, and their bill dusky brown.

2nd Species ? *MOTACILLA VARIEGATA* Auctorum.

3rd Species ? *TURDUS SOLITARIUS* Auctorum.

*Genus MOTACILLA.* Sub Genus, *ENICURUS*, Tem.

*Species*, new ; *SCHISTACEUS*, nobis.

*Form*, as in *MACULATUS*, but somewhat less in size.

*Colour.* Head, neck, back and flanks, dark slaty blue : cheeks, throat and a very narrow band round the bill, jet black : a white frontal band above the last from eye to eye : whole neck and body below, with the rump and upper tail coverts, white : wings and tail precisely as in *Maculatus*, save that the blanching of the alar quills at their bases is more extended and reveals itself like a speculum on the primaries. Bill, legs, and iris, as in *Maculatus*, and indeed in all the other species ; for I know

not one which has not white feet, a black bill, and brown iris. Sexes alike, very nearly allied to *Velatus Temminkii*.

*2nd Species.* FULIGINOSUS, nobis.

Size and form, as in *Maculatus*. Head, neck, back and breast, dusky, or sooty brown: lower back or rump, and body below, white: wings and tail, bill and feet, as in *Maculatus*; but the black hue less pure and jetty. Sexes alike.

*3d Species.* IMMACULATUS, nobis.

Form as in *Maculatus* and coloured exactly similarly, save that the breast is white, and the mantle immaculate. Size not larger than *Scouleri*, allowance being made for the long and typical tail of our species. Sexes alike, and bill, feet and iris, as before.

*Remark.* The discovery of *Scouleri* proves that 'tail forked' is a dubious mark of this genus, or rather subgenus, for such only is the value of the group. Very nearly as it is affined to *Motacilla*, I should distinguish it, chiefly, by its lunate nares nearly closed by an unarched membrane, its gradated wings with short tertials, and its bristly gape.

The tarsi are higher and smoother, but *not* more slender, than in *Motacilla* proper, several species of which have similar claws.

*Genus.* MOTACILLA Auctorum.

*Subgenus.* BUDYTES CUVIER.

*Species, new*; CALCARATA, nobis, closely allied to *M. Neglecta*. Obviously distinguishable from the typical Wagtails by the shortness of the tail, the superior height and strength of the tarsi, and the longer, straighter, and extremely acuminate nails; the hind one of which is longer than its toe, and, in our species, as nearly *straight* as may be,  $7\frac{1}{4}$  inches long, whereof the tail is but  $3\frac{1}{2}$ , extending only two inches beyond the tips of the wings. Expanse of wings 11 inches, weight less 1 oz.: bill  $\frac{1}{8}$  of inch, and equal to head. Tarsus  $1\frac{3}{8}$ : central toe  $\frac{1}{8}$ : hind  $\frac{1}{8}$ : its claws  $\frac{1}{8}$ . Above the flanks, grey slaty: below, bright yellow: a yellow line on each side the head, above the eye, from bill to nape: wings, 6 central tail feathers, and upper coverts of tail, black: the great coverts of wings and the alar plumes, very widely margined below, and also tipped with white: the

6 lateral rectrices, much blanché, increasingly to the extremes which are nearly all white: legs black: bill horn grey: iris brown. Female considerably less:  $6\frac{3}{4}$  inches long: similar to the male, but more dully coloured, and the alar and caudal black plumes of the male, brown in her.

**MOTACILLA PROPER** *Species, new; ALBOIDES, nobis.*

The oriental analogue of *Alba*, cui simill.; but clearly distinguishable by its white throat, its completely black neck, and the greater blanching of its wings which, when closed, show nothing but white, except on the tertials.

*Colour and size of mature male.* Forehead, cheeks, and throat, white, divided by a narrow black line from the gape. Back of the head, with the whole neck, breast, shoulders, body above, and 8 central tail feathers, jetty: 4 lateral caudals, with the body below and greatest portion of the closed wing, white: quills black internally, and apertly so on the tertials which, however, have very broad margins of white: bill and legs jet: iris brown: 8 inches long by  $11\frac{1}{2}$  wide, and less; 1 oz. in weight: tail  $3\frac{3}{4}$ : tarsus  $\frac{1\frac{5}{8}}{1\frac{5}{8}}$ : central toe  $\frac{1}{10}$ : hind  $\frac{1}{8}$ : its claw  $\frac{1}{18}$ : wings  $2\frac{1}{2}$  inches short of tail. Amidst all the changes of plumage to which this species is liable, I still think I may safely say that the female (like the young) is slaty above, and white below, with a black gorget on the breast, and a blackish zone round the cheeks: wings, mostly black brown, with a narrow white edging.

*Remark.* By comparing the proportions of this species with those of *Calcarata*, the characteristic difference of structure in *Motacilla* and *Budytes* may be at once perceived.

I am answerable for reducing *Enicurus* and *Budytes* to the station of Sub-genera; but, their internal structure, their habits and manners, are so similar that I cannot imagine the small discrepancy of external structure can want generic division. Certainly, however, there is this difference in the manners of the *Enicuri*, as compared with the *Motacilla*, that the former love the sheltered rills; the latter, the open streams; and the respective formation of the wing in each may be relative to those opposite habits. Through *Enicurus* and our *Dakila*, we are led easily from the

Wagtails to the Thrushes; and it is well worthy of notice that the two former have wings of exactly the same construction.

With regard to *Budytes*, much as its lark-like claws prepare us to expect some peculiarity of manners, I have failed thus far to perceive any, as compared with *Motacilla* proper.\*

In place of the 'unguis posticus *arcuatus*' of the generic character, I should read 'nails (all) straightened, slender, very acute: the hind one equal to its digit or longer?'

In our *Dahila*, also, the nails are *acute*; but they are strong and curved; and the very slight but perceptible depression or flatness of the soles of the feet distinctly indicates the perching and meruline propensity of *Dahila*.

The bill of *Dahila*, as compared with that of *Turdus*, is scarcely so thick, rather more depressed at the base, and rather less convex forwards upon the ridge; and the tip of its lower mandible shows evanescently the recurvation and notch so conspicuous in many of the *Lancidæ*, and distinct though fainter in some of the *Muscicapidæ* and even of the *Sylviadæ*. But these distinctions are all nice; and the general and effectual character of the bill of *Dahila* is *Turdine*. So too that of the legs, though here the superior height and strength of the tarsi with the depression of the thumb, and acuteness of the nails, are palpable distinctions. I have not noticed in either *Motacilla* or *Turdus*, the nuchal hairs of *Dahila*, and which with the strength of the tarsi seem to intimate a *Crateropine* tendency in our genus, harmonising well the shortened wings and graduated tail of *Dahila*, as compared with the genera to which it is related by affinity.

*Nepal, Sept. 1836.*

---

\* Thus much however may be said with truth; that the short-clawed Wagtails often frequent lawns and meadows; the long-clawed, seldom or never; and that the foot of the latter is admirably suited to support the birds upon the most yielding and semi-fluid sand-banks, or the precise situations to which they are almost limited.

# XIII.

---

## NOTE

ON THE

URSUS SIVALENSIS,  
A NEW FOSSIL SPECIES,  
FROM THE  
SIVALIK HILLS.

---

BY CAPTAIN P. T. CAUTLEY,

*Superintendent Doab Canal,*

AND

HUGH FALCONER, M. D.,

*Superintendent Botanical Garden, Seharanpur.*

---

WE are now enabled to record another new form in fossil zoology drawn from the rich deposits of the Sivalik hills. In a preceding article we have noticed a new feline extinct species, of dimensions approaching those of the existing Tiger; in the present one, we shall endeavour to characterize another member of the same family, of the genus *Ursus*, essentially distinct from existing or extinct species in some prominent points of its osteology, and remarkable also for large size, like some other of its associated fossil contemporaries.

Our knowledge of the species is derived from two fossil specimens. The one consisting of the right half of the lower jaw mutilated at the symphysis, and ascending portion of the ramus, exhibited in Fig. 2, gave us the first idea of a new animal. The other, Fig 1, a subsequent acquisition, is a superb specimen of the head, which although a good deal fractured, is at the same time so well preserved in its principal features as to give little difficulty in determining the specific character. The three

rear molars are perfect on one side and but little damaged on the other. Both canines are present, and that of the right side is entire. The alveoli of the false molars and incisors are distinct, although the teeth are wanting. The only considerable deficiencies are in the posterior and lower parts of the occiput, both zygomatic arches, and in the lower end of the nasals, where a fissure extends across the face, on both sides towards the orbits.

The chief peculiarities of the fossil are to be found in the teeth, which are constructed more after the type of the higher Carnivora than any other described species of the genus. Before entering upon these it will be convenient, for comparison, shortly to refer to the dentary system of the Bears generally.

The number of the teeth varies more in the different species of the Bears, than in any other genus of the Carnivora. The incisors, canines, and the three posterior molars are constant in both jaws, in all the species. The false molars are subject to great variation. They are usually entirely wanting\* in the upper jaw of the *Ursus spelæus*, or large fossil Bear of Europe, while in other species they amount to three on either side. The same variation holds in the lower jaw. In the *Ursus labiatus*† there are four false molars on each side, while in the *Ursus spelæus* there is generally but one present: so that while the number of teeth in the former extends in both jaws to 42, it is commonly reduced in the latter to 30. This irregularity in the number of the false molars, exists to a certain extent in different individuals of the same species. In one skull of the *Ursus Tibetanus* in our collection, which belonged to an old animal, there are three false molars in the upper jaw on each side; while in the skull of a younger individual with unworn teeth, there are but two. In another skull, there are no false molars on the left side, while there is one on the right side: there being at the same time three false molars on either side of the lower jaw.

The characters depending on the form of the teeth are very constant in the genus. The carnassier or ante-penultimate molar, in the upper

---

\* CUVIER, Ossements Fossiles, tom. 4. p 351.

† This is constant in several skulls in our collection.

jaw, has but two lobes or points, along its length; and the tubercle of its inner side is placed opposite the rear lobe. The two rear molars are oblong, and the last one has the additional development of a crenulated spur or heel. The higher Carnivora differ widely in these characters from the Bears; their carnassier teeth being three lobed, and the tubercle of the inside being placed forwards, as in the Cats and Hyæna; while the rear or tubercular teeth are reduced in number, and are rudimentary.

We shall now proceed to the teeth of the fossil, which in many respects deviate from the type of the genus, and approximate that of the more perfect Carnivora. Along with the dimensions we annex those of the *Ursus Spelæus* and *Ursus Tibetanus* for comparison.\*

| <i>Molars, Upper Jaw.</i>               | <i>Ursus Sivalensis.</i> |               | <i>Ursus Spelæus.</i> |               | <i>Ursus Tibetanus.</i> |               |
|---|--------------------------|---------------|-----------------------|---------------|-------------------------|---------------|
|   | <i>Inch.</i>             | <i>Metre.</i> | <i>Inch.</i>          | <i>Metre.</i> | <i>Inch.</i>            | <i>Metre.</i> |
| Length of last molar, .....             | 1.1                      | .028          | 1.84                  | .048          | 1.1                     | .028          |
| Width of ditto, .....                   | 1.2                      | .03           | ....                  | ....          | 0.6                     | .015          |
| Length of penultimate ditto, .....      | 1.2                      | .03           | 1.23                  | .031          | 0.8                     | .02           |
| Width of ditto, .....                   | 1.2                      | .03           | ....                  | ....          | 0.55                    | .013          |
| Length of ante-penultimate ditto, ..... | 1.3                      | .032          | 0.83                  | .021          | 0.5                     | .012          |
| Width of ditto, .....                   | 0.85                     | .022          | ....                  | ....          | 0.35                    | .008          |
| <i>Molars, Lower Jaw.</i>               |                          |               |                       |               |                         |               |
| Length of last molar, .....             | ....                     | ....          | 1.03                  | .026          | 0.65                    | .017          |
| Width of ditto, .....                   | ....                     | ....          | ....                  | ....          | 0.48                    | .012          |
| Length of penultimate ditto, .....      | 1.15                     | .029          | 1.30                  | .032          | 0.8                     | .02           |
| Width of ditto, .....                   | 0.75                     | .019          | ....                  | ....          | 0.45                    | .011          |
| Length of ante-penultimate, .....       | 1.35                     | .0335         | 1.32                  | .033          | 0.6                     | .02           |
| Width of ditto, .....                   | ....                     | ....          | ....                  | ....          | 0.38                    | .005          |
| Length of last false molar, .....       | 0.9                      | .023          | ....                  | ....          | 0.4                     | .01           |
| Width of ditto, .....                   | 0.5                      | .012          | ....                  | ....          | 0.25                    | .006          |

The incisors as indicated by the alveoli were 6, and the external one of each side larger than the others, as is usual in the family. The canines are of great size. The right one is entire: its point is worn off, indicating

\* In the *Ossements Fossiles*, CUVIER does not give the dimensions in width of the teeth of the *Ursus Spelæus*. We have to regret this omission, as one of the most marked characters about our fossil is the great width of the molars; and we have no other source to refer to regarding the *Ursus Spelæus*, besides the *Ossements Fossiles*.



the animal to have been more than adult, and there are also stripes of wear both on its posterior and inner sides. It is 1.4 inch in anteroposterior diameter at the base, and 1 inch transversely. The socket of the first false molar is close behind the canine, that of the second is near the anterior one, and the tooth appears to have been two fanged. There can have been no other false molars besides these two, the sockets of which are close together, and occupy the interval between the canine and carnassier, which is inconsiderable for the size of head, being but 1.2 inch in length.

The three rear molars present marked peculiarities. The antepenultimate or carnassier is of very large size; it slightly exceeds both of the rear teeth in length, and is about half an inch longer than the corresponding tooth of the *Ursus Spelæus*. Instead of having but two points like the rest of the Bears, it has three, the anterior lobe being well developed as in the higher Carnivora; and the tubercle of the inside, instead of being to the rear as in the other species, is advanced forwards opposite the middle lobe. It has altogether a great analogy with the corresponding tooth of the Hyæna. The teeth of the opposite sides are unequally worn.

The two rear or tubercular molars are also marked in their form. Instead of being oblong, as in all the other species, with their length greater by a third than the breadth, they are square in our fossil. The penultimate, if any thing, is longer than the rear one, the reverse of which holds in the rest of the genus. It has two tubercles at its outer side as in other species; at the inside it is somewhat shortened in length, and the cleft between the tubercles is nearly obsolete, so as to give the appearance of one large tubercle. In this respect there is a remote analogy with the corresponding tooth of the Dog, and a deviation from the usual type of the Bears. The last tubercular is as contrasted in form with that of the other species as the carnassier tooth is. At its outer side there are two tubercles to the crown smaller than in the penultimate, as is normal in the genus, and at its inner side a ridge indistinctly divided by three slight furrows. There is no heel to the tooth: The crown is square, and the only part which can be considered as representing a heel or spur is a flattish disk at the inside, alternate with the posterior outer tubercle, and partly opposed to the rear

portion of it. None of the rest of the Bears have the last tubercular in the upper jaw square, or without a crenulated spur added on to the rear of it.

Our specimen of the lower jaw, Fig. 2, is deficient in the incisors and in the protruded portion of the canine. It is broken off, just where the latter emerges from its socket. The section of the imbedded portion of the canine gives 1.6 inch of vertical dimension and .95 transversely. The molars are six in number. The two anterior false molars and the last tubercular have dropped out, but the sockets remain unobliterated. The anterior false molar was close behind the canine, and there is not space for another to have been inserted between. The second was close to the first and almost in contact with the third false molar. This latter, like the carnassier of the upper jaw is of large size, compared with the same tooth of the other species, and distinctly three lobed; which is another peculiarity, and further supports the analogy shown by the upper carnassier with the *Hyæna*, to the second false molar of which it bears a considerable resemblance. The anterior and posterior lobes are small, the middle point being chiefly developed. The antepenultimate or carnassier is so defined, as to give no indication of form to notice except its length. The penultimate or first tubercular molar is oblong. It is broader for its length than generally holds in the genus, and the crown less complicated with tubercles. Of the rear tubercular, the socket alone remains, the tooth having fallen out. It is situated with considerable obliquity to the rest of the series, in the root of the ascending portion of the ramus. The alveolus is inconsiderable, and the tooth appears to have been comparatively small.

The teeth in the fossil appear to have been thus: incisors  $\frac{1}{2}:\frac{1}{2}$ : canines  $\frac{1}{2}:\frac{1}{2}$ : false molars  $\frac{1}{2}:\frac{1}{2}$ : cheek teeth  $\frac{1}{2}:\frac{1}{2}$ : in all 38.

The size and form of the head bear out the specific distinction established by the teeth. No Bear, fossil or recent, attains the enormous size of our fossil, except the *Ursus spelæus*, and the absence of any bulge in the forehead above the orbits at once distinguishes it from the latter. The mutilation of the cranium at the occiput, prevents an exact comparison of the length with that of the *Ursus spelæus*. In the tables of the *Ossements*

*Fossiles*,\* an adult specimen of the latter measures 17.9 inches from the incisives to the occipital crest. The fossil cranium although mutilated at the occiput, measures 17 inches : with the deficient portion restored, it would probably measure 19 inches. The facial half of the head, from the post-orbitary processes to the incisives, measures 9.3 inches ; and in almost all the Bears the cranial portion is longer than the facial. Supposing this proportion to hold in our fossil the head would be more than 19 inches, and exceed that of the *Ursus spelæus*.

The form of the cranium in profile is shown in Fig. 1. The most striking feature is the almost rectilinear outline, and absence of any notable curvature. From along the nasals to between the intraorbitary processes is almost a straight line. There is but a trifling degree of convexity from that backwards : and the sagittal crest rises in a very prominent ridge above the parietals. No species of Bear has so straight a cranium. The *Ursus spelæus* is chiefly characterised by a bulge of the forehead above the root of the nasals. The only species which at all approaches the fossil in profile is the white Polar Bear, *Ursus maritimus*.† But besides the great difference of size, the latter has nothing of the salient sagittal crest, which is so prominent in the fossil ; all the other Bears have more or less convexity of profile.

Exclusive therefore of the teeth, the size and cranial outline would suffice to establish the fossil, as a distinct species. The other peculiarities of the head are these. The frontal is very broad, although an accidental indented fracture on the brow takes off from the measurement. The orbits have considerable obliquity, and large size, the depth from the postorbitary process to the malar margin being 3.1 inches. Their anterior margin only advances to above the posterior surface of the rear molar. The temporal ridges are but slightly marked and meet at an open angle as in the *Ursus spelæus*. From their commissure backwards there is scarcely any sink, the sagittal crest starting with great prominence from the parietals. The crest is not complete in its whole length, being broken off obliquely towards

---

\* Tom. 4, p. 359.

† Ossements Fossiles, tom. 4, tab. • • Fig.

the occipital. The parietals swell out backwards and downwards. The cranial cavity appears to have expanded much laterally, towards the occiput, which is broken off. The temporal fossæ are of great depth and extent; the zygomatic arches on both sides are wanting; judging from the depth of the temporal fossæ they must have been of great expanse. The malar apophysis comes off low and is  $2\frac{1}{2}$  inches in height. The nasals are partly removed by a fissure in the fossil extending across the face. They appear to have been rather long and the external opening of the nostrils to have been much shorter and less oblique than in the *Ursus spelæus*. The muzzle is broad and obtuse; being about one-fourth of the length of the head, and a little wider than the interorbital portion of the frontal. In this respect it resembles the *Ursus labiatus*. The palate is strongly arched both longitudinally and transversely: the greatest depth from a line across the worn molars, to its surface, being 2.3 inches. The horizontal plate of the palatines, hardly extends an inch beyond the rear molar; whereas in a head of the *Ursus labiatus* measuring a foot in length, it extends more than two inches. The palatine sinus is also proportionably narrow for the size of head.

In place of a single suborbital foramen, there are three distinct foramina nearly of the same size, placed over each other and a few lines apart. They are considerably advanced on the jaw, the uppermost being 1.6 inch from the margin of the orbit and placed over the carnassier. It is difficult to say whether this is common to the species or merely an individual peculiarity. Nothing of the sort is seen upon the heads figured in the Ossements Fossiles.

We only know the lower jaw by the fragment represented in Fig. 1. It consists of the greater part of the body of the right side, broken off where the canine protrudes. It is also deficient in the articulating and coronoid processes. There is therefore little to remark about the form. The lower edge has a good deal of curvature backwards, and the outer surface is deeply indented by a muscular hollow towards the angle. The dimensions of the fragment are thus:

|   |            |
|---|------------|
| Extreme length of the fragment.....     | 10.3 inch. |
| Height of jaw over 1st false molar..... | 2.5        |
| Ditto between the two rear molars.....  | 3.0        |
| Greatest thickness at rear molar .....  | 0.9        |

We have not yet found out or identified any bones of the trunk or extremities. The species does not appear to have been abundant, as no other specimens of the head or teeth have been discovered, so far as we know, among the immense collections of fossil bones got from the Sivalik Hills.

The dimensions of the cranium, contrasted with some of the measurements of the *Ursus spelæus* for comparison, are thus :

| Dimensions of Cranium.  | Ursus Sivalensis. |        | Ursus Spelæus. |        |
|---|-------------------|--------|----------------|--------|
|   | Inch.             | Metre. | Inch.          | Metre. |
| * From the incisives to the occipital crest, .....  | ....              | ....   | 17.9           | .457   |
| Width of cranium between post-orbitary processes, ..                                      | 5.45              | .139   | 4.7            | .121   |
| From the incisives to a line between ditto, .....   | 9.3               | .237   | 8.6            | .245   |
| * From occipital crest to the same point, .....   | ....              | ....   | 11.2           | .285   |
| Width of brow between the orbits, .....   | 4.7               | .121   | ....           | ....   |
| Do. of muzzle over the canines, .....   | 4.8               | .122   | ....           | ....   |
| Length from the alveoli of the incisors to the poste-<br>rior margin of the palate, ..... | 7.3               | .186   | ....           | ....   |
| Width of palate in the interval between the carnas-<br>sial molars, .....                 | 3.35              | .085   | ....           | ....   |
| interval between the canines, .....   | 2.7               | .07    | ....           | ....   |

\* These two measurements are incomplete in the fossil, from the mutilation at the occiput. The first or extreme length is 17 inches or .434 metres, the second 7.7 inch or .197 metres.

To conclude. It follows, that there existed along with the Mastodon, Sivatherium, Fossil Camel, &c. of the Sivalik deposits, a large distinct species of Bear, equalling if not exceeding the largest known of the genus. Its teeth deviated widely from the type of the genus, approximating it more to the higher Carnivora than to any other species; the carnassier teeth of the upper jaw connecting it with the Hyæna while the tuberculars have a more remote analogy with those of the Dog. The size and extent of the temporal fossæ and the prominence of the sagittal crest, taken in conjunction with the teeth, show that it had a more strictly carnivorous than a frugiverous habit.

We have designated it *URSUS SIVALENSIS*.

# XIV.

---

## DAILY REGISTER

OF THE

## TIDES AT SINGAPORE,

FROM THE

1ST SEPTEMBER 1834 TO THE 31ST AUGUST 1835, INCLUSIVE.

---

OBSERVED

BY MR. J. DIAS.

---

[The present Register was kept in pursuance of an order from the Honorable the Court of Directors, dated the 20th February, 1833, for the purpose of aiding the Rev. Professor WHEWELL's investigation of the general cotidal lines on the surface of the globe. In forwarding it to the Bengal Government, (by whom it was liberally placed at the disposal of the Society,) the Resident Councillor, Mr. BONHAM, states that he is not aware what degree of confidence is to be placed in it; the Master Attendant having only three peons attached to his office was unable to spare one for this particular duty, and was forced to employ an extra person who performed the task without any stipulated remuneration for his service, and was finally rewarded with a gratuity of 100 Rupees. It may very reasonably be doubted, under this explanation, whether the Register will prove to be of that value, in a scientific point of view, which might have been expected from its official character; and it is to be feared that the tenor of Professor WHEWELL's instructions and the nature of his elaborate investigation were not duly apprehended, if it was imagined that a mere Register made without due attention, apparently, even to the exact time of the daily maxima and minima,—the state and force of the wind, the set of the current, &c. would answer the purpose required. The official correspondence gives no information as to mode of taking the observations, nor as to the fixation of the Zero-point on the tidal gauge—but it is understood that the jetty at Singapore affords every facility on these points, as there is a perpendicular wall washed by the tide which never quits its base at the lowest ebb.]

Notwithstanding the evident imperfections above pointed out, the Register has been deemed worthy of preservation, in the uncertainty of procuring more accurate materials, and in the hope that the Professor may be able to glean from it the necessary averages towards fixing the elements of a station so important as Singapore in the discussion of the tidal theory. It would be very desirable to obtain tables even of similarly moderate pretensions of the daily tides at one or two principal stations on the long range of coast upwards from Singapore to Chittagong, and it is hoped that the attention of the Executive Engineers may be invited to the subject. All that seems necessary is to set up a gauge at some convenient spot, and to employ an intelligent native servant to read off the rise and fall, and to note the time as nearly as he can estimate it.—SEC.]



| DAY.<br><br>1834. | MORNING TIDE. A. M. |         |             |         | Range<br>of Tide.<br>Ft. In. | Wind. | EVENING TIDE. P. M. |         |             |         | Range<br>of Tide.<br>Ft. In. | Wind. | Weather. |             |             |
|-------------------|---------------------|---------|-------------|---------|------------------------------|-------|---------------------|---------|-------------|---------|------------------------------|-------|----------|-------------|-------------|
|                   | Low Water.          |         | High Water. |         |                              |       | Low Water.          |         | High Water. |         |                              |       |          |             |             |
|                   | Time A. M.          |         | Time A. M.  |         |                              |       | Time P. M.          |         | Time P. M.  |         |                              |       |          |             |             |
|                   | H. M.               | Ft. In. | H. M.       | Ft. In. |                              |       | H. M.               | Ft. In. | H. M.       | Ft. In. |                              |       |          |             |             |
| October           | 1 ...               | 3 25    | 5 3         | 10 20   | 11 3                         | 6 0   | S. S. E.            | 3 48    | 5 6         | 10 50   | 10 8                         | 5 2   | S. S. W. | Cloudy.     |             |
| "                 | 2 ...               | 4 4     | 4 10        | 10 58   | 11 0                         | 6 6   | S. S. E.            | 4 30    | 5 0         | 11 5    | 10 10                        | 6 9   | 2        | Light Vble. | Ditto.      |
| "                 | 3 ...               | 4 48    | 4 5         | 11 9    | 11 10                        | 7 5   | S. S. E.            | 4 40    | 3 7         | 11 13   | 11 6                         | 7 11  | 3        | Light Vble. | Ditto.      |
| "                 | 4 ...               | 5 0     | 2 8         | 11 20   | 10 8                         | 8 0   | N. W.               | 5 10    | 2 6         | 10 50   | 10 11                        | 8 4   | 2        | S. S. W.    | Ditto.      |
| "                 | 5 ...               | 5 10    | 2 0         | 11 50   | 10 7                         | 8 7   | Variable.           | 5 20    | 1 9         | 11 58   | 10 10                        | 9 2   | 4        | S. S. W.    | Ditto.      |
| "                 | 6 ...               | 5 28    | 1 6         | 12 0    | 9 10                         | 8 4   | S. E.               | 5 40    | 1 10        | 11 55   | 10 5                         | 8 7   | 4        | Light Vble. | Clear.      |
| "                 | 7 ...               | 6 4     | 1 8         | 1 0     | 10 0                         | 8 4   | S. E.               | 7 0     | 1 10        | 1 30    | 11 2                         | 9 4   | 4        | S. W.       | Light rain. |
| "                 | 8 ...               | 8 30    | 1 5         | 2 10    | 10 8                         | 9 3   | W.                  | 8 48    | 2 0         | 3 0     | 10 0                         | 8 0   | 8        | S.          | Cloudy.     |
| "                 | 9 ...               | 9 30    | 1 11        | 3 38    | 10 8                         | 8 9   | S. E. W.            | 9 50    | 2 4         | 4 0     | 10 0                         | 7 8   | 8        | Light S.    | Clear.      |
| "                 | 10 ...              | 10 12   | 1 10        | 4 7     | 9 5                          | 7 7   | S. S. W.            | 9 15    | 1 5         | 3 40    | 9 7                          | 8 2   | 2        | S. E. S.    | Ditto.      |
| "                 | 11 ...              | 9 40    | 2 8         | 4 45    | 9 6                          | 6 10  | N. W.               | 10 0    | 3 6         | 5 6     | 10 4                         | 7 10  | 5        | W.          | Cloudy.     |
| "                 | 12 ...              | 10 35   | 4 8         | 5 15    | 9 9                          | 5 1   | N. W.               | 0 30    | 5 4         | 7 40    | 10 6                         | 5 2   | 2        | S. E.       | Showers.    |
| "                 | 13 ...              | 11 50   | 4 6         | 6 50    | 9 10                         | 5 4   | N. W.               | 2 35    | 5 6         | 9 30    | 10 0                         | 4 6   | 5        | N. W.       | Clear.      |
| "                 | 14 ...              | 1 20    | 4 8         | 8 35    | 9 8                          | 5 0   | N. W.               | 4 15    | 4 10        | 10 28   | 10 7                         | 5 9   | 4        | N. W.       | Rain.       |
| "                 | 15 ...              | 3 50    | 5 4         | 10 0    | 9 10                         | 4 6   | N. W.               | 4 48    | 4 0         | 11 15   | 9 8                          | 5 8   | 3        | Variable.   | Cloudy.     |
| "                 | 16 ...              | 4 25    | 4 7         | 10 55   | 10 5                         | 5 10  | Variable.           | 4 48    | 4 0         | 11 54   | 10 5                         | 7 5   | 6        | S. W.       | Hazy.       |
| "                 | 17 ...              | 5 10    | 4 2         | 11 30   | 10 9                         | 6 7   | S.                  | 5 45    | 3 5         | 0 54    | 10 6                         | 7 1   | 1        | S.          | Cloudy.     |
| "                 | 18 ...              | 6 10    | 4 2         | 0 20    | 10 3                         | 6 1   | Light Vble.         | 6 35    | 3 5         | 0 30    | 10 4                         | 6 11  | 4        | W.          | Ditto.      |
| "                 | 19 ...              | 6 50    | 4 0         | 0 40    | 10 9                         | 6 9   | N. W.               | 6 55    | 3 5         | 0 48    | 10 9                         | 7 0   | 7        | S.          | Clear.      |
| "                 | 20 ...              | 6 38    | 2 10        | 0 55    | 10 6                         | 7 8   | N. W.               | 6 40    | 3 0         | 0 50    | 10 4                         | 7 6   | 6        | S. W.       | Rain.       |
| "                 | 21 ...              | 6 45    | 5 0         | 0 55    | 10 5                         | 5 5   | S. W.               | 6 53    | 2 10        | 1 6     | 11 8                         | 9 4   | 9        | W.          | Light rain. |
| "                 | 22 ...              | 7 0     | 4 6         | 0 0     | 0 0                          | 5 10  | S. to S. W.         | 7 5     | 2 4         | 1 6     | 11 7                         | 7 7   | 8        | S.          | Cloudy.     |
| "                 | 23 ...              | 7 10    | 5 0         | 1 16    | 10 6                         | 5 6   | N. E.               | 7 20    | 3 3         | 2 25    | 11 10                        | 7 8   | 7        | Cal.        | Hazy.       |
| "                 | 24 ...              | 8 5     | 6 0         | 1 40    | 11 0                         | 5 0   | Variable.           | 8 40    | 4 0         | 2 40    | 11 0                         | 8 7   | 8        | W.          | Clear.      |
| "                 | 25 ...              | 9 10    | 6 3         | 3 0     | 11 5                         | 5 2   | S. W. to W.         | 9 35    | 5 4         | 3 30    | 11 0                         | 9 8   | 5        | S. W.       | Clear.      |
| "                 | 26 ...              | 10 40   | 7 0         | 4 10    | 10 5                         | 3 5   | Winds.              | 11 20   | 3 4         | 4 50    | 10 7                         | 6 6   | 4        | S. E.       | Cloudy.     |
| "                 | 27 ...              | 11 58   | 4 5         | 5 20    | 10 4                         | 5 11  | S. W.               | 0 50    | 4 9         | 6 10    | 9 0                          | 4 3   | 1        | N. N. W.    | Clear.      |
| "                 | 28 ...              | 1 10    | 5 4         | 6 40    | 10 4                         | 5 1   | N. N. W.            | 1 33    | 5 0         | 7 10    | 10 1                         | 5 2   | 1        | S. W.       | Squally.    |
| "                 | 29 ...              | 1 47    | 5 4         | 7 47    | 9 10                         | 4 6   | S. W.               | 2 4     | 5 0         | 8 10    | 10 2                         | 5 3   | 2        | S. S.       | Clear.      |
| "                 | 30 ...              | 2 43    | 4 6         | 8 35    | 10 11                        | 6 5   | Cal.                | 3 0     | 4 4         | 9 8     | 11 0                         | 6 3   | 3        | S.          | Cloudy.     |
| "                 | 31 ...              | 3 40    | 5 7         | 9 45    | 11 8                         | 6 1   | S.                  | 4 50    | 4 4         | 10 50   | 10 9                         | 6 5   | 5        | S.          | Clear.      |



## REGISTER OF THE TIDES AT SINGAPORE.

| DAY.         | MORNING TIDE. A. M. |                   |                     |                   |                     |                   | Wind. | EVENING TIDE. P. M.       |                     |                   |           |             |                   | WEATHER. |                           |  |
|--------------|---------------------|-------------------|---------------------|-------------------|---------------------|-------------------|-------|---------------------------|---------------------|-------------------|-----------|-------------|-------------------|----------|---------------------------|--|
|              | Low Water.          |                   |                     | High Water.       |                     |                   |       | Range of Tide.<br>Ft. In. | Low Water.          |                   |           | High Water. |                   |          | Range of Tide.<br>Ft. In. |  |
|              | Time A. M.<br>H. M. | Height<br>Ft. In. | Time A. M.<br>H. M. | Height<br>Ft. In. | Time P. M.<br>H. M. | Height<br>Ft. In. |       |                           | Time P. M.<br>H. M. | Height<br>Ft. In. |           |             |                   |          |                           |  |
|              |                     |                   |                     |                   |                     |                   |       |                           |                     |                   |           |             |                   |          |                           |  |
| 1834.        |                     |                   |                     |                   |                     |                   |       |                           |                     |                   |           |             |                   |          |                           |  |
| November 1 ● | 4 30                | 6 1               | 10 40               | 12 8              | S. E.               | 6 7               | 4 2   | 5 5                       | 11 25               | 10 4              | S. W.     | 2 3         | Cloudy.           |          |                           |  |
| " 2 ...      | 5 6                 | 6 2               | 11 40               | 13 0              | N. E.               | 6 10              | 4 3   | 5 45                      | 11 50               | 10 6              | W.        | 2 3         | Ditto.            |          |                           |  |
| " 3 ...      | 5 55                | 6 4               | 12 10               | 13 8              | W. by N.            | 6 7               | 3 6   | 7 10                      | 12 40               | 10 6              | W.        | 11 4        | Clear.            |          |                           |  |
| " 4 ...      | 6 30                | 5 7               | 1 0                 | 12 3              | N. E.               | 6 6               | 2 10  | 8 0                       | 1 15                | 12 2              | N. W.     | 2 4         | Showers at times. |          |                           |  |
| " 5 ...      | 7 30                | 6 6               | 1 30                | 10 6              | W. by N.            | 4 30              | 3 2   | 9 0                       | 1 35                | 11 6              | N. E.     | 8 4         | Passing showers.  |          |                           |  |
| " 6 ...      | 8 10                | 7 2               | 2 0                 | 10 10             | N. E.               | 2 8               | 3 2   | 9 0                       | 2 10                | 12 0              | N. E.     | 10 4        | Cloudy.           |          |                           |  |
| " 7 ●        | 9 10                | 8 0               | 2 30                | 11 0              | N. E.               | 3 0               | 5 0   | 10 0                      | 3 0                 | 12 0              | N. E.     | 7 2         | Ditto.            |          |                           |  |
| " 8 ...      | 10 20               | 8 0               | 4 0                 | 11 0              | N. E.               | 3 0               | 5 2   | 11 0                      | 4 20                | 10 5              | N. E.     | 5 3         | Ditto.            |          |                           |  |
| " 9 ...      | 11 15               | 8 5               | 5 0                 | 10 5              | N. E.               | 2 0               | 6 5   | 12 0                      | 5 0                 | 9 2               | N. E.     | 2 1         | Cloudy.           |          |                           |  |
| " 10 ...     | 12 15               | 7 5               | 6 0                 | 9 7               | N. E.               | 2 2               | 7 10  | 1 30                      | 7 30                | 9 0               | N. E.     | 1 2         | Ditto.            |          |                           |  |
| " 11 ...     | 2 0                 | 6 0               | 8 0                 | 9 8               | N. E.               | 3 8               | 7 0   | 2 15                      | 8 10                | 9 8               | N. E.     | 2 8         | Ditto.            |          |                           |  |
| " 12 ...     | 3 0                 | 5 7               | 9 0                 | 10 0              | Ny.                 | 4 5               | 6 0   | 3 0                       | 9 30                | 10 4              | N. E.     | 4 4         | Rain.             |          |                           |  |
| " 13 ...     | 3 30                | 5 2               | 9 50                | 10 4              | N. E.               | 5 2               | 5 9   | 4 0                       | 10 0                | 10 4              | N. E.     | 4 1         | Rain.             |          |                           |  |
| " 14 ...     | 4 0                 | 5 7               | 10 15               | 11 0              | N. E.               | 5 11              | 5 2   | 4 15                      | 10 45               | 11 2              | N. E.     | 6 0         | Rain.             |          |                           |  |
| " 15 ...     | 4 45                | 4 11              | 10 50               | 11 8              | N. E.               | 6 9               | 4 9   | 4 50                      | 11 0                | 11 6              | N. E.     | 6 9         | Cloudy.           |          |                           |  |
| " 16 ○       | 5 15                | 5 9               | 11 0                | 11 3              | Ny.                 | 5 6               | 3 7   | 5 18                      | 11 40               | 10 6              | N. E.     | 6 11        | Fine.             |          |                           |  |
| " 17 ...     | 5 30                | 5 0               | 11 45               | 11 5              | N. E.               | 6 5               | 3 5   | 5 38                      | 12 0                | 10 7              | N. E.     | 7 5         | Cloudy.           |          |                           |  |
| " 18 ...     | 6 0                 | 5 8               | 12 0                | 11 5              | N. E.               | 4 11              | 3 6   | 6 10                      | 12 50               | 10 10             | S.        | 6 4         | Ditto.            |          |                           |  |
| " 19 ...     | 6 30                | 5 10              | 12 15               | 11 5              | N. E.               | 5 5               | 3 3   | 6 44                      | 1 30                | 10 8              | N. E.     | 7 5         | Heavy rain.       |          |                           |  |
| " 20 ...     | 6 50                | 5 7               | 12 50               | 11 4              | N. E.               | 5 9               | 3 4   | 7 0                       | 10 0                | 9 6               | N. E.     | 8 8         | Squally and rain. |          |                           |  |
| " 21 ...     | 7 8                 | 5 2               | 1 50                | 11 0              | S.                  | 5 10              | 3 5   | 7 30                      | 10 0                | 9 10              | N. E.     | 5 5         | Rain.             |          |                           |  |
| " 22 ...     | 7 55                | 5 10              | 1 44                | 9 8               | N. E.               | 3 10              | 3 11  | 8 0                       | 9 0                 | 9 0               | N. E.     | 5 0         | Clear.            |          |                           |  |
| " 23 ●       | 9 12                | 4 8               | 2 14                | 10 0              | N. E.               | 4 4               | 5 0   | 9 20                      | 10 0                | 10 0              | N. E.     | 5 0         | Rain.             |          |                           |  |
| " 24 ...     | 9 28                | 7 0               | 3 10                | 10 3              | N. E.               | 3 3               | 4 6   | 0 0                       | 3 30                | 10 30             | Variable. | 5 9         | Cloudy.           |          |                           |  |
| " 25 ...     | 10 0                | 4 6               | 4 0                 | 9 6               | N. E.               | 5 0               | 7 8   | 0 5                       | 3 50                | 9 8               | N. E.     | 2 0         | Rain.             |          |                           |  |
| " 26 ...     | 10 45               | 4 8               | 3 48                | 9 8               | N. E.               | 5 0               | 6 0   | 2 0                       | 8 4                 | 10 5              | N. E.     | 7 8         | Fine.             |          |                           |  |
| " 27 ...     | 2 10                | 3 4               | 8 40                | 10 9              | N. E.               | 7 5               | 3 0   | 12 25                     | 8 40                | 10 8              | N. E.     | 4 6         | Squally.          |          |                           |  |
| " 28 ...     | 2 30                | 3 0               | 8 50                | 11 2              | N. E.               | 8 2               | 5 1   | 13 0                      | 9 10                | 11 4              | N. E.     | 6 3         | Cloudy.           |          |                           |  |
| " 29 ...     | 3 15                | 5 3               | 9 15                | 12 2              | N. E.               | 8 11              | 4 11  | 4 0                       | 10 0                | 11 2              | N. E.     | 3 3         | Hot.              |          |                           |  |
| " 30 ●       | 4 10                | 3 4               | 11 0                | 11 6              | N. E.               | 8 12              | 3 10  | 5 15                      | 11 20               | 11 1              | N. E.     | 8 1         |                   |          |                           |  |

| DAY.  | MORNING TIDE. A. M. |                    |                     |                    |                     |                    | EVENING TIDE. P. M. |                     |                    |  |             |  | WEATHER. |                   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|-------|---------------------|--------------------|---------------------|--------------------|---------------------|--------------------|---------------------|---------------------|--------------------|--|-------------|--|----------|-------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
|       | Low Water.          |                    |                     | High Water.        |                     |                    | Range<br>of Tide.   | Low Water.          |                    |  | High Water. |  |          | Range<br>of Tide. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|       | Time A. M.<br>H. M. | Height.<br>Ft. In. | Time A. M.<br>H. M. | Height.<br>Ft. In. | Time P. M.<br>H. M. | Height.<br>Ft. In. |                     | Time P. M.<br>H. M. | Height.<br>Ft. In. |  |             |  |          |                   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|       |                     |                    |                     |                    |                     |                    |                     |                     |                    |  |             |  |          |                   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1894. |                     |                    |                     |                    |                     |                    |                     |                     |                    |  |             |  |          |                   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

## REGISTER OF THE TIDES AT SINGAPORE.

| DAY.  | MORNING TIDE. A. M. |                   |                     |                   | EVENING TIDE. P. M. |                   |                     |                   | WEATHER. |                   |  |                   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|-------|---------------------|-------------------|---------------------|-------------------|---------------------|-------------------|---------------------|-------------------|----------|-------------------|--|-------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
|       | Low Water.          |                   | High Water.         |                   | Low Water.          |                   | High Water.         |                   |          |                   |  |                   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|       | Time A. M.<br>H. M. | Height<br>Ft. In. | Time A. M.<br>H. M. | Height<br>Ft. In. | Time P. M.<br>H. M. | Height<br>Ft. In. | Time P. M.<br>H. M. | Height<br>Ft. In. |          |                   |  |                   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|       |                     |                   |                     |                   |                     |                   |                     |                   |          | Range<br>of Tide. |  | Range<br>of Tide. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|       |                     |                   |                     |                   |                     |                   |                     |                   |          | Ft. In.           |  | Ft. In.           |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1886. |                     |                   |                     |                   |                     |                   |                     |                   |          |                   |  |                   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

| DAY.     | MORNING TIDE. A. M. |                    |                     |                    |                           | EVENING TIDE. P. M. |                    |                     |                    |                           | WEATHER.      |                   |  |
|----------|---------------------|--------------------|---------------------|--------------------|---------------------------|---------------------|--------------------|---------------------|--------------------|---------------------------|---------------|-------------------|--|
|          | Low Water.          |                    | High Water.         |                    | Range of Tide.<br>Ft. In. | Low Water.          |                    | High Water.         |                    | Range of Tide.<br>Ft. In. |               |                   |  |
|          | Time A. M.<br>H. M. | Height.<br>Ft. In. | Time A. M.<br>H. M. | Height.<br>Ft. In. |                           | Time P. M.<br>H. M. | Height.<br>Ft. In. | Time P. M.<br>H. M. | Height.<br>Ft. In. |                           |               |                   |  |
|          |                     |                    |                     |                    |                           |                     |                    |                     |                    |                           |               |                   |  |
| 1835.    |                     |                    |                     |                    |                           |                     |                    |                     |                    |                           |               |                   |  |
| February | 1 ...               | 7 35               | 7 2                 | 0 40               | 4                         | 8 0                 | 3 7                | 1 0                 | 12 3               | 8 8                       | N. E.         | Fine.             |  |
| "        | 2 ...               | 9 0                | 7 6                 | 1 30               | 4                         | 7 50                | 4 7                | 1 45                | 11 8               | 7 1                       | N. to N. E.   | Clear.            |  |
| "        | 3 ...               | 8 30               | 7 5                 | 2 50               | 2 5                       | 7 25                | 4 8                | 2 35                | 11 1               | 6 5                       | N. E.         | Dry.              |  |
| "        | 4 ...               | 9 10               | 7 9                 | 2 45               | 2 1                       | 9 0                 | 5 3                | 2 30                | 10 6               | 5 3                       | N. E.         | Clear.            |  |
| "        | 5 ...               | 9 5                | 7 9                 | 3 0                | 1 11                      | 9 0                 | 5 3                | 2 30                | 10 6               | 5 3                       | N. E.         | Passing showers.  |  |
| "        | 6 ...               | 9 20               | 7 6                 | 3 15               | 3 10                      | 8 45                | 4 3                | 3 15                | 9 7                | 5 4                       | N. E.         | Clear.            |  |
| "        | 7 ...               | 10 20              | 4 3                 | 5 15               | 5 5                       | 9 9                 | 6 5                | 3 30                | 9 0                | 2 7                       | N. E.         | Dry, hot.         |  |
| "        | 8 ...               | 11 25              | 5 4                 | 5 30               | 4 1                       | 10 43               | 4 6                | .....               | .....              | 4 11                      | N. E.         | Clear.            |  |
| "        | 9 ...               | 0 35               | 5 6                 | 6 40               | 4 5                       | 9 2                 | 6 10               | .....               | .....              | 2 7                       | N. E.         | Clear.            |  |
| "        | 10 ...              | 2 5                | 5 3                 | 10 0               | 2 9                       | 1 10                | 4 10               | 8 0                 | 9 9                | 4 11                      | N.            | Fine.             |  |
| "        | 11 ...              | 3 15               | 4 11                | 9 20               | 3 5                       | 3 5                 | 3 10               | 9 15                | 9 11               | 4 2                       | N. E.         | Clear & hot.      |  |
| "        | 12 ...              | 3 55               | 6 1                 | 10 0               | 4 9                       | 3 5                 | 3 0                | 10 3                | 9 11               | 6 11                      | N. E.         | Dry.              |  |
| "        | 13 ...              | 4 15               | 6 3                 | 10 40              | 11 6                      | 4 0                 | 2 11               | 10 0                | 10 3               | 7 4                       | S.            | Clear.            |  |
| "        | 14 ...              | 4 20               | 6 0                 | 10 45              | 11 0                      | 4 20                | 2 1                | 10 40               | 10 11              | 8 10                      | N. W.         | Dry hot.          |  |
| "        | 15 ...              | 5 0                | 6 2                 | 11 5               | 12 3                      | 4 25                | 2 4                | 10 50               | 10 11              | 8 7                       | N. W.         | Clear.            |  |
| "        | 16 ...              | 7 0                | 6 3                 | 12 10              | 11 7                      | 6 0                 | 2 9                | .....               | .....              | 9 6                       | N.            | Ditto.            |  |
| "        | 17 ...              | 8 0                | 5 5                 | 1 20               | 11 5                      | 7 20                | 2 8                | 1 0                 | 12 1               | 9 5                       | N. E.         | Dry hot.          |  |
| "        | 18 ...              | 8 25               | 3 4                 | 2 15               | 10 11                     | 7 55                | 4 7                | 1 50                | 11 10              | 7 3                       | N. E.         | Ditto.            |  |
| "        | 19 ...              | 8 25               | 3 2                 | 2 15               | 10 11                     | 7 55                | 4 8                | 2 0                 | 11 8               | 7 0                       | S. W.         | Passing showers.  |  |
| "        | 20 ...              | 9 15               | 3 11                | 3 5                | 10 8                      | 8 40                | 4 6                | 2 55                | 11 2               | 6 8                       | Variable.     | Cloudy & Squally. |  |
| "        | 21 ...              | 10 0               | 3 5                 | 3 40               | 9 6                       | 9 35                | 4 0                | 3 55                | 9 11               | 5 11                      | N. E.         | Showers.          |  |
| "        | 22 ...              | 12 0               | 4 5                 | 5 15               | 10 2                      | 11 0                | 5 6                | 4 30                | 9 4                | 3 10                      | N. E.         | Fine.             |  |
| "        | 23 ...              | 1 15               | 5 11                | 7 20               | 9 11                      | .....               | .....              | 6 0                 | 9 3                | 4 10                      | N. E.         | Ditto.            |  |
| "        | 24 ...              | 1 35               | 5 2                 | 8 0                | 9 7                       | 1 35                | 3 7                | 7 25                | 9 4                | 5 9                       | S.            | Cloudy.           |  |
| "        | 25 ...              | 3 0                | 4 4                 | 9 15               | 10 4                      | 2 30                | 3 2                | 8 40                | 9 11               | 6 9                       | N. E.         | Clear.            |  |
| "        | 26 ...              | 4 5                | 4 0                 | 9 45               | 10 11                     | 3 30                | 3 1                | 9 25                | 10 7               | 7 6                       | S. W. & N. E. | Cloudy.           |  |
| "        | 27 ...              | 4 30               | 3 8                 | 10 20              | 11 4                      | 4 25                | 2 11               | 10 15               | 10 11              | 7 11                      | N. E.         | Clear.            |  |
| "        | 28 ...              | 5 15               | 3 9                 | 11 10              | 11 6                      | 5 0                 | 2 9                | 11 0                | 11 1               | 8 6                       | N. E.         | Cloudy.           |  |
| "        |                     |                    |                     |                    |                           | 5 20                | 2 9                | 12 0                | 10 9               | 8 0                       | N. E.         | Clear.            |  |

## REGISTER OF THE TIDES AT SINGAPORE.

| DAY.<br><br>1885. | MORNING TIDE. A. M. |                   |                     |                   |                   | WIND.<br><br>D. | EVENING TIDE. P. M. |                   |                     |                   |                   | WEATHER. |                  |
|-------------------|---------------------|-------------------|---------------------|-------------------|-------------------|-----------------|---------------------|-------------------|---------------------|-------------------|-------------------|----------|------------------|
|                   | Low Water.          |                   | High Water.         |                   | Range<br>of Tide. |                 | Low Water.          |                   | High Water.         |                   | Range<br>of Tide. |          |                  |
|                   | Time A. M.<br>H. M. | Height<br>Ft. In. | Time A. M.<br>H. M. | Height<br>Ft. In. |                   |                 | Time P. M.<br>H. M. | Height<br>Ft. In. | Time P. M.<br>H. M. | Height<br>Ft. In. |                   |          |                  |
|                   |                     |                   |                     |                   |                   |                 |                     |                   |                     |                   |                   |          |                  |
| March             | 1 ...               | 6 15              | 3 10                | 11 4              | 7 4               | N. E.           | 6 25                | 2 11              | 0 50                | 11 0              | 8 1               | E.       | Clear.           |
| "                 | 2 ...               | 7 10              | 3 11                | 1 5               | 6 8               | S. E.           | 6 55                | 3 4               | 0 35                | 11 7              | 8 3               | N. E.    | Fine.            |
| "                 | 3 ...               | 7 0               | 2 11                | 1 30              | 10 7              | S. E.           | 7 30                | 3 4               | 1 10                | 11 5              | 8 6               | N. E.    | Squally.         |
| "                 | 4 ...               | 8 5               | 2 9                 | 1 45              | 10 10             | N. E.           | 7 15                | 4 9               | 1 20                | 11 11             | 6 2               | N. W.    | Dry hot.         |
| "                 | 5 ...               | 8 0               | 5 4                 | 1 45              | 11 1              | N. E.           | 7 30                | 5 4               | 1 50                | 11 0              | 5 8               | N. W.    | Rain.            |
| "                 | 6 ...               | 7 45              | 4 7                 | 2 5               | 11 0              | N. W.           | 8 5                 | 5 3               | 2 5                 | 10 2              | 4 11              | N. W.    | Cloudy.          |
| "                 | 7 ...               | 8 0               | 4 5                 | 2 20              | 10 8              | N. W.           | 9 10                | 6 7               | 2 45                | 8 11              | 2 4               | N. W.    | Shower of rain.  |
| "                 | 8 ...               | 9 25              | 5 4                 | 3 15              | 8 10              | N. to N. E.     | 10 5                | 6 3               | 3 35                | 8 4               | 2 1               | N. E.    | Cloudy.          |
| "                 | 9 ...               | 10 20             | 4 11                | 4 0               | 9 3               | N. E.           | 11 15               | 6 2               | 4 35                | 8 3               | 2 4               | N. E.    | Fine.            |
| "                 | 10 ...              | 11 40             | 4 9                 | 5 20              | 9 5               | N. E.           | .....               | .....             | 7 0                 | 9 2               | 4 5               | N. E.    | Cloudy.          |
| "                 | 11 ...              | 1 0               | 6 1                 | 6 50              | 9 7               | N. E.           | 2 45                | 4 0               | 9 0                 | 10 1              | 6 1               | N. E.    | Heavy showers.   |
| "                 | 12 ...              | 2 10              | 5 7                 | 8 20              | 10 4              | N. E.           | 3 7                 | 2 11              | 9 30                | 10 5              | 7 6               | N. E.    | Passing showers. |
| "                 | 13 ...              | 3 0               | 4 5                 | 9 15              | 10 4              | N. E.           | 3 45                | 2 6               | 9 50                | 10 8              | 8 2               | N. E.    | Rain.            |
| "                 | 14 ...              | 3 40              | 3 10                | 9 45              | 10 11             | S. E.           | 4 40                | 2 8               | 11 9                | 10 11             | 7 3               | S. E.    | Ditto.           |
| "                 | 15 ...              | 4 20              | 3 5                 | 10 25             | 11 6              | N. E.           | 5 46                | 2 9               | 12 0                | 11 4              | 8 7               | N. E.    | Heavy showers.   |
| "                 | 16 ...              | 4 57              | 3 4                 | 11 50             | 12 1              | N. E.           | 7 10                | 3 2               | 0 40                | 12 3              | 9 1               | S. W.    | Clear.           |
| "                 | 17 ...              | 6 20              | 3 10                | .....             | 7 6               | N. E.           | 7 45                | 3 5               | 1 35                | 11 7              | 8 6               | S. W.    | Cloudy.          |
| "                 | 18 ...              | 7 5               | 4 2                 | 1 15              | 10 9              | S. W.           | 8 16                | 3 11              | 2 20                | 10 8              | 9 9               | S. E.    | Ditto.           |
| "                 | 19 ...              | 8 0               | 2 7                 | 1 57              | 10 5              | N. E.           | 9 17                | 5 3               | 3 20                | 10 4              | 5 1               | S. W.    | Ditto.           |
| "                 | 20 ...              | 8 40              | 2 3                 | 2 30              | 9 11              | N. E.           | 9 17                | 5 3               | 4 28                | 9 5               | 3 1               | S. W.    | Ditto.           |
| "                 | 21 ...              | 9 25              | 3 3                 | 3 5               | 9 8               | N. E.           | 11 5                | 6 2               | 5 40                | 8 10              | 1 7               | S. W.    | Clear.           |
| "                 | 22 ...              | 11 17             | 3 9                 | 5 37              | 9 2               | N. E.           | 12 0                | 7 3               | 5 40                | 8 5               | 4 5               | S. W.    | Cloudy.          |
| "                 | 23 ...              | 11 30             | 3 10                | 6 15              | 8 8               | N. E.           | .....               | .....             | 7 25                | 8 5               | 5 2               | N. E.    | Ditto.           |
| "                 | 24 ...              | 1 27              | 7 8                 | 7 0               | 8 8               | S. E.           | 1 27                | 3 11              | 8 0                 | 9 3               | 6 4               | N. W.    | Ditto.           |
| "                 | 25 ...              | 2 10              | 6 8                 | 8 17              | 9 9               | S. E.           | 2 36                | 3 11              | 9 0                 | 10 3              | 6 4               | N. W.    | Rain.            |
| "                 | 26 ...              | 3 25              | 6 2                 | 9 35              | 11 1              | S. E.           | 4 10                | 5 4               | 10 17               | 11 8              | 6 0               | N. E.    | Rain & cloudy.   |
| "                 | 27 ...              | 4 26              | 6 0                 | 10 0              | 12 0              | N. E.           | 4 35                | 5 3               | 10 20               | 11 6              | 0 4               | N. E.    | Rain.            |
| "                 | 28 ...              | 4 27              | 6 2                 | 10 37             | 11 8              | N. E.           | 4 40                | 5 0               | 11 7                | 11 10             | 6 10              | N. E.    | Ditto.           |
| "                 | 29 ...              | 5 16              | 4 8                 | 11 30             | 11 10             | N. E. & E.      | 5 27                | 4 6               | 11 50               | 11 8              | 7 2               | N. E.    | Cloudy.          |
| "                 | 30 ...              | 5 48              | 4 3                 | 12 0              | 11 10             | Variable.       | 5 50                | 4 5               | .....               | .....             | 7 5               | N. E.    | Ditto.           |
| "                 | 31 ...              | 5 27              | 4 0                 | 0 16              | 11 10             | N. E.           | 5 55                | 4 5               | 0 45                | 11 9              | 7 1               | N. E.    | Ditto.           |

# REGISTER OF THE TIDES AT SINGAPORE

209

| DAY.<br>1855. | MORNING TIDE. A. M. |                   |                     |                   |                | EVENING TIDE. P. M. |                   |                     |                   |                | WEATHER. |                |                  |
|---------------|---------------------|-------------------|---------------------|-------------------|----------------|---------------------|-------------------|---------------------|-------------------|----------------|----------|----------------|------------------|
|               | Low Water.          |                   | High Water.         |                   | Range of Tide. | Low Water.          |                   | High Water.         |                   | Range of Tide. |          |                |                  |
|               | Time A. M.<br>H. M. | Height<br>Ft. In. | Time A. M.<br>H. M. | Height<br>Ft. In. |                | Time P. M.<br>H. M. | Height<br>Ft. In. | Time P. M.<br>H. M. | Height<br>Ft. In. |                |          |                |                  |
| April         | 1 ...               | 5 45              | 4 11                | .....             | 6 10           | N. E.               | 6 0               | 4 3                 | 1 0               | 0              | 6 9      | N. E.          | Cloudy.          |
| "             | 2 ...               | 7 27              | 3 3                 | 1 47              | 11 3           | N. E.               | 7 30              | 5 4                 | 1 50              | 11 3           | 5 11     | N. E.          | Do. & rain.      |
| "             | 3 ...               | 8 7               | 3 3                 | 2 0               | 10 1           | N. E.               | 7 56              | 5 9                 | 2 0               | 10 2           | 5 11     | N. E.          | Clear.           |
| "             | 4 ...               | 8 5               | 3 7                 | 1 30              | 10 6           | N. E.               | 7 45              | 5 10                | 2 0               | 10 1           | 4 2      | N. E.          | Fine.            |
| "             | 5 ...               | 8 20              | 2 10                | 2 10              | 9 8            | N. E.               | 8 37              | 6 4                 | 2 25              | 9 4            | 4 3      | N. E.          | Ditto.           |
| "             | 6 ...               | 9 0               | 3 8                 | 3 10              | 9 3            | N. E.               | 9 47              | 7 1                 | 3 35              | 9 4            | 2 3      | N. E.          | Showers.         |
| "             | 7 ...               | 10 15             | 4 3                 | 3 56              | 9 1            | N. E.               | 11 20             | 7 3                 | 4 30              | 8 4            | 1 1      | N. E.          | Cloudy.          |
| "             | 8 ...               | Noon              | 5 0                 | 5 15              | 9 5            | N. to N. E.         | .....             | .....               | 7 0               | 9 7            | 4 7      | .....          | Rain.            |
| "             | 9 ...               | 2 0               | 7 10                | 8 30              | 8 9            | N. E.               | 1 50              | 4 1                 | 8 30              | 9 7            | 5 6      | N. E.          | Fine.            |
| "             | 10 ...              | 2 37              | 6 9                 | 8 40              | 9 10           | S. W.               | 2 40              | 3 8                 | 9 17              | 9 7            | 6 0      | S. W.          | Dry hot.         |
| "             | 11 ...              | 3 10              | 4 11                | 9 35              | 10 7           | S. W.               | 3 30              | 3 8                 | 10 0              | 10 5           | 6 9      | S. W.          | Ditto.           |
| "             | 12 ...              | 3 55              | 4 2                 | 10 27             | 11 4           | S. W.               | 4 36              | 3 1                 | 10 35             | 10 11          | 7 10     | S. W.          | Fine.            |
| "             | 13 ...              | 5 15              | 3 8                 | 10 45             | 11 3           | S. W.               | 5 20              | 3 1                 | 11 7              | 10 11          | 7 8      | S. W.          | Clear.           |
| "             | 14 ...              | 6 30              | 2 11                | 11 20             | 11 6           | S. W.               | 6 25              | 3 7                 | 0 30              | 11 6           | 7 11     | S. W.          | Dry hot.         |
| "             | 15 ...              | 6 6               | 2 2                 | .....             | .....          | S. W.               | 6 35              | 3 7                 | 1 25              | 11 0           | 8 9      | S. W.          | Cloudy.          |
| "             | 16 ...              | 6 45              | 1 9                 | 0 47              | 11 9           | N. E.               | 7 57              | 4 10                | 2 0               | 10 5           | 5 5      | N. W.          | Sultry.          |
| "             | 17 ...              | 7 26              | 1 9                 | 1 38              | 10 8           | N. E.               | 8 26              | 4 11                | 2 45              | 9 6            | 4 7      | N. W.          | Cloudy.          |
| "             | 18 ...              | 8 20              | 1 10                | 2 15              | 11 1           | S. W.               | 9 50              | 6 3                 | 4 7               | 8 11           | 2 8      | N. W.          | Slight rain.     |
| "             | 19 ...              | 9 20              | 2 2                 | 3 26              | 9 7            | S. W.               | 10 56             | 7 4                 | 4 35              | 8 2            | 0 10     | S. W.          | Passing showers. |
| "             | 20 ...              | 10 0              | 2 10                | 4 25              | 9 10           | S. E.               | 12 0              | 7 3                 | 5 27              | 8 4            | 1 1      | S. E. to S. W. | Cloudy.          |
| "             | 21 ...              | 10 45             | 3 7                 | 4 50              | 9 9            | S. E.               | .....             | .....               | 5 27              | 8 4            | 1 1      | S. E. to S. W. | Dry hot.         |
| "             | 22 ...              | .....             | .....               | 5 35              | 9 2            | S. E.               | 2 0               | 3 6                 | 8 20              | 9 1            | 5 7      | N. E.          | Cloudy.          |
| "             | 23 ...              | 2 10              | 6 7                 | 8 15              | 8 11           | S. E.               | 2 50              | 3 6                 | 9 15              | 9 2            | 5 8      | N. W.          | Dry hot.         |
| "             | 24 ...              | 2 35              | 6 8                 | 8 55              | 9 5            | Variable.           | 3 15              | 3 6                 | 9 15              | 9 2            | 5 8      | N. W.          | Hot sultry.      |
| "             | 25 ...              | 4 10              | 5 6                 | 10 25             | 9 11           | N. E. to S. E.      | 3 55              | 3 7                 | 10 40             | 10 2           | 6 6      | N. E. to S. E. | Ditto.           |
| "             | 26 ...              | 4 50              | 4 11                | 10 35             | 10 1           | S. E.               | 4 55              | 3 10                | 11 10             | 10 4           | 6 6      | S. E.          | Clear.           |
| "             | 27 ...              | 5 10              | 3 5                 | 11 5              | 10 0           | S. E.               | 5 15              | 3 10                | 11 10             | 10 4           | 6 6      | S. to S. E.    | Cloudy.          |
| "             | 28 ...              | 5 25              | 2 8                 | 11 55             | 10 6           | S. to S. E.         | 5 35              | 4 0                 | 12 10             | 10 5           | 6 5      | Variable.      | Hot sultry.      |
| "             | 29 ...              | 6 0               | 2 5                 | 11 55             | 10 3           | S. W.               | 6 20              | 4 2                 | 12 10             | 10 6           | 6 4      | N. E. to S. W. | Squally.         |
| "             | 30 ...              | 6 35              | 7 6                 | 0 10              | 10 6           | N. W.               | 6 45              | 4 7                 | 0 25              | 9 10           | 6 3      | N. W.          | Clear.           |

## REGISTER OF THE TIDES AT SINGAPORE.

| DAY.  | MORNING TIDE. A. M. |         |            |                |            |           | EVENING TIDE. P. M. |         |            |                |               |         | WEATHER.               |
|-------|---------------------|---------|------------|----------------|------------|-----------|---------------------|---------|------------|----------------|---------------|---------|------------------------|
|       | Low Water.          |         |            | High Water.    |            |           | Low Water.          |         |            | High Water.    |               |         |                        |
|       | Range of Tide.      |         |            | Range of Tide. |            |           | Range of Tide.      |         |            | Range of Tide. |               |         |                        |
|       | Time A. M.          | Height. | Time P. M. | Height.        | Time A. M. | Height.   | Time P. M.          | Height. | Time P. M. | Height.        | Time P. M.    | Height. |                        |
| 1855. | H. M.               | Ft. In. | H. M.      | Ft. In.        | H. M.      | Ft. In.   | H. M.               | Ft. In. | H. M.      | Ft. In.        | H. M.         | Ft. In. |                        |
| May   | 1 ...               | 7 5     | 2 3        | 10 5           | 0 50       | Variable. | 7 10                | 4 11    | 1 15       | 9 8            | S. E.         | 4 9     | Cloudy.                |
| "     | 2 ...               | 7 35    | 2 1        | 10 9           | 1 26       | S. W.     | 7 45                | 5 6     | 1 40       | 9 3            | W.            | 3 9     | Ditto.                 |
| "     | 3 ...               | 8 0     | 1 11       | 10 5           | 1 55       | S.        | 8 15                | 4 3     | 2 10       | 8 11           | S. W.         | 3 8     | Ditto.                 |
| "     | 4 ...               | 8 30    | 2 2        | 10 2           | 2 27       | S. E.     | 8 40                | 5 8     | 2 50       | 8 5            | S. S. W.      | 2 9     | Ditto.                 |
| "     | 5 ...               | 8 50    | 2 7        | 10 7           | 3 30       | S. E.     | 9 20                | 6 4     | 3 40       | 8 0            | S. E.         | 1 8     | Light cloudy.          |
| "     | 6 ...               | 9 35    | 1 11       | 4 5            | 9 4        | S. E.     | 10 20               | 6 7     | 4 30       | 8 0            | S. E.         | 3 5     | Cloudy.                |
| "     | 7 ...               | 11 30   | 3 4        | 4 48           | 8 10       | E.        | .....               | .....   | 5 10       | 8 7            | Variable.     | 5 3     | Cloudy.                |
| "     | 8 ...               | 0 40    | 6 9        | 5 40           | 8 10       | E.        | 0 50                | 3 3     | 7 50       | 8 11           | Variable.     | 5 3     | Hot sultry.            |
| "     | 9 ...               | 1 30    | 6 10       | 8 20           | 9 2        | Variable. | 1 40                | 3 3     | 8 30       | 9 7            | S.            | 6 4     | Clear.                 |
| "     | 10 ...              | 1 55    | 4 11       | 8 55           | 9 11       | Variable. | 2 15                | 3 2     | 9 17       | 9 10           | Southerly.    | 6 8     | Cloudy.                |
| "     | 11 ...              | 3 0     | 3 7        | 9 25           | 10 9       | S. W.     | 4 0                 | 3 5     | 9 40       | 10 5           | Sd.           | 7 0     | Sultry.                |
| "     | 12 O                | 4 35    | 3 2        | 10 20          | 10 10      | N. W.     | 4 45                | 3 9     | 10 35      | 11 6           | N. W.         | 7 9     | Cloudy.                |
| "     | 13 ...              | 5 17    | 2 8        | 10 50          | 10 10      | N. W.     | 5 25                | 4 6     | 11 18      | 11 7           | N. W.         | 7 7     | Ditto.                 |
| "     | 14 ...              | 5 30    | 1 10       | 12 0           | 10 11      | S. W.     | 5 40                | 5 3     | 12 0       | 12 0           | Variable.     | 6 9     | Ditto.                 |
| "     | 15 ...              | 6 10    | 1 9        | .....          | .....      | Variable. | 6 18                | 5 6     | 1 50       | 10 9           | S. W.         | 5 3     | Ditto.                 |
| "     | 16 ...              | 6 55    | 1 7        | .....          | .....      | S. E.     | 7 30                | 6 1     | 1 50       | 10 7           | S. W.         | 4 6     | Ditto.                 |
| "     | 17 ...              | 7 30    | 1 10       | 2 0            | 11 2       | S.        | 8 28                | 6 4     | 3 0        | 10 3           | S.            | 3 11    | Rain.                  |
| "     | 18 C                | 8 36    | 2 1        | 2 9            | 10 7       | N. W.     | 9 0                 | 6 3     | 3 28       | 8 11           | S. W.         | 2 8     | Hot.                   |
| "     | 19 ...              | 9 30    | 2 9        | 3 40           | 10 3       | N. W.     | 10 10               | 6 7     | 4 20       | 8 4            | S. W.         | 1 9     | Clear.                 |
| "     | 20 ...              | 10 49   | 3 2        | 4 40           | 9 4        | N. W.     | 11 20               | 6 2     | 5 17       | 8 1            | S. W.         | 1 11    | Hot sultry.            |
| "     | 21 ...              | 11 47   | 3 8        | 5 28           | 8 5        | N. W.     | 12 0                | 7 5     | 6 10       | 8 5            | .....         | 1 0     | Ditto.                 |
| "     | 22 ...              | .....   | .....      | 6 45           | 8 4        | Variable. | 12 30               | 6 5     | 7 0        | 8 6            | Variable.     | 2 1     | Cloudy.                |
| "     | 23 ...              | 1 0     | 3 3        | 8 0            | 8 8        | S. W.     | 1 50                | 4 1     | 8 27       | 8 8            | S. E.         | 4 7     | Hot sultry.            |
| "     | 24 ...              | 2 50    | 3 7        | 9 19           | 8 11       | S. W.     | 3 25                | 4 2     | 9 35       | 9 4            | S. W. & S. E. | 5 2     | Ditto.                 |
| "     | 25 ...              | 4 19    | 3 4        | 9 40           | 8 10       | S. W.     | 4 30                | 4 4     | 9 46       | 9 11           | N. W.         | 5 8     | Thunder and lightning. |
| "     | 26 ...              | 4 47    | 2 7        | 10 30          | 9 2        | S. W.     | 5 0                 | 4 5     | 10 34      | 10 0           | S. W.         | 5 7     | Flare.                 |
| "     | 27 ●                | 5 20    | 2 5        | 10 50          | 9 2        | S. W.     | 5 0                 | 4 7     | 11 16      | 10 3           | S. E. & S. W. | 5 8     | Cloudy.                |
| "     | 28 ...              | 5 30    | 2 3        | 12 0           | 9 4        | S. W.     | 5 50                | 4 8     | .....      | .....          | S. W.         | .....   | Do. & hot sultry.      |
| "     | 29 ...              | 6 15    | 2 1        | 0 30           | 10 3       | Variable. | 6 20                | 5 5     | 0 38       | 9 3            | Variable.     | 3 10    | Ditto.                 |
| "     | 30 ...              | 6 30    | 1 11       | 0 50           | 10 0       | S.        | 6 47                | 5 4     | 1 15       | 9 0            | S. W.         | 3 8     | Hot sultry.            |
| "     | 31 ...              | 7 15    | 2 1        | 1 35           | 8 11       | S.        | 6 57                | 5 5     | 1 47       | 10 2           | S.            | 4 9     | Hot sultry.            |

## REGISTER OF THE TIDES AT SINGAPORE.

211

| DAY.  | MORNING TIDE. A. M. |                    |                     |                    | EVENING TIDE. P. M. |                    |                     |                    | WEATHER.       |
|-------|---------------------|--------------------|---------------------|--------------------|---------------------|--------------------|---------------------|--------------------|----------------|
|       | Low Water.          |                    | High Water.         |                    | Low Water.          |                    | High Water.         |                    |                |
|       | Time A. M.<br>H. M. | Height.<br>Ft. In. | Time A. M.<br>H. M. | Height.<br>Ft. In. | Time P. M.<br>H. M. | Height.<br>Ft. In. | Time P. M.<br>H. M. | Height.<br>Ft. In. |                |
| 1835. |                     |                    |                     |                    |                     |                    |                     |                    |                |
| June  | 1 ...               | 7 35               | 2 0                 | 1 55               | 10 0                | 8 1                | 2 1                 | S. W.              | Clear.         |
| "     | 2 ...               | 8 25               | 1 11                | 2 30               | 9 0                 | 8 8                | 2 2                 | S. W.              | Clear.         |
| "     | 3 ...               | 9 35               | 2 2                 | 3 18               | 9 8                 | 7 6                | 2 3                 | S. W.              | Cloudy.        |
| "     | 4 ...               | 10 5               | 2 5                 | 4 0                | 9 5                 | 7 0                | 2 4                 | S. W.              | Ditto.         |
| "     | 5 ...               | 11 0               | 3 11                | 4 27               | 8 11                | 5 6                | 2 5                 | S. W.              | Ditto.         |
| "     | 6 ...               | 11 45              | 3 3                 | 5 25               | 8 9                 | 5 3                | 2 6                 | S. W.              | Rain.          |
| "     | 7 ...               | .....              | .....               | 6 18               | 8 9                 | 5 3                | 2 7                 | S. W.              | Heavy showers. |
| "     | 8 ...               | .....              | .....               | 8 15               | 9 0                 | 5 4                | 2 8                 | S. W.              | Cloudy.        |
| "     | 9 ...               | 3 0                | 3 3                 | 9 28               | 9 4                 | 6 1                | 2 9                 | S. W.              | Clear.         |
| "     | 10 ...              | 4 20               | 2 1                 | 10 20              | 10 0                | 8 11               | 2 10                | S. W. & W.         | Clear.         |
| "     | 11 ...              | 4 58               | 1 9                 | 11 15              | 10 1                | 8 4                | 2 11                | S. W.              | Clear.         |
| "     | 12 ...              | 5 20               | 1 6                 | 12 0               | 10 4                | 8 10               | 2 12                | S. W.              | Clear.         |
| "     | 13 ...              | 7 5                | 1 3                 | 0 36               | 11 4                | 10 1               | 2 13                | S. W.              | Clear.         |
| "     | 14 ...              | 7 40               | 1 3                 | 1 50               | 9 8                 | 8 5                | 2 14                | Variable.          | Hot sultry.    |
| "     | 15 ...              | 7 58               | 1 7                 | 2 15               | 10 0                | 8 5                | 2 15                | S. W.              | Hot.           |
| "     | 16 ...              | 9 0                | 1 10                | 2 55               | 10 8                | 8 10               | 2 16                | S. W.              | Rain.          |
| "     | 17 ...              | 10 10              | 2 9                 | 3 59               | 9 11                | 7 2                | 2 17                | S. W.              | Cloudy.        |
| "     | 18 ...              | 10 18              | 2 9                 | 3 50               | 9 11                | 6 2                | 2 18                | S. W.              | Hot sultry.    |
| "     | 19 ...              | 11 40              | 4 1                 | 4 48               | 8 9                 | 4 8                | 2 19                | S. W.              | Cloudy.        |
| "     | 20 ...              | 11 55              | 3 8                 | 5 40               | 8 6                 | 4 10               | 2 20                | S. W.              | Clear.         |
| "     | 21 ...              | 1 50               | 4 8                 | 8 26               | 7 10                | 3 2                | 2 21                | S. E.              | Ditto.         |
| "     | 22 ...              | 3 18               | 3 10                | 9 16               | 8 1                 | 4 3                | 2 22                | S. E.              | Clear.         |
| "     | 23 ...              | 3 30               | 3 5                 | 9 30               | 8 4                 | 4 11               | 2 23                | S. W.              | Cloudy.        |
| "     | 24 ...              | 4 17               | 3 5                 | 10 20              | 8 7                 | 5 2                | 2 24                | S. W.              | Ditto.         |
| "     | 25 ...              | 4 50               | 2 3                 | 10 40              | 8 9                 | 6 6                | 2 25                | S. W.              | Clear.         |
| "     | 26 ...              | 5 34               | 2 0                 | 11 25              | 9 1                 | 7 1                | 2 26                | S. W.              | Clear.         |
| "     | 27 ...              | 5 37               | 1 11                | 12 0               | 9 1                 | 7 2                | 2 27                | S. E.              | Clear.         |
| "     | 28 ...              | 6 38               | 1 9                 | 0 18               | 10 4                | 8 7                | 2 28                | S. E.              | Hot sultry.    |
| "     | 29 ...              | 7 25               | 1 8                 | 1 10               | 10 7                | 8 11               | 2 29                | S. E.              | Hot sultry.    |
| "     | 30 ...              | 7 49               | 1 10                | 1 38               | 9 11                | 8 1                | 2 30                | S. E.              | Hot sultry.    |



| DAY. | MORNING TIDE. A. M. |         |             |         |                |             | EVENING TIDE. P. M. |         |             |         |                |                  | WEATHER.      |
|------|---------------------|---------|-------------|---------|----------------|-------------|---------------------|---------|-------------|---------|----------------|------------------|---------------|
|      | Low Water.          |         | High Water. |         | Range of Tide. | Wind.       | Low Water.          |         | High Water. |         | Range of Tide. | Wind.            |               |
|      | Time A. M.          | Height. | Time A. M.  | Height. |                |             | Time P. M.          | Height. | Time P. M.  | Height. |                |                  |               |
|      | H. M.               | Ft. In. | H. M.       | Ft. In. | H. M.          | Ft. In.     | H. M.               | Ft. In. | H. M.       | Ft. In. | H. M.          | Ft. In.          |               |
| July | 1 ...               | 8 46    | 2 0         | 2 10    | 9 8            | S. S. E.    | 7 8                 | 5 3     | 2 30        | 8 11    | 3 8            | S. S. W. & S. W. | Hot.          |
| "    | 2 ...               | 8 50    | 2 5         | 2 35    | 10 5           | S.          | 7 0                 | 5 3     | 3 0         | 9 0     | 4 3            | S. W.            | Dry hot.      |
| "    | 3 ...               | 9 30    | 2 10        | 3 28    | 10 1           | S.          | 7 0                 | 5 3     | 3 47        | 9 0     | 4 3            | S. W.            | Cloudy.       |
| "    | 4 ...               | 10 25   | 3 6         | 4 0     | 9 10           | W.          | 7 4                 | 4 8     | 4 56        | 9 0     | 4 5            | S. E. to S. W.   |               |
| "    | 5 ...               | 11 40   | 4 2         | 5 27    | 9 3            | W.          | 7 1                 | 4 3     | 5 45        | 9 4     | 5 1            | S. W.            | Cloudy.       |
| "    | 6 ...               | .....   | .....       | 6 37    | 9 1            | W. & S. W.  | 6 2                 | 4 6     | 6 50        | 9 8     | 5 2            | S. W.            | Ditto.        |
| "    | 7 ...               | 1 15    | 4 0         | 7 0     | 9 3            | S. & S. W.  | 6 5                 | 4 9     | 7 28        | 10 0    | 5 3            | S. & S. W.       | Ditto.        |
| "    | 8 ...               | 2 36    | 2 7         | 8 40    | 9 0            | W.          | 8 10                | 5 0     | 8 50        | 10 3    | 5 4            | S. W.            | Ditto.        |
| "    | 9 ...               | 3 50    | 1 7         | 9 40    | 10 5           | S. W.       | 8 10                | 5 0     | 9 57        | 10 0    | 5 4            | S. W.            | Ditto.        |
| "    | 10 ...              | 4 27    | 1 4         | 10 45   | 9 4            | S. W.       | 8 1                 | 5 5     | 10 57       | 10 9    | 5 4            | S. W.            | Ditto.        |
| "    | 11 ...              | 5 20    | 1 2         | 11 59   | 9 3            | W.          | 8 7                 | 5 4     | 12 0        | 9 8     | 4 6            | W.               | Heavy rain.   |
| "    | 12 ...              | 6 20    | 1 1         | .....   | .....          | S. W.       | 8 7                 | 5 6     | 12 40       | 10 0    | 4 4            | S. W.            | Cloudy.       |
| "    | 13 ...              | 7 10    | 1 2         | 1 18    | 11 2           | S. E.       | 10 0                | 5 3     | 1 25        | 9 4     | 4 1            | .....            | Hot sultry.   |
| "    | 14 ...              | 7 30    | 1 5         | 1 30    | 11 5           | S. E.       | 10 0                | 5 3     | 2 0         | 9 3     | 4 0            | .....            | Cloudy.       |
| "    | 15 ...              | 8 37    | 2 4         | 2 17    | 11 5           | S. E.       | 8 49                | 5 2     | 3 18        | 9 5     | 4 2            | S. E.            | Rain.         |
| "    | 16 ...              | 9 0     | 2 8         | 3 40    | 10 8           | S. to S. E. | 9 5                 | 5 3     | 3 50        | 9 5     | 4 2            | .....            | Ditto.        |
| "    | 17 ...              | 9 39    | 3 7         | 4 0     | 9 9            | S. E.       | 9 40                | 4 11    | 4 5         | 10 8    | 3 11           | S. to S. E.      | Ditto.        |
| "    | 18 ...              | 10 15   | 4 8         | 4 19    | 8 11           | S. W.       | 10 50               | 4 10    | 4 20        | 8 9     | 3 11           | S.               | Hot sultry.   |
| "    | 19 ...              | 10 56   | 5 3         | 4 57    | 8 5            | S. W.       | 11 35               | 4 8     | 5 19        | 8 9     | 3 11           | S. W.            | Cloudy.       |
| "    | 20 ...              | 11 40   | 6 0         | 5 35    | 8 3            | S. E.       | 12 0                | 4 3     | 6 17        | 9 0     | 4 1            | S. E.            | Clear.        |
| "    | 21 ...              | 12 48   | 4 3         | 7 20    | 7 3            | S. E.       | 2 0                 | 6 2     | 7 36        | 9 0     | 4 2            | S. E.            | Squally.      |
| "    | 22 ...              | 2 29    | 3 7         | 8 27    | 7 8            | S.          | 2 46                | 5 10    | 8 45        | 9 1     | 3 3            | S.               | Clear.        |
| "    | 23 ...              | 3 16    | 3 1         | 9 28    | 8 2            | S. E.       | 3 25                | 6 2     | 9 45        | 9 7     | 3 5            | S. & S. W.       | Hot sultry.   |
| "    | 24 ...              | 3 47    | 2 0         | 10 15   | 8 7            | S. & S. W.  | 4 17                | 5 9     | 10 25       | 9 0     | 4 7            | S. to S. W.      | Hot.          |
| "    | 25 ...              | 4 35    | 1 9         | 10 50   | 8 9            | S. W.       | 4 46                | 6 6     | 10 28       | 10 1    | 4 7            | S. W.            | Lead thunder. |
| "    | 26 ...              | 5 18    | 1 8         | 11 15   | 9 2            | S. to S. W. | 5 37                | 5 4     | 11 16       | 10 6    | 5 4            | .....            | Cloudy.       |
| "    | 27 ...              | 6 10    | 1 6         | 12 0    | 9 4            | S. W.       | 6 28                | 5 3     | .....       | .....   | 4 1            | .....            | Hot sultry.   |
| "    | 28 ...              | 6 30    | 5 1         | 0 40    | 10 7           | W.          | 7 0                 | 4 5     | 1 0         | 10 6    | 6 0            | .....            | Dark squally. |
| "    | 29 ...              | 7 46    | 1 6         | 1 37    | 10 11          | W.          | 7 55                | 4 9     | 1 40        | 9 8     | 4 11           | S. W.            | Cloudy.       |
| "    | 30 ...              | 8 24    | 2 2         | 2 10    | 11 8           | S. W.       | 8 30                | 4 10    | 2 15        | 9 10    | 5 0            | S. W.            | Ditto.        |
| "    | 31 ...              | 8 40    | 2 11        | 2 30    | 11 1           | .....       | 8 47                | 4 10    | 3 19        | 9 9     | 4 11           | S. W.            | Cloudy.       |

| DAY.<br>1885. | MORNING TIDE. A. M. |                   |                     |                   |                              | EVENING TIDE. P. M. |                   |                     |                   |                              | WEATHER. |             |                             |
|---------------|---------------------|-------------------|---------------------|-------------------|------------------------------|---------------------|-------------------|---------------------|-------------------|------------------------------|----------|-------------|-----------------------------|
|               | Low Water.          |                   | High Water.         |                   | Range<br>of Tide.<br>Ft. In. | Low Water.          |                   | High Water.         |                   | Range<br>of Tide.<br>Ft. In. |          |             |                             |
|               | Time A. M.<br>H. M. | Height<br>Ft. In. | Time A. M.<br>H. M. | Height<br>Ft. In. |                              | Time P. M.<br>H. M. | Height<br>Ft. In. | Time P. M.<br>H. M. | Height<br>Ft. In. |                              |          |             |                             |
|               |                     |                   |                     |                   |                              |                     |                   |                     |                   |                              |          |             |                             |
| August        | 1 D                 | 9 26              | 3 5                 | 3 30              | 10 9                         | 7 4                 | 9 30              | 4 2                 | 3 40              | 9 8                          | 5 6      | S. W.       | Rain.                       |
| "             | 2 ...               | 9 45              | 4 4                 | 4 5               | 10 9                         | 4 11                | 10 19             | 2 10                | 4 30              | 9 9                          | 5 11     | S. W.       | Ditto.                      |
| "             | 3 ...               | 11 31             | 5 1                 | 5 28              | 8 9                          | 3 8                 | 11 30             | 3 8                 | 5 30              | 9 10                         | 6 2      | S. W.       | Cloudy & rain.              |
| "             | 4 ...               | 11 50             | 4 5                 | 6 28              | 8 5                          | 4 0                 | 12 0              | 5 0                 | 6 24              | 8 5                          | 3 5      | S. W.       | Cloudy.                     |
| "             | 5 ...               | 0 30              | 4 2                 | 6 27              | 9 10                         | 5 8                 | 1 27              | 6 2                 | 6 56              | 8 9                          | 5 7      | S. W.       | Ditto.                      |
| "             | 6 ...               | 2 14              | 3 2                 | 8 38              | 9 1                          | 5 11                | 1 38              | 6 7                 | 8 50              | 10 1                         | 3 6      | S. W.       | Ditto.                      |
| "             | 7 ...               | 3 10              | 2 2                 | 9 28              | 9 8                          | 7 6                 | 2 34              | 6 7                 | 9 36              | 10 9                         | 4 2      | S. to S. W. | Hot.                        |
| "             | 8 O                 | 4 6               | 1 1                 | 10 39             | 11 3                         | 8 5                 | 3 24              | 6 7                 | 10 50             | 11 1                         | 4 8      | S. W.       | Cloudy.                     |
| "             | 9 ...               | 4 50              | 1 8                 | 11 24             | 10 3                         | 8 5                 | 4 23              | 6 5                 | 11 30             | 11 7                         | 6 1      | S. W.       | Ditto.                      |
| "             | 10 ...              | 5 29              | 1 9                 | 12 0              | 10 1                         | 8 4                 | 4 58              | 6 6                 | 11 30             | 11 7                         | 4 11     | S. & S. W.  | Rain.                       |
| "             | 11 ...              | 7 25              | 2 1                 | 1 15              | 11 11                        | 10 3                | 6 30              | 5 2                 | 1 50              | 9 10                         | 5 5      | S. W.       | Ditto.                      |
| "             | 12 ...              | 7 38              | 2 1                 | 1 55              | 10 11                        | 8 10                | 7 30              | 4 4                 | 2 0               | 9 7                          | 5 3      | S. W.       | Clear.                      |
| "             | 13 ...              | 8 15              | 3 2                 | 2 16              | 10 10                        | 7 8                 | 8 25              | 4 1                 | 2 25              | 9 8                          | 5 7      | S. W.       | Ditto.                      |
| "             | 14 ...              | 8 47              | 4 8                 | 3 35              | 10 9                         | 6 1                 | 9 0               | 3 10                | 2 40              | 9 7                          | 5 9      | S. W.       | Cloudy.                     |
| "             | 15 (                | 9 39              | 3 11                | 3 25              | 9 8                          | 5 9                 | 9 45              | 3 9                 | 3 29              | 8 3                          | 4 5      | S. W.       | Clear.                      |
| "             | 16 ...              | 10 15             | 4 7                 | 3 38              | 8 9                          | 4 2                 | 10 58             | 3 3                 | 4 0               | 8 0                          | 4 3      | S.          | Rain.                       |
| "             | 17 ...              | 10 55             | 5 2                 | 3 50              | 8 1                          | 2 11                | 10 10             | 4 1                 | 4 26              | 8 11                         | 4 10     | S. W.       | Showers.                    |
| "             | 18 ...              | 11 10             | 5 11                | 5 18              | 1 6                          | 1 9                 | 11 47             | 3 10                | 5 30              | 8 10                         | 5 0      | S. W.       | Cloudy.                     |
| "             | 19 ...              | 12 0              | 4 0                 | 6 28              | 7 1                          | 3 1                 | 1 19              | 6 7                 | 6 35              | 8 7                          | 3 9      | S. W.       | Ditto.                      |
| "             | 20 ...              | 1 40              | 3 11                | 7 34              | 7 7                          | 3 8                 | 1 50              | 5 0                 | 7 56              | 8 9                          | 4 4      | S. W.       | Ditto.                      |
| "             | 21 ...              | 2 18              | 3 2                 | 8 0               | 8 2                          | 5 0                 | 3 25              | 5 0                 | 9 40              | 9 8                          | 4 1      | S. W.       | Ditto.                      |
| "             | 22 ...              | 4 18              | 2 7                 | 10 26             | 9 0                          | 6 5                 | 4 20              | 5 11                | 10 35             | 10 0                         | 4 1      | S. W.       | Ditto.                      |
| "             | 23 ●                | 4 27              | 2 4                 | 10 58             | 9 2                          | 6 10                | 4 38              | 5 2                 | 11 28             | 10 0                         | 4 1      | S. W.       | Ditto.                      |
| "             | 24 ...              | 5 18              | 2 3                 | 11 38             | 10 5                         | 6 2                 | 6 0               | 5 0                 | 12 0              | 10 11                        | 5 2      | S. W.       | Settled.                    |
| "             | 25 ...              | 6 38              | 1 11                | 1 0               | 11 4                         | 4 8                 | 6 55              | 4 5                 | 0 38              | 9 7                          | 5 11     | S. W.       | Cloudy, & showers at times. |
| "             | 26 ...              | 6 59              | 1 8                 | 1 7               | 10 0                         | 4 8                 | 7 0               | 3 8                 | 1 20              | 9 11                         | 5 10     | S. W.       | Clear.                      |
| "             | 27 ...              | 7 10              | 1 7                 | 1 24              | 11 7                         | 10 0                | 7 20              | 3 8                 | 1 30              | 10 0                         | 6 4      | S. W.       | Ditto.                      |
| "             | 28 ...              | 7 39              | 2 7                 | 1 37              | 11 6                         | 9 1                 | 8 0               | 3 1                 | 1 45              | 10 1                         | 7 0      | S. W.       | Hot.                        |
| "             | 29 ...              | 8 20              | 3 0                 | 2 0               | 11 10                        | 8 10                | 8 48              | 6 3                 | 2 19              | 10 0                         | 3 9      | S. to S. W. | Cloudy.                     |
| "             | 30 D                | 9 27              | 5 1                 | 3 18              | 10 1                         | 5 0                 | 10 14             | 6 0                 | 3 45              | 10 0                         | 4 0      | S. to S. W. | Ditto.                      |
| "             | 31 ...              | 10 38             | 5 0                 | 4 20              | 10 0                         | 5 0                 | 10 58             | 3 7                 | 4 33              | 9 11                         | 6 4      | S. to S. W. | Ditto.                      |

# ERRATA.

---

- Page 8, line 5 from the bottom dele "on."  
 11, 5 from ditto, for "or" read "is."  
 12, in the last dimension, for "Palatial" read "Palatine."  
 16, line 14, for "molars" read "molar."  
 21, 11, "19 2 inches" read "12 2 inches."  
 21, 17, "circle" read "arch."  
 22, 9, "form" read "forma."  
 29, 1, "descend lower" read "descend lower in."  
 31, 8, "He Sivalensis" read "H. Sivalensis."  
 34, 5, "2 to 30°" read "20° to 30°"  
 34, 7, "margin of foramen" read "margin of the posterior nasal foramen."  
 36, 15, "pyal" read "frontal"  
 40, 24, "uniform" read "reniform"  
 50, 25, "but" read "not."  
 53, 9, "upper" read "lower."  
 145, line 1, "Noimenta" read "Ruhmenta"  
 146, note, from "Erythrocephala" read "Erythrogycha"  
 146, line 6, for " $\frac{1}{2}$ " read " $\frac{1}{6}$ "  
 157, for "Alaudine" read "Alaudine."  
 158, "Fringulanda" read "Fringulanda."  
 166, line 11, for "Conch" read "Concha."  
 169, 6 from bottom, for "Conch" read "Concha."  
 173, 4 from bottom, for "outer *tau*" read "upper *fore*"  
 180, 6 from bottom, for "Larsa" read "Larsa."  
 181, line 10-11, words former and latter transposed.  
 186 for "subgenus" read "genus."  
 190, line 5 from bottom, after above put *and*,  
 192, 2 from bottom, after well put *with*.

MADE BY  
 WESTINGHOUSE  
 CALCULATING





