JOURNAL

OF THE

ASIATIC SOCIETY OF BENGAL.

VOL. LI.

PART II. (NATURAL HISTORY, &c.)

(Nos. I TO IV.—1882: with 4 plates.)

EDITED BY

THE NATURAL HISTORY SECRETARY.

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

CALCUTTA:

PRINTED BY J. W. THOMAS, AT THE BAPTIST MISSION PRESS,

AND PUBLISHED BY THE

ASIATIC SOCIETY, 57, PARK STREET.

1882.

LIST OF CONTRIBUTORS.

Date of issue of the different numbers of the Journal, Part II, 1882.

No. I.—Containing pp. 1—36, with Plates I and III ; and Title-page, Index, and 3 Plates for Vol. L, was issued on August 21st, 1882.

Nos. II—III.—Containing pp. 37—66, with Plate XVI for Vol. L, was issued on December 30th, 1882.

No. IV.—Containing pp. 67—90, with Plate V, and Title-page, Index, &c., for Vol. LI, was issued on March 1st, 1883.

LIST OF PLATES.

I.—New Japanese and Indian *Clausiliæ*.
II.—Wanting.
III.—Diurnal *Lepidoptera* inhabiting the Nicobar Islands.
IV.—*Rhopalocerous Lepidoptera* from the Indian region. (This plate will be published with No. I of 1883.)
V.—Indian Land Shells.

JOURNAL

OF THE

ASIATIC SOCIETY OF BENGAL.

Part II.—PHYSICAL SCIENCE.

No. I.—1882.

I.—*On a collection of Japanese* Clausiliæ *made by Brigade Surgeon R. Hungerford in* 1881.—*By* O. F. von Möllendorff, Ph. D., *Vice-consul for Germany, Hongkong.*

(Received January, 3rd;—Read February, 1882.)

(With Plate I).

When E. von Martens (Preuss. Exped. n. Ostasien, Landschnecken) published the first connected list of Japanese landshells in 1868, there were only 8 species of *Clausilia* known from that country, but their number has so rapidly increased of late years that Kobelt in his Fauna of Japan was able to enumerate not less than 35 species, including one *Balea*. These show a great variety of forms, and have necessitated the creation of many new sections and groups of the subgenus *Phaedusa*, many of which are confined to Japan. As only a small portion of the Japanese archipelago has been explored as yet, and that for the greater part by travellers for whom conchology had only a secondary interest, it is not not to be wondered at that Brigade Surgeon Hungerford's excursions have been most successful. His collection, made in a few weeks, contained, as the following list will show, 21 species of *Clausilia*, ten of which I consider to be undescribed. In enumerating them, I follow the judicious arrangement of *Phaedusa* by Dr. Boettger in his "Clausilien studien" (Cassel, 1877) and "Systematisches Verzeichniss der Gattung Clausilia" (Frankfurt, 1878), which I find corroborated nearly throughout. In a few instances, however, the creation of new groups for some of the novelties will eventually prove to be necessary.

I may add here that I have used throughout the terminology now generally adopted in Germany. We use the term "*lamellae*" only for the

parietal and subcolumellar plaits, *i. e.*, *lamella supera, infera, spiralis, subcolumellaris;* while all the palatal ones are termed "*plicæ.*" Of these latter the long upper plait, in many species the only one, is called "*plica principalis,*" those above the principal are "*plicæ suturales,*" those below it, "*plicæ palatales.*"

Genus CLAUSILIA, Drap.

Subgenus *Phaedusa*, H. and A. Adams.

a. Group of *Clausilia Shanghaiensis.* Pfr. = *Euphaedusa*, Böttg., Claus. Stud. 1877, p. 57.

1. CLAUSILIA DIGONOPTYX.

1877. *Clausilia digonoptyx*, Böttger, Claus. Stud. p. 58.
1878. —— —— ——. Jahrb. D. Mal. Ges. v, p. 45, t. iii, f. 1.
—— —— —— —— Syst. Verz. Claus. p. 54.
1879. —— —— —— Jahrb. D. M G. vi, p. 108.
—— —— —— —— Kobelt, Fauna Jap. extramar. p. 69, t. viii, f. 17.

The type from Kamatokogiro; var. *minor*, diam. maj. 11½ mm., near the same place.

2. CLAUSILIA TAU.

1877. *Clausilia tau*, Böttger, Claus. Stud. p. 58.
—— —— —— Nachrichtsbl. D. M. G. no. 6, p. 70.
1878. —— —— Jahrb. D. M. Ges. vi, p. 46, t. iii, f. 2.
—— —— —— Syst. Verz, p. 54.
1879. —— —— Jahrb. D. M. G. vi, p. 108.
—— —— —— Kobelt, Fauna Jap. p. 70, t. viii, f. 18.

Very numerous at Kioto, Kobi, Nara, and other places in the island of Nippon.

3. CLAUSILIA PROBA.

1868. *Clausilia proba*, A. Adams, Ann. & Mag. Nat. Hist. 4th ser. i. p. 471.
—— —— *aculus*, E. von. Martens, Ostas. Landschn, p. 33, t. xxii. f. 15 (nec Benson).
1877. —— —— Böttger, Claus. Stud. p. 58 (ex parte).
1878. —— —— —— Jahrb. D. M. G. v, p. 49, t. iii, f. 3.
—— —— —— —— Syst. Verz. p. 54.
1879. —— —— Kobelt, Fauna Jap. p. 71 t. viii, f. 19.
1879. *Clausilia proba*, Böttger, Jahrb. D. M. G. VI, p. 108.

Common at Nagasaki (where the species was likewise collected by Professor Rein) and at Utsonomda and Mamada.

4. CLAUSILIA HUNGERFORDIANA, n. sp., Pl. I, Fig. 1.

Testa subrimata, fusiformis, pellucida, sericina, arcuatim striatula, corneofusca, maculis albis interrupte signata (quasi zebrina); anfr. 9 *convexiusculi, suturâ profundâ disjuncti, ultimus rotundatus pone aperturam*

subinflatus, irregulariter costulato-striatus; apertura subobliqua, rotundato-piriformis, sinulo recto, peristoma continuum solutum, superne vix sinuatum, valde protractum, expansum, reflexiusculum, parum incrassatum; lamella supera obsoleta, interdum in margine peristomatis noduli instar vix distinguenda, lamella spiralis recedens, lamella infera a margine valde remota, late arcuata, subcolumellaris immersa. Plica principalis modica, palatalis una supera brevis cum lunellâ interruptâ fere obsoletâ subtus ramum parvum retrorsum mittente convexa. Clausiliam latissimum, subquadratum antice acuminatum.

Alt. 12½, lat. 2¾, apert. alt. 2¼, lat. 2 mm.

Hab. Nara in insula Nippon.

In its closing apparatus this pretty little novelty greatly resembles *Clausilia proba*. The upper parietal lamella is, in the majority of specimens, only marked by a slight thickening of the lip. Rarely there is a minute knob. After a distinct interval the "lamella spiralis" sets in. The lamella infera is somewhat like that of *Clausilia digonoptyx*, Böttg., so that the parietal lamellæ would approach very close to one another, if the upper one were properly developed. The specific character of our species is the fine sericine epidermis with alternating white and brown spots.

b. Group of *Clausilia valida*, Pfr. = *Stereophaedusa*, Böttger, Clausilienstudien, p. 61.

5. Clausilia Hilgendorfi.

1877. *Clausilia Hilgendorfi*, v. Martens, Sitz. Ber. Ges. Nat. Fr. Berlin, 17 April, p. 106.
1877. —— ——— Böttger, Claus. Stud. p. 60.
1878. —— ——— „ Syst. Verz. p. 55.
1879. —— ——— Kobelt, Fauna Jap. p. 76, t. ix, f. 2.

Three specimens of a large *Clausilia*, from 30 to 35 millim. in length, of a dark chestnut-brown colour, collected by Mr. Hungerford at Chinsinji, agree very well with Prof. von Martens' diagnosis and Kobelt's figure of *C. Hilgendorfi*. In one specimen the subcolumellar lamella is somewhat receding.

6. Clausilia Kobensis.

1876. *Clausilia Kobensis*, Edg. Smith, Quart. J. of Conchology, i, p. 122 (February).
—— —— *Nipponensis*, Kobelt, Jahrb. D. Mal. Ges. iii, p. 275, t. viii, f. 3,4.
1877. —— *japonica*, E. von. Martens, Sitz. Ber. Nat. Fr. Berlin, p. 108 (an Crosse?).
—— —— *japonica* (cum var. *Nipponensis*), Böttger, Claus. Stud. p. 62.
1878. —— —— —— Syst. Verz. p.
1879. —— —— Kobelt, Fauna Jap. p. 75, t. viii, f. 10, 11.

An *Clausilia japonica*, Crosse (Journ. de Conch. XIX, 1871, p. 228, t. XIII, f. 5) ?

I am by no means sure of the correctness of the identification of *Clausilia Kobensis*, Smith, with *japonica*, Crosse, as proposed by Böttger and Kobelt. Crosse's diagnosis is very vague and incomplete, and I have seen neither figures nor specimens of the true *japonica*. On the other hand, there is no doubt that Kobelt's *nipponensis* and *Kobensis*, Smith, belong to one and the same species, and that Smith's name has the priority.

Mr. Hungerford collected numerous specimens of the type at Kobi, the original habitat, and near Koma Kasunga. A much smaller form from Suma Yushi, I propose to distinguish as

var. PALLENS, nova.

differt a typo testâ minore—23 millim longâ—tenuiore pallide flavescenti-corneâ, lamellâ inferâ magis elevatâ, superae in profundo magis approximatâ.

7. CLAUSILIA OOSTOMA, n. sp., Pl. I, Fig. 2.

Testa elongato-fusiformis, solidula, subpellucida, striatula, corneo-fusca, spira gracilis apice obtuso, anfr. 12—12½ *subplani, ultimus subdistortus rotundatus; apertura oviformis, subrecta, peristoma continuum, solutum, expansum, reflexiusculum, superne leviter sinuatum. Lamella supera marginalis, obliqua, cum spirali contigua, infera marginem haud attingens, retrorsum valde elevata, spiraliter torta, fere horizontalis, intus ultra lamellam spiralem producta, lamella subcolumellaris emersa usque ad marginem protracta; plica principalis mediocris, palatalis supera brevis cum principali divergens, infera obsoleta vel nulla, lunella nulla. Clausilium latissimum sicut precedentis speciei.*

Alt. 28½, lat. 5½, apert. long. 6, lat. 4¾ millim.

HAB. Only three specimens from Hakoni.

A near relation to the preceding species, but sufficiently distinguished by the more elongate shape, the thinner shell, the very regular oviform aperture, the more valid and still more spirally twisted, nearly horizontal lower parietal lamella, the much more divergent upper, and obsolete lower, palatal plait.

c. Group of *Cl. Yokohamensis*, Crosse = *Megalophaedusa*, Böttg. (Clausilienstudien, p. 62).

8. CLAUSILIA VASTA.

1877. *Clausilia vasta*, Böttger, Claus. Stud. p. 62.
1878. —— —— —— Jahrb. D. M. G. v, p. 51, t. iii, f. 4.
—— —— —— —— Syst. Verz. p. 56.
1879. —— —— Kobelt, Fauna Jap. p. 82, t. viii, f. 15.

HAB. Nagasaki.

9. Clausilia ducalis.

1876. *Clausilia ducalis*, Kobelt, Jahrb. D. M. G. iii, p. 152, t. v, f. 7.
1877. —— —— Böttger, Claus. Stud. p. 63.
1878. —— —— —— Syst. Verz. p. 56.
1879. —— —— Kobelt, Fauna Jap. p. 83, t. viii, f. 10.

Two magnificent specimens of a *Megalophaedusa* from Hakoni agree fairly well with Kobelt's diagnosis and figure of *Clausilia ducalis*. They are, however, longer—38 millim. instead of 36,—of a dark chestnut colour with a slight violet tint, not "yellowish horn-coloured" (*luteo-cornea*) as Kobelt describes his *C. ducalis*, and the subcolumellar lamella is completely immersed so that it can only be seen by holding the shell in an oblique position. There being but two specimens known of *Clausilia ducalis*, it seems advisable to class the specimens collected by Mr. Hungerford with that species provisionally, although they may deserve a new name as a variety.

d. Group of *Clausilia cylindrica*, Gray = *Cylindrophaedusa*, Böttger (Claus. Stud. p. 64).

10. Clausilia gracilispira, n. sp., Pl. I, Fig. 3.

Testa elongato-fusiformis, subcylindrica, tenera, pellucida, subtiliter costulato-striata, viridiflava, anfractus 10-11 *subplani suturâ valde distinctâ discreti; apertura parva, subobliqua, rotundato-piriformis, peristoma continuum solutum, superne leviter sinuatum, breviter expansum. Lamella parietalis supera marginalis, obliqua, satis valida, cum spirali continua, infera remotissima, vix conspicua, subcolumellaris immersa; plica palatalis mediocris, lunella nulla, plicae palatales tres quarum prima et tertia subaequales, media brevis. Clausilium angustum linguiforme, acuminatum.*

Alt. 9½—13½, diam. 2, apert. long. 2, lat. 1½ millim.

Hab. Near Kobi.

A very well-marked species, which I can only compare to *Clausilia cylindrica*, Gray. The slender, subcylindrical shape, the small aperture, the absence of a lunella, the very remote and oblique lower parietal lamella, the immersed subcolumellar lamella indicate its relation to the group *Cylindrophaedusa* created by Böttger for *Cl. cylindrica*. It differs, besides size, shape, colouring, and sculpture of the shell, by the spiral lamella completely continuous with the lamella supera instead of "fere contigua," by the *three* palatal plaits instead of two. I think, therefore, that the Japanese species has to be placed in the group *Cylindrophaedusa*. The clausilium is like that of the next group, *Hemiphaedusa*.

Before passing on to the last-named group, I shall here enumerate two new species which do not very well agree with any of Böttger's subsections of *Phaedusa*, and for which I should propose to make a new group, if I

knew any species of Böttger's *Acrophaedusa* (l. c. p. 64). This group, comprising two Javanese Clausiliæ, *Cl. Junghuhni*, Phil., and *cornea*, Phil., is perhaps the only one to which these novelties could be referred. On the other hand, there are relations to the first subgroup ("Formenkreis") of *Hemiphaedusa*. Unfortunately, Mr. Hungerford collected only a few specimens of each, and I have been unable to study the clausilium of either species. The decision whether they belong to *Hemiphaedusa* as a special subgroup or ought to form a new group by themselves has to be reserved until more material will allow the breaking up of some specimens.

11. Clausilia sericina, n. sp., Pl. I, Fig. 4.

Testa ventricoso-fusiformis solida cornea subtiliter striatula sericina; anfr. 10—10½ *convexiusculi sutura distincta, ultimus subdistortus, haud magis striatus; apertura subobliqua, rotundato-piriformis; peristoma continuum, solutum, valde incrassatum. Lamella supera valida, obliqua, ad marginem descendens, cum spirali contigua, infera antrorsum vix conspicua, subtus truncata, subcolumellaris vix emersa; plica principalis profunda, in apertura haud conspicua, palatales duo, supera brevis, secunda punctiformis vel obsoleta, infera lunellaque nullae. Clausilium? (non vidi).*

Alt. 22½, lat. 5, apert. long. 5½, lat. 4 millim.

var. minor *alt.* 20½ *millim. anfract.* 11, *lamella subcolumellaris immersa.*

Hab. Two specimens of the typical form from Chinsinji, and one specimen of the smaller variety from Yumagaaishi.

The palatal plaits might be compared to those in the group *Stereophaedusa*, from which our species is otherwise widely different. The lower parietal lamella refers *Cl. sericina* to *Hemiphaedusa*.

12. Clausilia caryostoma, n, sp., Pl. I, Fig. 5.

Testa ventricoso-fusiformis solidula, striatula, pallide cornea, anfr. 9 *subplani suturâ distinctâ discreti, ultimus penultimo vix altior; apertura rotundata, subobliqua, peristoma continuum, superne haud sinuatum, breviter solutum, expansum, incrassatum. Lamella supera mediocris, obliqua, cum spirali continua, infera valde remota, parva, intus furcata, subcolumellaris immersa; plica principalis valida, longa, lunella nulla, plicae palatales tres ventrales quarum prima et tertia subaequales, breves, secunda punctiformis. Clausilium?*

Alt. 14½, lat 3½, apert. long. 3½, lat. 3 millim.

Hab. Kobi; four specimens.

This novelty likewise does not seem to fit into any of Dr. Böttger's subdivisions of *Phaedusa*. The lower parietal lamella reminds one of that

of *Cl. subgibbera*, also of *Cl. hyperolia*, v. Mart. The palatal 'plicae' are so far up in the shell that they are visible above the aperture, a position for which Ad. Schmidt has introduced the appropriate term "ventralis." The same position of the "plicae palatales" occurs in *Cl. aurantiaca*, Böttg. Our species differs from the group *Hemiphaedusa* by the immersed subcolumellar lamella, and the absence of a lunella. The small number of specimens prevented the examination of the clausilium, and, as mentioned before, the final classification of this species and *Cl. sericina* has to be reserved.

e. Group of *Clausilia pluviatilis*, Bens = *Hemiphaedusa*, Böttg. (l. c p. 65).

a. Subgroup of *Clausilia validiuscula*, v. Mart.

13. Clausilia æthiops, n. sp., Pl. I, Fig. 6.

Testa elongato-fusiformis solida, striata, obscure castaneofusca, anfr. 12 *subplani; apertura subobliqua, ovali-piriformis, peristoma satis incrassatum, vix solutum, reflexum, albolabiatum. Lamella supera obliqua, marginalis cum spirali contigua, infera oblique ascendens in profundo dextrorsum retorta, subcolumellaris modica, emersa, marginem attingens. Plica principalis mediocris, sat profunda, palatales tres laterales obliquae quarum media minor, lunella nulla. Clausilium ?*

Alt. 33, lat. 6½, apert. long. , lat. millim.

Hab. The unique specimen was collected near Nagasaki.

This fine *Clausilia* is a near relation of *Cl. Hickonis*, Böttg., with which is has all the characteristics of the closing apparatus in common. It differs, however, by the habitus (which has nothing of the curious claviform shape of *Cl. Hickonis*, but is rather slender), the considerably larger size, the dark brown colour, and some smaller differences of the lamellæ and plicæ; so that I do not hesitate to make it a separate species.

14. Clausilia tetraptyx, n. sp., Pl. I, Fig. 7.

Testa fusiformis, solidula, spirâ gracilis attenuatâ apice acutiusculo, subtiliter costulato-striata, corneofusca; anfr. 9½ *convexiusculi; apertura piriformi-ovata, subobliqua, marginibus parallelis, peristoma continuum, superne leviter solutum, leviter incrassatum et expansum; lamella supera subobliqua, marginalis cum spirali continua, infera spiraliter recedens, haud furcata, antrorsum complanata, subcolumellaris valida, emersa, marginem attingens. Plica principalis longa, palatales quatuor quarum prima et quarta subaequales majores, mediae subaequales minores. Clausilium satis angustum, antice haud incrassatum, rotundato acuminatum.*

Alt. 17—18, lat. 4, apert. long. 4, lat. 3½ millim.

Hab. Fujisawa.

By the shape of the clausilium and the four palatal plaits instead of a lunella this form belongs to the subgroup of *Cl. validiuscula*, v. Mart.

It is well characterised by the small size, the less solid shell, the sculpture, the less oblique upper parietal lamella.

β. Subgroup of *Clausilia platydera*, v. Mart.

15. CLAUSILIA PLATYDERA.

1876. *Clausilia platydera*, v. Martens, Jahrb. D. M. G. iii, p. 362.
1877. —— —— Böttger, Claus. Stud. p. 67.
1878. —— —— —— Syst. Verz. p. 57.
1879. —— —— Kobelt, Fauna Jap. p. 91, t. ix, f. 9.

var. ELONGATA, Böttger, Syst. Verz. Clausilia, p. 57.

Mr. Hungerford collected some elongate slender forms of 27½—29½ millim. in length at Nara. These I think are Böttger's var. *elongata*.

Another form was found numerous near Kobi. It is more ventricose, has a more solid shell, a broader and rounder aperture than the type; the lunella is shaped nearly as in Böttger's var. *lambda* (Claus. Stud. p. 67), forming a right or obtuse angle with the *plica principalis*. On the other hand, the peristome is always solute above and the subcolumellar lamella always reaches the margin, while Böttger says of his variety, "peristoma superne *haud* solutum," "lamella subcolumellaris *subimmersa*." This form therefore shows a transition from the type to var. *lambda*, and might deserve a new name as a variety or a subvariety.

16. CLAUSILIA FUSANGENSIS, n. sp., Pl. I, Fig. 8.

Testa gracili-fusiformis interdum decollata, solidula, striatula, cornea; anfr. 12 *convexiusculi, sutura satis profunda disjuncti; apertura recta, basi recedens, ovato-piriformis, peristoma continuum, solutum, undique expansum et reflexum, albolabiatum. Lamella supera valida, obliqua, marginalis, cum spirali continua, infera a margine satis remota oblique ascendens, furcata, in profundo dextrorsum retorta, intus lamellam spiralem superans, subcolumellaris immersa. Plica principalis mediocris, lunella cum plicâ palatali superiore et inferiore parvis connexa figuram litterae graecae* λ *instar formans. Clausilium angustum.*

alt. 27—30, lat. 5, apert. long. 6, lat. 4 millim.

HAB. Chin-sin-ji.

Nearly related to *Clausilia platydera*, especially to the var. *elongata*, this fine form offers by the much slenderer shape, the invisible subcolumellar lamella, the more twisted lower parietal lamella etc., sufficient differences to deserve a new name, which I have formed from Fusang, the old poetic name of Japan.

17. CLAUSILIA AURANTIACA, Böttger.

1877. *Clausilia aurantiaca*, Böttger, Claus. Stud. p. 68.
1878. —— —— —— Syst. Verz. p. 57.
—— —— —— —— Jahrb. D. M. G. v, p. 101, t. iv, f. 5.
1879. —— —— Kobelt, Fauna Jap. p. 95, t. ix, f. 11.

var. MINOR, v. Möll. *Differt a typo testâ minore, graciliore, peristomate vix incrassato, lamellâ subcolumellari immersâ vel vix emersâ—marginem haud attingente.*

Alt. 8¾—11 millim.

HAB. Nara.

The differences above mentioned excepted, this dwarf variety agrees very well with the type, especially in the orange-brown colour.

18. CLAUSILIA BILABRATA.

1876. *Clausilia bilabrata*, E. Smith, Quart. J. of Conchol., Febr. p. 120.
1877. —— —— Böttger, Claus. Stud. p. 68.
1878. —— —— —— Syst. Verz. p. 38.
—— —— —— —— Jahrb. D. M. G. v, p. 103, t. iv, f. 6.
1879. —— —— Kobelt, Fauna. Jap. p. 96, t. ix, f. 12.

HAB. Kobi.

γ. Subgroup of *Clausilia hyperolia*, v. Mart.

19. CLAUSILIA HYPEROLIA.

1877. *Clausilia hyperolia*, E. von Martens, Sitz. Ber. Ges. Nat. Fr. 17 April, p. 110
—— —— —— Böttger, Claus. Stud. p. 69
1878. —— —— —— Syst. Verz. p. 58.
1879. —— —— Kobelt, Fauna Jap. p. 99, t. ix, f. 13.

Two specimens collected by Mr. Hungerford near Jotsuka, I think I can safely identify with E. von Martens' species, although I have seen but one not quite full grown specimen of the latter. Diagnosis and figure agree very well.

20. CLAUSILIA RECTALUNA, n. sp., Pl. I, Fig. 9.

Testa fusiformis, solidula, subpellucida, striatula, pallide cornea; anfr. 11½ *ultimus penultimo subaequalis, irregulariter costulatus; apertura subobliqua, tetragono-piriformis, peristoma continuum, solutum, expansum, valde incrassatum, reflexiusculum. Lamella supera valida marginem attingens cum spirali contigua, infera antrorsum fere obsoleta, retrorsum subverticaliter ascendens, in margine peristomatis incrassata, nodulifera; lamella subcolumellaris valida emersa usque ad marginem producta, fossulâ ab inferâ discreta. Plica principalis obsoleta punctiformis cum lunellâ rectâ conjuncta, plica suturalis post lunellam una brevissima, palatales nullae.*

Alt. 18—20, lat. 4, apert. long. 4, lat. 3 millim.

HAB. Kamatokogiro.

By its peculiar inner structure this remarkable shell can only be compared with the last mentioned species, with which it has in common the almost vertical and receding lower parietal lamella, the long and straight

lunar plait, and the strongly emersed subcolumellar lamella. It is, however sufficiently characterised as a separate species by the short *plica principalis* (which does not exist in *C. hyperolia*), the existence of a short sutural plait, the want of spiral lines on the epidermis, the horny colour, and the lower end of the *lamella infera*. This is more spirally twisted, gradually evanescent towards the peristome, but again thickens on the margin into a small knob, while the same lamella of *C. hyperolia* is cut off abruptly.

21. Clausilia aptychia, n. sp., Pl. I, Fig. 10.

Testa ventricosulo-fusiformis, solida, subpellucida, subtilissime striatula, pallide flavescens, saepe decollata; anfr. 11½ *convexiusculi, ultimus penultimo subaequalis, apertura subobliqua rotundato-tetragona, peristoma continuum, solutum, valde incrassatum, reflexiusculum. Lamella supera marginalis, mediocris, cum spirali contigua, infera antrorsum obsoleta, subtus truncata, verticaliter ascendens, intus validissima ante lamellam spiralem tenuem evanescentem abrupte desinens, lamella subcolumellaris valida emersa usque ad marginem producta. Plicae palatales nullae, lunella obsoleta. Clausilium satis angustum, marginibus parallelis, antice rotundatum.*

Alt. 22, lat. 4½, apert. long. 5, lat. 4 millim.

Hab. Hakoni.

Another interesting novelty of the subgroup of *C. hyperolia*, nearly related to the two preceding species, but larger than either of them and somewhat more ventricose There are not any palatal plaits and even the lunella is in some specimens entirely obsolete, in the others there is a thin layer of calcareous matter parallel with the outer edge of the *clausilium*. The spiral lamella is very low and thin and its inner end almost evanescent, although it extends beyond the inner end of the *lamella infera*. The latter is comparatively short, but very thick and high. Its abruptly cut off outer end is more like that of *Cl. hyperolia*, but somewhat more visible in the aperture; it then ascends vertically almost without any spiral twist and occupies nearly half the width of the whorl, the inner end being again truncated.

The systematic arrangement of these three species ought to be: *recta-luna, hyperolia, aptychia*, the first having rudimentary principal and sutural plaits and being thereby more nearly related to the preceding groups. I have, however, given *Clausilia hyperolia* the first place as the only species hitherto described.

II.—Clausilia Nevilliana, *a new Species from the Nicobars.*

By O. F. von Möllendorff, Ph. D.

(Received January 15th;—Read April 5th, 1882.)

Clausilia nevilliana, n. sp., Pl. I, Fig. 11.

Testa elongato fusiformis, subtiliter oblique striatula, fusca, nitidula; anfr. 10 *convexiusculi, apertura mediocris, fere verticalis, elongato-piriformis, sinulo recto perlongo, peristoma continuum, solutum, tenue, brevissime expansum, superne profunde sinuatum fere angulatum. Lamella supera obliqua, marginalis, valida, cum lamellâ spirali continua, infera a supera valde remota, spiraliter recedens, brevissime conspicua. Plica principalis longa, palatales duae majores profundae, ventrales, (antice intuenti suprâ aperturam conspicuae), lunella nulla. Clausilium? (non vidi.)*

Alt. 20, lat. 4, apert. long. 4, lat. 3 millim.

Hab. This very fine novelty was discovered by Mr. de Roepstorff on the island of Camorta, Nicobars, under a fallen tree in a damp place.

The small number of specimens—I have seen but two—has prevented as yet the examination of the inner structure of this interesting new *Clausilia*. This is the more to be regretted as it does not seem to belong to the same group as the only other species of the genus hitherto recorded from the Nicobars, *Cl. wüllerstorffi*, Zeleb. This species (of which I have seen one specimen in Brigade Surgeon Hungerford's collection) is nearly related to *Cl. javana*, Pfr., and should find its place in Böttger's second section of *Phaedusa* (*Pseudonenia*) and therein in the 5th subgroup ("Formenkreis") of *Cl. javana*. Our *Clausilia nevilliana* has nothing of the Nenia-like shape of that group, effected by the small number of whorls, the very large aperture, which is more or less protracted below. It is on the contrary rather slender, the aperture is rather small and though not very oblique still not quite vertical. The closing apparatus agrees pretty well with the characters given by Böttger of his section *Acrophaedusa* (Clausilienstudien, p. 64), *viz.*, a very long "principal plait," two or three rather long and deep palatal plaits, no lunella, small parietal lamellæ, piriform aperture, not dilatate peristome. This group was created for two Javanese species, *Cl. cornea* and *junghuhni*, Phil., and includes the Indian forms *Cl. monticola*, Godw.-Aust., and *aracana*, Theob. Unless the breaking up of a specimen should necessitate a different classification, I think that *Clausilia nevilliana* can more safely be considered to be an *Acrophaedusa*.

III.—*Descriptions of some new Asiatic* Clausiliæ.

By O. F. von Möllendorff, Ph. D.

(Received and read May 3rd, 1882).

Clausilia (Pseudonenia) andersoniana, n. sp., Pl. I, Fig. 12.

Testa ventricoso-fusiformis, solidula, subtilissime striatula, fere laevigata, pallide corneofusca, apice obtusiusculo; anfr. 10 *convexiusculi, ultimus valde attenuatus, subtus rotundatus, distinctius striatus; apertura parum obliqua, oblique piriformis, peristoma continuum, valde solutum, expansum, reflexiusculum, pallide corneum. Lamella parietalis supera obliqua, sat valida, cum spirali continua, infera crassa ante marginem subabrupte desinens, subcolumellaris immersa. Plica principalis valde elongata, palatales tres subventrales, divergentes, infima arcuata. Clausilium?*

Alt. 20, lat. 4, apert. long 4½, lat. 3¼ mill.

Hab. In insula Mergui provinciæ Tenasserim leg. Dr. Anderson.

This fine new Clausilia, of which Dr. Anderson discovered only two specimens in Mergui, is, as Mr. Nevill justly pointed out to me, nearly related to *Cl. insignis*, Gould, of the same province, to which species Dr. Böttger has assigned a separate group ("Formenkreis") in his subsection *Pseudonenia* of *Phaedusa*. It differs by the smaller size, less ventricose shape, the number of whorls 10 instead of 9, the more elongate and oblique aperture, the freer and more protruding peristome and its pale colouring and by the closing apparatus. The latter is much more immersed inasmuch as the palatal plaits of *Cl. insignis* are lateral, while those of our novelty are nearly ventral and are, together with the inner end of the very long principal plait, conspicuous in the penultimate whorl above the aperture. Besides, the number of palatal plaits is only three against five of *Cl. insignis*.

I add the diagnoses of two new Japanese species, which have recently been obtained by Brigade Surgeon Hungerford.

Clausilia micropeas, n. sp.

Testa gracilis, elongato-fusiformis, tenera, pellucida, subtiliter costulata; pallide cornea; anfr. 9½ *convexiusculi, apertura rotundato-piriformis, peristoma continuum, solutum, expansum, reflexiusculum, albolabiatum. Lamella parietalis supera marginalis obliqua sat valida cum spirali continua, infera valde remota, vix conspicua, subcolumellaris immersa. Plica principalis sat brevis, palatalis una supera brevis lateralis, interdum*

secunda punctiformis. Clausilium linguiforme, marginibus parallelis, subtus acuminatum, haud incrassatum.

Alt. 10½-11⅓, lat. 2¼-2½, apert. alt. 2-2⅓, lat. 1¾-2 mill.

Hab. Ad lacum Chinsinji insulæ Nippon leg. cl. B. Hungerford.

Affinis Cl. *gracilispirae* differt numero anfractuum minore, habitu minus gracili, apertura paullo majore, plica principali breviore, plica palatali (plerumque) unica. Speciem utramque ad subsectionem *Cylindrophaeŏusam* Boettgeri referendam esse existimo.

Clausilia (Hemiphædusa) subulina, n. sp.

Testa gracili-fusiformis, subtiliter striatula, solidula, subpellucida, f cornea, anfr. 10 *subplani, ultimus rotundatus subinflatus, rugoso-striatus, apertura rotundato-piriformis, peristoma solutum, expansum, reflexiusculum, incrassatum, albo-labiatum, superne sinuatum. Lamella parietalis supera marginalis valida, obliqua, cum spirali valida continua; infera remota, antrorsum evanescens, nodulum ad marginem emittens, subcolumellaris emersa. Plica principalis modica, palatalis supera divergens, lunella lateralis subobsoleta vel plicis* 2 *aut* 3 *punctiformibus confluentibus constituta. Clausilium linguiforme sat angustum subtus rotundato-attenuatum haud incrassatum.*

Alt. 16, lat. 3, apert. alt. 3⅓, lat. 2¾ mill.

Hab. Ad lacum Chinsinji insulæ Nippon leg. cl. R. Hungerford specimen unicum.

Explanation of Plate I.

Fig. 1. *Clausilia hungerfordiana*, n. sp., × 2, p. 2.
Fig. 2. —— *oostoma*, n. sp., nat. size, p. 4.
Fig. 3. —— *gracilispira*, n. sp., × 2, p. 5.
Fig. 4. —— *sericina*, n. sp., × 2, p. 6.
Fig. 5. —— *caryostoma*, n. sp., × 2, p. 6.
Fig. 6. —— *æthiops*, n. sp., nat. size, p. 7.
Fig. 7. —— *tetraptyx*, n. sp., × 2, p. 7.
Fig. 8. —— *fusangensis*, n. sp., nat. size, p. 8.
Fig. 9. —— *rectaluna*, n. sp., × 2, p. 9.
Fig. 10. —— *aptychia*, n. sp., × 2, p. 10.
Fig. 11. —— *nevilliana*, n. sp., × 2, p. 11.
Fig. 12. —— *wüllerstorffi*, Mörch, nat. size, p. 11.
Fig. 13. —— *andersoniana*, n. sp., × 2, p. 12.

IV.—*Second List of Diurnal* Lepidoptera *inhabiting the Nicobar Islands.*

By J. Wood-Mason, *Deputy Superintendent of the Indian Museum, Calcutta, and* L. de Nicéville.

[Received April 10th ;—Read May 3rd, 1882.]

(With Plate III.)

RHOPALOCERA.

Family NYMPHALIDÆ.

Subfamily Danainæ.

1. Radena similis, var. nicobarica, W.-M. & de N.

J. A. S. B. 1881, vol. l, pt. ii, p. 225, ♂ ♀ (woodcut).

Upperside. ♂. *Underside.*

Upperside. ♀. *Underside.*

Great Nicobar.

2. Danais limniace, Cramer.

Nankowri, Kamorta, and Katschall.

3. DANAIS AGLAÏOIDES, Felder.

Nankowri, Kamorta, Kar Nicobar, Katschall, Trinkut, and Great Nicobar.

4. DANAIS GENUTIA, Cramer.

Nankowri, Kar Nicobar, Kamorta, and Katschall.

5. DANAIS CHRYSIPPUS, Linn.

One male from Katschall.

6. DANAIS HEGESIPPUS, var. NESIPPUS, Felder.

Nankowri and Great Nicobar.

7. EUPLŒA ESPERI, Felder.

Kamorta, Katschall, Pulo Kondul, and Trinkut.

8. EUPLŒA CASTELNAUI, Felder.

Kar Nicobar; and Mergui, Lower Tennasserim.

*9. EUPLŒA NOVARÆ, Felder.

Kar Nicobar (Felder); and Upper Tennasserim.

10. EUPLŒA CAMORTA, Moore.

Nankowri, Katschall, Kamorta, and Kar Nicobar.

11. EUPLŒA SIMULATRIX, W.-M. & de N., Pl. III, Fig. 1 ♂, 2 ♀.

J. A. S. B. 1881, vol. l, p. 229, ♂; p. 228, ♀ (as aberrant ♀ of *E. camorta* from Gt. Nic.).

♀. Wings above and below all lighter and more broadly bordered externally with paler of much the same tint as in *E. camorta*.

Anterior wings above with an increasing series of three subapical spots, an elongated subcostal spot, a minute dot near the end of the cell, and a larger one just beyond it near the base of the interspace between the second and third median veinlets, all white.

Posterior wings above spotless.

Wings below with the discal spots of all, and the subapical ones of the anterior pair, larger and more prominent, but with the submarginal series of the posterior incomplete and less distinct, only two speck-like representatives of them being present in one wing and three in the other, with a short linear dash between the submedian and the first branch of the median forming a seventh circumcellular mark in the posterior ones, and with all the spots coloured as in the male.

A second and smaller specimen approaches the male in the colour of the upperside and in the breadth of the pale outer borders; it lacks the seventh circumcellular mark, and has only one indistinct representative of the submarginal series of dots, on the underside of the posterior wings.

Length of the anterior wing 1·88—1·54; whence expanse = 3·86—3·18.

Great Nicobar.

Appears to be very closely allied to the Javan *E. sepulchralis*, Butler.

Subfamily SATYRINÆ.

12. MYCALESIS MEDUS, Fabr.
Nankowri, Kamorta, Katschall, and Great Nicobar.
13. MYCALESIS DRUSIA, Cramer.
Nankowri, Kamorta, Kar Nicobar, Katschall, and Great Nicobar.
14. MELANITIS ISMENE, Cramer.
♂ ♀. Kamorta.
15. ELYMNIAS MIMUS, W.-M. & de N., Pl. III, Fig. 3 ♂, 4 ♀.
Kar Nicobar, Pulo Kondul, Kamorta, and Katschall.

Subfamily NYMPHALINÆ.

16. CETHOSIA NIKOBARICA, Felder.
Nankowri, Pulo Kondul, and Great Nicobar.
17. CIRRHOCHROA NICOBARICA, W.-M. & de N., Pl. III, Fig. 5 ♂.
J. A. S. B. 1881, vol. l, p. 231, ♂.
Great Nicobar.
18. MESSARAS ERYMANTHIS, var. NIKOBARICA, Felder.
Kamorta, Katschall, and Great Nicobar.
19. ATELLA ALCIPPE, Cramer.
Katschall.
20. PYRAMEIS CARDUI, Linn.
Kamorta.
*21. JUNONIA ASTERIE, var. NIKOBARIENSIS, Felder.
Kar Nicobar (*Felder*).
22. JUNONIA LAOMEDIA, Linn.
Kamorta, Nankowri, and Katschall.
23. HYPOLIMNAS MISIPPUS, Linn.
♂ Nankowri and ♀ Katschall.
24. HYPOLIMNAS BOLINA, Linn.
Great Nicobar and Tillangschong.
25. NEPTIS NICOBARICA, Moore.
Kamorta, Nankowri, Kar Nicobar, and Katschall.
*26. NEPTIS MATUTA, Hübner.
Nankowri (*Felder*).
27. NEPTIS MANANDA, Moore.
Kar Nicobar.
28. TANAECIA CIBARITIS, Hewitson.
Nankowri.

Family ERYCINIDÆ.

29. ABISARA BIFASCIATA, Moore.
Kar Nicobar.

Family LYCÆNIDÆ.

30. CURETIS THETYS, Drury.
Nankowri and Trinkut.

*31. CASTALIUS MANLUENA, Felder.
Kondul (*Felder*).

32. LAMPIDES ÆLIANUS, Fabr.
Kamorta, Nankowri, Trinkut, and Katschall.

33. LAMPIDES PANDAVA, Horsfield.
Nankowri, Kamorta, Katschall, and Trinkut.

34. LAMPIDES STRABO, Fabr.
Nankowri, Kamorta, and Trinkut.

35. LAMPIDES PARRHASIUS (Fabr.), Horsfield.
Nankowri and Katschall.

36. LAMPIDES PLATO, var. NICOBARICUS, W.-M. & de N.
Nankowri, Kamorta, Trinkut, and Katschall.

37. LAMPIDES ARDATES, Moore.
Kamorta, Katschall, and Nankowri.

38. LAMPIDES PLUMBEOMICANS, var. NICOBARICUS, W.-M. & de N.
Katschall.

*39. LAMPIDES CNEJUS, Fabr.
Kamorta (*Moore*).

*40. LAMPIDES KINKURKA, Felder.
Kar Nicobar (*Felder*) and Nankowri (*Moore*).

*41. LAMPIDES KANKENA, Felder.
Kar Nicobar (*Felder*).

*42. LAMPIDES KONDULANA, Felder.
Kondul (*Felder*).

*43. LAMPIDES MACROPHTHALMA, Felder.
Pulo Milo (*Felder*).

44. LAMPIDES BOSIMON, Fabr.
Nankowri.

45. POLYOMMATUS KARSANDRA, Moore.
Kamorta, Katschall, and Trinkut.

46. POLYOMMATUS SANGRA, Moore.
Kamorta, Katschall, and Trinkut.

47. HYPOLYCÆNA THECLOIDES, Felder.
Nankowri and Katschall.

*48. SITHON SUGRIVA, var. ARECA, Felder.
Kar Nicobar (*Felder*).

49. SITHON KAMORTA, Felder.
Numerous males from Kamorta, Nankowri, and Kar Nicobar; and numerous females from Kamorta; Great Nicobar (*Felder*).

*50. Deudorix orseis, Hewitson.
Kamorta (*Moore*).

51. Myrina atymnus, Cramer.
Nankowri.

Family PAPILIONIDÆ.

Subfamily Pierinæ.

52. Terias hecabe, Linn.
Kamorta, Katschall, Trinkut, and Nankowri.

53. Terias nikobariensis, Felder.
Kamorta; and Kar Nicobar (*Felder*).

54. Terias drona, Horsfield.
Kamorta, Nankowri, and Katschall.

55. Tachyris hippo, var. hippoides.
Pap. hippo, Cramer, Pap. Exot. 1779, iii, pl. cxcv, figs. B. C, ♀.

A pair from Kamorta are nearest to the N.-Eastern Indian variety (*T. hippoides*, Moore, Trans. Ent. Soc. Lond. 1881, p. 312, ♂ ♀); differing only in the wings of the male being not quite so broadly margined with brown either above or below.

56. Tachyris panda (Godart), Snell. v. Vollenhoven.
Great Nicobar.

57. Tachyris paulina, var. galathea, Felder.
Males and a female from Nankowri, Katschall, and Great Nicobar.

The specimen of the latter sex differs from N.-E. Indian and Madras ones only in having the base and outer margin of the posterior wings washed with sulphureous.

*58. Catopsilia crocale, Cramer.
Kamorta (*Moore*).

59. Pieris coronis, var. lichenosa, Moore.
Kar Nicobar and probably Kamorta.

Subfamily Papilioninæ.

60. Papilio aristolochiæ, var. camorta, Moore.
Nankowri, Kar Nicobar, Kamorta, Katschall, and Great Nicobar.

61. Papilio polytes, var. nikobarus, Felder.
Males and females of the 1st form from Nankowri and Kar Nicobar; males from Pulo Kondul and Great Nicobar; and one female of the 2nd form from Nankowri or Kamorta.

*62. Papilio agamemnon, Linn.
Kamorta (*Moore*).

Family HESPERIIDÆ.

*63. Tagiades helferi, Felder.
Pulo Milo (*Felder*).

64. TAGIADES RAVI, Moore.

Nankowri, Kamorta, and Katschall.

65. ISMENE EXCLAMATIONIS, Fabr.

One female from Kamorta.

66. ISMENE MALAYANA, Felder.

Two females from Kamorta, and one from Katschall without the small semitransparent yellow discal speck between the two posterior branches of the median vein.

67. HESPERIA COLACA, Moore.

Kamorta, Nankowri, Katschall, and Trinkut.

68. HESPERIA AGNA, Moore.

Kamorta (*Moore*) and Katschall.

69. HESPERIA KARSANA, var. SATURATA.

Hesperia karsana, Moore, Proc. Zool. Soc. Lond. 1874, p. 576, ♂ ♀, pl. lxvii, fig. 6.

Much darker and without a trace of spots on the upperside.

One female from Kamorta; and Kulu, N. W. Himalayas.

70. PAMPHILA PALMARUM, Moore.

Nankowri and Katschall.

71. TELEGONUS THYRSIS, Fabr.

Probably from Nankowri.

Although upwards of one thousand specimens, the product of a whole year's collecting carried on by Mr. de Roepstorff in conjunction with the native collectors whom Col. Cadell, Chief Commissioner of the Andaman and Nicobars, had so courteously placed at our disposal, have been examined since our first little list of Nicobar Butterflies was published in this Journal, we have but seven fresh species to add to that list. The meagreness of this result appears to be entirely due to the exceptional difficulties that beset the path of the collector of zoological specimens at the Nicobars, —difficulties arising partly from the unhealthiness of the climate, and partly from the visits of the settlement-officers to the more distant and productive islands, such as Katschall, Teressa, and Great Nicobar, being necessarily so few and of such short duration, but chiefly no doubt from the almost complete absence of clearings and of paths through the dense and often impenetrable forests, and the consequent uniform distribution of attractive flowering plants and anthophilous insects,—and not to the poverty of the fauna, for the above list speaks to this being a rich one, and, besides, it would be unreasonable to suppose that a group of islands clothed, as the Nicobars are, almost to the water's edge, with a rich and fairly varied tropical vegetation only supported some 70 species, or little more than one

third of the number that could in one season be obtained in the Calcutta district, which has been under cultivation for ages. But small as the net results of our work are, they already afford a tolerably clear indication that the Nicobar fauna, so far as the Rhopalocerous portion of it is concerned, possesses a much stronger Malayan element in its composition than that of the Andamans, whence we have received twice the number of distinct species. It would be premature to attempt a detailed analysis, but we cannot allow this opportunity to pass by without pointing out that, of the five recorded species of *Euplœa*, three are unquestionably Malayan forms, and that neither of the five is represented either in peninsular and northern India or at the Andamans; that the only *Elymnias* is a local form of a Javan species with a representative in Burneo; that the Javan *Tachyris panda* appears never to have been before recorded from any place so far to the westward as Great Nicobar; that *Hypolycæna thecloides* has hitherto only been reported from the Malay Peninsula and Singapore; that in *Sithon kamorta* and *S. areca* we have two striking and congeneric lycænids whose affinities are decidedly Malayan, instead of one, as in the Andamans; and that the Nicobar form of *Radena similis* more nearly resembles the Javan than it does any other.

In conclusion, we have to state that in the foregoing list *Hesperia agna* = *P. mathias* of our former paper (*see* Moore, Lep. Ceylon, where the differences between these too closely allied forms are for the first time pointed out), that *Euplœa castelnaui* = *E phœbus* (Mr. W. L. Distant having made out to his own satisfaction and to ours that Felder's name has priority over Butler's), and that *Danais genutia*, Cramer = *D. plexippus* (Messrs. Salvin and Godman and others having recently shown that Linné's *D. plexippus* is not the Oriental species which had so long gone by that name, but an American species, and that the former ought to be known by the name bestowed upon it by Cramer); and we ought after having so pointedly drawn attention to their apparent absence, also to draw attention to fact of the presence, at the Nicobars of *Hypolimnas misippus* ♀ and of *Papilio polytes* ♀ second form, which latter, however, would appear to be of exceedingly rare occurrence.

An asterisk (*) is prefixed to the names of those recorded species of which we have not as yet received specimens.

EXPLANATION OF PLATE III.

Fig. 1. *Euplœa simulatrix*, W.-M. & de N., ♂.
Fig. 2. ——— ——— ——— ♀.
Fig. 3. *Elymnias mimus*, W.-M. & de N., ♂.
Fig. 4. ——— ——— ——— ♀.
Fig. 5. *Cirrhochroa nicobarica*, W.-M. & de N., ♂.

V.—*On new and little-known* Mantodea.—*By* J. Wood-Mason.

(Read August 2nd, 1882.)

Subfamily AMORPHOSCELIDÆ, Stål.

Amorphoscelis annulicornis.

Stal, Oefersigt af Kongl. Vetenskaps-Akad. förhand. Stockholm, 1873, p. 401.

I received an imperfect spirit specimen of this small but remarkable form several years ago from Nazeerah, Assam; and, while I was in England on furlough in 1877-79, Professor Westwood presented me with a dried female which, although also defective in many respects, has those parts present that in the Assam insect are absent, and which enables me to complete Stål's somewhat imperfect diagnosis drawn up from a specimen that had lost its abdomen. This part is long and almost linear, tapering very slightly and gradually towards the extremity, which extends a short distance beyond the closed organs of flight; its supra-anal plate is triangular with the sides slightly concave, as long as it is broad at the base, and carinate; and the cerci are racket-shaped, the basal joints being cylindrical, the two penultimate ones compressed and subfoliaceous, and the last expanded into a great broadly-oval plate. The anterior tibiæ have the tarsus inserted rather nearer to the base than to the apex, although from Stål's description—"tarsis anticis *ante* medium tibiarum insertis"—one would have expected to find the reverse of this to be the case.

Subfamily EREMOPHILIDÆ.

Chœradodis brunneri, n. sp.

♀. Closely allied to *Ch. rhombicollis*, Latr., and *Ch. Servillei*, W.-M., differing from both in the size, shape, and position of the femoral blotch (which is nearly thrice as long as broad, extends rather further in front of the ungual groove than it does behind it, and is followed by four black puncta arranged along the lower margin of the joint at the bases of alternate spines), and in having the posterior margin of the pronotum slightly convex instead of concave; from the former in its much narrower and from the latter in its rather broader tegmina; and from the latter in the upper margin of its fore femora being coarsely granulated, and sinuous instead of straight, in which latter respect it approaches the former.

Hab. Santa Fé de Bogotá, New Granada. The nymph from Bogotá assigned by me (J. A. S. B., 1880, Vol. XLIX, pt. II, p. 83) with hesitation to *Ch. rhombicollis* agrees perfectly with the specimen briefly described above in the form and colouring of the fore femora and without

doubt belongs to the same species, as also in all probability do the specimens from New Granada named *Ch. strumaria* by Stål.

EREMOPHILA ARABICA.

Saussure, Mél. Orthopt. 3 me fasc. Suppl. 1871, p. 378, ♀, from Djeddah.

For the first specimen of an *Eremophila* from the desert country on the north-western frontier of India, I am indebted to Mr. Francis Fedden, of the Geological Survey, who obtained it in Western Sind. It is a female, and it differs from de Saussure's description of the above species only in having five instead of four spines on the outer edge of the fore tibiæ. I have recently received from Mr. Murray of the Karachi Museum three females and two males of the same species, which exhibit a considerable amount of variation in size, in the roughness of the integument, and in the number of spines on the outer edge of the fore tibiæ, two specimens having only four and another only three developed on one tibia but the usual number on the other in each case. A male taken some years ago in the Suliman Range, and presented to me with some other insects, by Professor V. Ball, differs from the Sind specimens in having the band on the underside of the tegmina broader and 14 teeth instead of 13 on the inner side of the fore tibiæ.

The four posterior legs, of which de Saussure makes no mention in his description, and which may have been wanting in his type specimen, are all annulated with brown and roughened with spiniform granules on the upperside in the Indian specimens.

No species of this remarkable desert genus has before been recorded from any place further to the eastward than Djeddah in Arabia.

TARACHODES INSIDIATOR, n. sp.

♂. Body and appendages brown of the colour of a dead and decayed leaf. Antennæ rather coarsely setaceous. Pronotum with a polished conical spine on each side at the junction of the anterior with the lateral margin, which is obsoletely denticulated as far back as the level of the supracoxal groove.

Organs of flight extending by about 1/6 of their length beyond the extremity of the abdomen, not quite perfectly hyaline, being just perceptibly milky, with the veins and veinlets horn-coloured, short-streaked or annulated with darker in the anterior area of both pairs, though much less distinctly so in the wings than in the tegmina, the latter semiopaque horny anteriorly, as also are the former in a less degree; the stigma of the latter long and linear, pale whity-brown, almost colourless.

Legs obsoletely and rarely punctated and mottled with darker, and only moderately pubescent. The anterior ones marked with darker-brown (? red in the living insect) on the inner surface, the smooth-crested coxa

being tipped at both ends, the trochanter streaked, and the femur ornamented along the middle with a streak commencing at the base and tapering to a point before the extremity of the joint; fore tibia furnished with 15 and 13 spines on the inner and outer edges respectively.

Abdomen slightly fusiform, with at least the 2nd to 7th of its ventral arcs bimaculated with dark brown. Cerci rather broad.

Total length 47 millims.; height or length of head 6·5, breadth 8; length of pronotum 11·5, greatest breadth (between the lateral bulgings) 6; length of meso. + metanotum = 10; of abdomen 23·5, greatest breadth of abdomen 6·75; length of tegmina 40, breadth (just before the middle) 11·5, of the marginal field 2; length of wings 35; length of fore coxa 7, femur 10; of intermediate femur 7, tibia 6·75; of posterior femur 8·75, tibia 8·75; of cerci. 7.

Hab. Nyassa.

TARACHODES DISSIMULATOR, n. sp.

♂. Pale greyish testaceous or earth-coloured, with the head, the upper (outer in the anterior ones) surface of the legs, and the pronotum symmetrically, speckled and mottled with darker.

Head with the line of the vertex very slightly bisinuous. Antennæ extremely finely-setaceous. Pronotum with two conical tubercles on each side at the junction of the obsoletely denticulate lateral with the anterior margin, which latter has a minute rounded median emargination.

Organs of flight in repose extending but little beyond the extremity of the abdomen, not quite hyaline, with veins and veinlets pale testaceous marked, especially in their anterior areæ, with dark brown short coalescent streaks, both more clouded anteriorly, the tegmina with an oval discoidal pale patch before the middle devoid of dark marks followed by another irregular and less distinct; the stigma shorter and brownish. Legs and leg-bases long-pubescent; the anterior pair internally yellowish and conspicuously marked with shining black, the coxa (which has its upper crest minutely 4-denticulate) throughout except at its two ends, and the femur from the base to the end of the second third, processes being given off from the lower margin of the black patch to all but the apical one of the black spines of the inner and inferior crest and from its distal end along each side of the femoral brush; fore tibiæ armed internally with 14 teeth concolorous with the outer surface and internally with the same number of jet-black spines.

Prosternum marked behind the middle with a large and conspicuous deep, but dead, black cordiform blotch, which is succeeded by a pair of similarly coloured puncta placed near the posterior margin of the somite; and by a small roundish, also dead black, spot on the middle of the metathoracic sternum.

Abdomen more broadly fusiform; its cerci, though narrow, have the four or five terminal joints distinctly foliaceous.

Total length 41 millims.; height of head 6, breadth 7·25; length of pronotum 10·5, greatest breadth 5·25; length of meso. + metanotum 9; of abdomen 20, greatest breadth 7; length of tegmina 31, breadth 8·5, of the marginal field 1·5; length of wings 26; of fore coxa 6·5, femur 9·5; of intermediate femur 6·5, tibia 6; of posterior femur 7·5, tibia 7·5; of cerci 5·5.

HAB. Cameroon Mountains, West Africa.

Genus DIDYMOCORYPHA, W.-M.

Ann. and Mag. Nat. Hist. 1877, March, p. 222.

DIDYMOCORYPHA ENSIFERA.

Didymocorypha ensifera, Wood-Mason, loc. cit.
Pyrgocotis gracilipes, Stal, Syst. Mant. 1877, p. 17, ♂.

In the structure of the head this remarkable form differs from the similar and allied *Pyrgomantis* of Africa in having the juxtocular lobes prolonged into two tall cones which touch one another in the middle line instead of the middle of the vertex together with the juxtocular lobes elevated into a median azygous process.

The part of my description (*loc. supra cit.*) relating to the prothorax should read thus:—"*Prothorax* narrow, with its sides suparallel, slightly narrowed behind the insertion of the fore legs, then widening again slightly to its base; its supracoxal dilatation and cervical groove hardly perceptible; its neck quadrate; its disk," &c., &c.

The structural differences between the Asiatic *Schizocephala bicornis* and the African *Episcopus* (olim *Schizocephala*) *chalybeus* are of similar kind and of equal importance; in the former the "ocular spines" are in reality prolongations of the juxtocular lobes of the vertex, while in the latter the faceted cornea of the eyes is itself produced upwards into a conspicuous spine.

HAB. Tinpahar, on the eastern flank of the Rájmáhal Hills; Ceylon *(Stăl)*; and Kulu, Kangra, in the N.-W. Himalayas.

The names proposed by me for this remarkable form have priority over those of Stăl by several months.

EPISCOPUS CHALYBEUS.

Schizocephala chalybea, Burm., Handb. d. Entom. 1839, vol. ii, p. 552.
Ozyophthalma chalybea, Saussure, Mél. Orthopt. 4me fasc. 1872, p. 12, fig. 22 *a*, ♂.
Episcopus chalybeus, Stal, Syst. Mant. 1877, p. 18, from Damara Land.

♀. Organs of flight abbreviated. Tegmina about 1½ times as long as the pronotum, scarcely extending to the middle of the fourth abdominal

somite, thin-coriaceous, opaque, light yellowish green, the anal gusset alone membranous and semihyaline. Wings reaching to a little beyond the end of the 3rd abdominal somite reduced nearly to a quadrant of a circle, their anal emargination almost none, their anterior area semicoriaceous, yellow, their posterior area at the base and along the abdominal margin membranous and milky like the anal gusset of the tegmina, ornamented in the middle by a large violet-brown metallic blotch (on which the veins are broadly margined with paler and yellower brown), at the basal end of which are 3 or 4 small opaque yellowish spots on transverse veinlets, and between which and the outer margin are alternate arcs of violet-brown and opaque yellow.

Total length 47 millims.; length of pronotum 11; of tegmina 16; of wings 12·5.

Hab. South Africa (*J. P. Mansel Weale*).

Dysaules longicollis.

Stål, Syst. Mant., 1877, p. 18, ♂ *non* ♀, from Bengal.

♀. Wings and tegmina, abbreviated, semiopaque; the latter scarcely longer than the pronotum, yellowish horny with the meshes all faintly smoky or sordid, and with the apex and a discoidal punctular spot fuscous; the former with the anal emargination very slight and shallow and obtuse-angled, with the anterior area reddish-horny tipped with fuscous, and the posterior bright yellow and bearing near the base a large oval dark violet-fuscous patch, which is succeeded by a number of concentric lines of the same colour extending to and becoming successively closer and closer together towards the outer margin, where they unite to form with the fuscous apex a fuscous outer border decreasing from the apex to the posterior angle of the organs.

Total length 56 millims.; length of pronotum 18; of tegmina 19, width of tegmina 6; length of wings 15.

♂. ♀. Anterior femora marked on the inside just in front of the ungual groove by a small round black spot.

Hab. ♂♀ Kulu, Kangra, in the N.-W. Himalayas and Bengal (*Stål*).

Var. brevipennis. ♀. Organs of flight more abbreviated; the tegmina being shorter than the pronotum, and the wings having the shape of a quadrant of a circle with the anal emargination less evident.

Length of pronotum 18·75, of tegmina 15·5, and of wings 12·5 millims.

Hab. Bangalore, Mysore, S. India: obtained by a soldier of H. M.'s 45th Regt., whom I formerly employed to collect for the Museum.

The eyes in all specimens of the species are furnished near the summit with a very minute and smooth granule, or blind spot, overlooked by Stål.

Subfamily MANTIDÆ.

Gonypeta authæmon, n. sp.

♀. Body and appendages pale fleshy brown or earth-coloured thickly punctulated and marbled with darker; the still darker markings of the tegmina and legs of a rich warm vandyke-brown, arranged on the latter in rings, especially on their two terminal divisions; postacetabular portion of the prosternum, all but the anterior margin of the mesosternum, and the intermediate coxæ internally, jet-black.

Facial shield crescentic, about thrice as broad at its anterior or inferior margin as it is long. Pronotum strongly dilated at the insertion of the fore legs, whence it narrows to either end, its setulose margins scarcely denticulated and slightly hollowed out posteriorly; the disc of its anterior lobe convex, raised into a prominent trilobed obcordiform boss, that of its posterior lobe bearing an indistinct raised median longitudinal line, on either side of which is a row of smooth and very low rounded tubercles arranged in four pairs, of which the one next to the posterior margin of the somite is the most prominent, coloured dark brown, and separated from those in front by a transverse depression.

Tegmina subcoriaceous, abbreviated, about 2½ times as long as the pronotum, not reaching to the extremity of the abdomen, their marginal field spotted longitudinally with rich dark brown, their veins and long linear stigma whity-brown, the former spotted and streaked with dark brown, their membrane concolorous with the body and legs, their discoidal field marked across the middle of its length with a large spot or band narrower at each end and broader in the middle, their posterior area or anal gusset with the meshes brown and the net-work whity-brown, their interior radial vein and the first branch of the ulnar both simple and undivided, and the anal and axillary veins anastomosed very close to the posterior margin. Wings semiopaque, dull red, with the outer margin of both areas rather narrowly margined with fuscous, on which the transverse veins are whity-brown indistinctly edged with subhyaline; anterior margin having the veins towards the apex streaked with darker and the membrane paler and consequently presenting a spotted appearance; anal emargination distinct, the apex of the posterior area reaching the level of that of the anterior.

Legs all annulated with bands of brown punctulations, the anterior ones externally; with the first joint of the tarsus in all longer than the rest taken together. Anterior tibiæ more richly (almost black) banded internally than externally, armed below in the outer edge with 11 and on the inner with 9 spines exclusive in each case of the terminal claw; anterior

coxæ scarcely denticulated on the upper crest, furnished with hairs rather than with spines, punctulate externally but internally washed with fuscous along the middle; femora dilated, triangular, only about twice as long as broad with their superior crest sharp and arcuate, and with a large oval black blotch preceded by and marked with a whity-brown patch on their inner face.

Total length (about) 28 millims.; length of pronotum 5·75, of which the anterior lobe is 2·5, width of pronotum at dilatation 3·5; width of head 5·3; length of tegmina 15, width of tegmina 4·5, of marginal field 1; length of wings 12, width of their fuscous outer border about 1; length of fore coxa 6, femur 6·5, width of femur at angulation 3; length of intermediate femur 8, tibia 6, tarsus 6; of posterior femur 9, tibia 9·5, tarsus 9·5.

Hab. A single specimen was obtained at Minthantoung, on the Tenasserim river, near Mergui, by Dr. J. Anderson on December 22nd, 1882.

Euchomena thoracica.

Mantis (Thespis) thoracica, De Haan, Orthopt. Orient. p. 94, ♀.

Phasmomantis? thoracica, Saussure, Mélanges Orthopt. i. 3e fasc. p. 192 (44); ibid. p. 403 (279).

Fischeria thoracica, Saussure, *op. cit.* ii. 4e fasc. p. 58.

Euchomena thoracica, Wood-Mason, Ann. and Mag. Nat. Hist. 5th ser. vol. i, 1878, p. 144, ♀.

Mantis heteroptera, De Haan, *op. cit.* p. 78, pl. xviii, fig. 1, ♂ (*nec* fig. 2, ♀).

Many years ago I recognized an insect obtained by my native collector at Johore in the Malay peninsula, as the *Mantis thoracica* of De Haan, a species briefly described in Latin from a specimen without locality, and in 1878 I published a short account of it referring it to the genus *Euchomena*. I have since received from Mr. H. O. Forbes, who obtained the insects at Bantam in the island of Java, two spirit-specimens of the male of De Haan's *Mantis heteroptera*, which, on comparison with the female insect above-mentioned, prove to be examples of the opposite sex. The insect from Celebes considered by De Haan to be the female of his *Mantis heteroptera* consequently represents, as indeed its totally different structure shows, a totally distinct species, for which the name *heteroptera* may conveniently be retained.

The following are the measurements of one of Mr. Forbes' specimens of the male:—

Total length of body 62·5 millims.; height of head 3, breadth of head 6; length of pronotum 28, of which the anterior lobe is 5, breadth of pronotum at narrowest part just behind dilatation 1·5; length of tegmina 35, width of tegmina across middle 6, width of marginal field 1·3; length

of abdomen 24; of fore coxa 12·5, of femur 15, of its unarmed part 8; of intermediate femur 15, tibia 12·5; of posterior femur 16·3, tibia 16·3.

The fore tibiæ are armed with 7—14 teeth.

The legs are all banded and the apex of the fore femur is dark brown on the inner face, as in the female.

Hierodula (Sphodropoda) quinquedens.

Mantis 5-dens, MacLeay, King's Survey.
Hierodula quinquedens, Mél. Orthopt. 4me fasc. p. 42, ♀.

This curious species unquestionably belongs to the section *Sphodropoda* as by Stăl defined; being provided with a marginal series of tubercles on the under surface of the anterior lobe of the pronotum, as well as with a præacetabular spine, and having the margins of the outer face of the fore femora granulated. The form and colouring of the fore coxæ are remarkable: these are broadly bevelled rather than grooved at the upper margin of their inner face, and the bevelled edge is rich orange-coloured marked with white or lighter vertical stripes, the prolonged bases of the marginal spines, the rest of the surface being pale violet. The colours of the tegmina and wings are no less remarkable, the latter being hyaline yellow, but the former opaque reddish brown varied with yellow of the colour of the stigma throughout except on the under side of the marginal field, which is red-violet broadly bordered externally with black.

The front edge of the tegmina is denticulate, but the four posterior femora are devoid of all traces of a lateral ridge; as in *H.* (*S.*) *dentifrons*, Stăl.

Hab. Trinity Bay and the northern territory of South Australia (*C. French*).

Hierodula (Sphodromantis) bicarinata.

Hierodula bicarinata, Saussure, Bull. Ent. Suisse. vol. iii, 1869, p. 68, ♂ ♀, et Mél Orthopt. 3me fasc. 1871, p. 222, pl. 5, fig. 22, ♀.
Mantis kersteni, Gerstaecker, Arch. f. Naturg. 1869, p. 209, ♂, et v. d. Decken's Reisen in Ost-Africa 2te Band 2te Abth., 1873, p. 13.

I have a large series of both sexes of this species from the Cameroon Mountains, Somali Land, South Africa, and Sierra Leone.

Like the closely allied *H. gastrica*, Stăl, this species has the front edge of the tegmina strongly toothed* so as to serve as a stridulating organ, and a strong ridge on the apical half of the upper or posterior face of each of the posterior femora, by which doubtless the toothed edge

* *See* Fig. 2 of my memoir 'On the Presence of a Stridulating Apparatus in certain Mantidæ,' in Trans. Ent. Soc. 1878, p. 263 *et seq.*

of the partially separated tegmina is rubbed; for, if the tegmina of a limply-articulated spirit-specimen be moved horizontally outwards, so as to be slightly separated from one another, their toothed anterior margin comes quite naturally into relation with these ridges, and, if either of the four posterior legs be then rapidly moved backwards and forwards, a crepitating or rasping sound is given out, which in the living insect, with its wings so disposed as to act as resonators, would, I feel confident, be as loud as that made by many grasshoppers in scraping their toothed femora across the sharp projecting nervures of their tegmina.

While I was engaged in correcting the first proof of this paper Mr. J. G. Furnivall, a gentleman who had lived and travelled for many years in South Africa, informed me that stridulating Mantises very frequently came under his notice during his residence in that country; that the sounds emitted by them were as loud as, but more crepitating in character than, the hiss of a large snake; and that, on account of their possessing these sound-producing powers in so eminent a degree, it was a common practice with native children to bring specimens of them alive as curiosities to the European settlers. The species observed by Mr. Furnivall was in all probability *Idolomorpha capensis*, Burmeister.

Hierodula (Sphodromantis) arabica, n. sp.

Hierodula trimacula, Wood-Mason, Ann. & Mag. Nat. Hist. 1878, 5th ser. vol. i, p. 147, (*nec* Saussure).

♀. Very closely allied to *H. (S.) bioculata*, Burm., but differing in its much less expanded pronotum (which is scarcely more enlarged anteriorly than that of *H. trimacula*), in its more pointed and thinner tegmina (which are thin-coriaceous in the marginal field, but membranous and only slightly clouded throughout behind the principal nervure), in its less strongly spined coxæ (two or three spines of which are similarly connected with yellowish callosities on the inner face), and in the four-branched discoidal vein of its wings.

Total length 65; length of head 7·75; breadth of head 9·5; length of pronotum 22·3, of which the anterior lobe is 6·5; length of tegmina 43, breadth 13, of marginal field 4; length of wings 37; of fore coxa 17, femur 20; of intermediate femur 17·5, tibia 17; of posterior femur 21, tibia 23·5.

Hab. Oman, Arabia. Obtained by Colonel Miles.

The anterior edge of the tegmina is delicately toothed and the four posterior femora are laterally ridged; the sides of the anterior lobe of the pronotum are peculiarly straightened as if truncate; and the fore tibiæ are armed with 10 teeth on the outside and with 16 or 17 on the inside.

HIERODULA (SPHODROMANTIS) MUTA, n. sp.

♀. Of small or moderate size, green.

Facial shield broader than long, 2-4 carinate, the two lateral carinæ obsolescent. Pronotum of about the same shape and proportions as in *H. trimacula*, but with the margins more narrowly rounded at the dilatation, and very distinctly denticulate nearly to the base of the posterior lobe.

Organs of flight extending little if at all beyond the extremity of the abdomen, with the apex of their anterior area sharply pointed. The tegmina coriaceous with the posterior margin broadly, and the anal area wholly, membranous; their anterior edge appearing indistinctly and irregularly jagged under a lens; their stigma elongate, narrow, with a brown point at either end. Wings hyaline a little obscured with greenish along the front margin and at the very apex, where, also, the transverse venulation is denser; their discoidal vein two-branched on one side and three on the other.

Fore coxa armed on the upper crest with numerous very small teeth (five or six of which, a little larger than the rest, are yellow-based, and arise from the inner face), devoid of the usual marginal groove, but ornamented on the inner face with two large subquadrate or subrotundate depressed yellow spots extending from the edge of the upper crest for more than two-thirds of the distance towards the lower margin, separated from one another by a large oblong jet-black spot about 1½ times as large as either of them, and each bounded at its free end by a jet-black line, and with a very much smaller yellow spot touching the black encircling line of the basal one of the large spots; posterior femora not ridged on their upper or posterior faces, as in the stridulating species. The fore tibiæ are armed in the outer side with 10 (there are only 8 and a rudiment on one tibia, owing probably to an injury received during larval life), and on the inner with 13 teeth.

Total length 57 millims.; length of head 6·5, breadth of head 8; length of pronotum 19, of which the anterior lobe is 6, breadth of pronotum at dilatation, 6; length of tegmina 36, breadth of tegmina 10, breadth of marginal field 3; length of wings 31; of fore coxa 13, femur 16·5; of intermediate femur, 16, tibia 13·5; of posterior femur 20, tibia 20·5.

HAB. Cameroon Mountains, West Africa.

HIERODULA SIMULACRUM.

Mantis simulacrum, Fabr., Ent. Syst. vol. ii, 21, 34

—— —— Burm., Handb. d. Entom, vol. ii, p. 536.

Hierodula simulacrum, Saussure, Mél. Orthopt. 3me fasc. p. 225, fig., 23, ♀, 23 ♂.

A specimen of the female has been received from Mr. H. O. Forbes from Bantam in Java.

HIERODULA STERNOSTICTA, n. sp.

♀. Allied to *H. vitrea*, Stoll, from which it differs in being larger and much more robust, in its much more opaque tegmina (which are finely serrated on the anterior margin so as to serve as stridulating organs), in having the fore tibiæ armed with 12 and 15 instead of 11 and 14 teeth, in having the basal half and the lower apical lobe of the fore coxæ, with the lower half of the base of the fore femora to a little beyond the ungual groove, washed with red on the inside, in the prosternum and mesosternum being symmetrically punctated with dark red-brown of the colour of the lower apical lobe of the fore femora, and in the tegmina being bordered in front with pale red-violet on the underside.

Total length 85 millims.; length of pronotum 30·5, of which the anterior lobe is 9, breadth at supracoxal dilatation 10; length of tegmina 52, breadth 20·5, breadth of marginal field 6·5; length of fore coxa 19, femur 24; of intermediate femur 20, tibia 18; of posterior femur 23·5, tibia 25; breadth of head 12, length 10.

The discoidal vein of the wings is 4 and 5-branched in the type specimen, 3 and 4 in another, and 3 and 4 in a third, in which the anterior branch of the three-branched wing is forked.

HAB. Near Trinity Bay, Australia *(C. French)*. Nine specimens, 3 adult females, and 3 nymphs of each sex.

HIERODULA (RHOMBODERA) ATRICOXIS, var. GRANDIS.

♀. Differs from typical *Hierodula atricoxis*, W.-M., in its larger size, in the relatively narrower foliaceous expansions of its pronotum, and in having the two anterior black spots of the prosternum squarish instead of pyriform.

Total length about 100 millims.; length of pronotum 33, of which the anterior lobe is 10, greatest breadth of pronotum 16, breadth of primitive pronotum at supracoxal dilatation 11·5; length of tegmina 62, breadth of tegmina 23·5, breadth of marginal field 7·5; length of fore coxa 21·5, femur 27; of intermediate femur 22·5, tibia 20·5; of posterior femur 27, tibia 29·5.

HAB. Murray Island, Torres Straits.

HIERODULA (RHOMBODERA) FLAVA.

Mantis flava, De Haan, Orthopt. Orient. p. 68, ♂ ♀, from Java.

Mantis macropsis, Giebel, Zeitschr. f. gesammt. naturwiss. 1861, p. 111, from Banka.

Hierodula (Rhombodera) macropsis, Saussure, Mél. Orthopt. 3me fasc. p. 218, fig. 18, ♀; Suppl. p. 408; et 4me fasc. p. 36, ♂.

A specimen of the female of this very distinct species has been forwarded to me from Bantam in Java by Mr. H. O. Forbes.

The fore margin of the tegmina is minutely and irregularly jagged, but not modified to serve as a stridulating organ, as in some of the other Eastern species of the same section.

HIERODULA (RHOMBODERA) BASALIS.

Mantis basalis, De Haan, Orthopt. Orient. p. 67 ♀.

Hierodula (Rhombodera) basalis, Saussure, Mél. Orthopt. 4 me fasc. p. 35, fig. 6, 7, ♀, from Java and Malacca.

Three fine specimens of the female were recently obtained near Mergui by Dr. J. Anderson, all having the stigma encircled with rich dark brown. From the anal orifice of one of them, there project the terminal coils of two specimens of a species of *Gordius* measuring five and eight inches in length respectively.

The fore margin of the tegmina is not serrated.

MANTIS, Linn., Sauss.

All the species furnished with 9 spines (African) on the outer edge of the fore tibiæ are distinguished from those (European, Asiatic, and African) with only 7 by having marginal denticles on the under surface of the anterior lobe of the pronotum, as in *Sphodropoda* and *Sphodromantis*, sections of *Hierodula*.

The following species belongs to this category :—

MANTIS CALLIFERA, n. sp.

♀. Pronotum much slenderer than in *M. pia*, Serville, and more suddenly narrowed behind the insertion of the fore legs.

Anterior coxæ armed on the upper crest with numerous minute denticles, and ornamented on the inside with four large highly polished convex oval callosities (red or yellow in the living insect) connected with the bases of as many minute spines springing from the side of the crest; femora without black marks; tibiæ armed with 9 spines on the outer edge and 13 on the inner in one specimen and with 8 to 9 and 12 to 13 in the other.

Total length about 62 millims.; of pronotum 20·75, of which the posterior lobe is 15, width of pronotum at dilatation 5·25; length of tegmina 47; of fore coxa 14, femur 18; of intermediate femur 14, tibia 11; of posterior femur 17·5, tibia 17·5.

HAB. Cape of Good Hope,—two specimens.

IRIS ORIENTALIS, n. sp.

♂. ♀. Much slenderer than *I. oratoria*, Linn., from which it also differs in being without a trace of talc-like fenestræ in the anterior area of the wings.

♂. Organs of flight long, very delicately clouded with green and almost perfectly hyaline everywhere except in the marginal field of the

tegmina and at the anterior margin of the wings, in which parts they are semiopaque bright green; posterior area of wings ornamented with a large oval violet-fuscous subbasal blotch succeeded by four or five concentric lines of the same colour, which are successively narrower and less distinct from within outwards.

♀. Organs of flight much abbreviated. Tegmina semicoriaceous, light bright green like the body and legs. Wings reduced nearly to a quadrant of a circle, the margin and the apex of their anterior area yellowish-green, the rest of the anterior, together with the base of the posterior, area dull wine-red, their posterior area bearing a huge violet-fuscous discal blotch, between which and the outer margin the ground-colour is yellow marked with a series of about four concentric violet-fuscous lines successively decreasing in width and distinctness from within outwards.

Total length ♂ 40, ♀ 42 millims.; length of pronotum ♂ 11, ♀ 12, width of pronotum at dilatation ♂ 8, ♀ 8·5; length of tegmina ♂ 28, ♀ 13, width of tegmina ♂ 6·5, ♀ 5; length of wings ♂ 25, ♀ 10·5.

Hab. Kulu Valley, Kangra, in the N.-W. Himalayas, where it was discovered in extraordinary numbers in 1880 by Mr. A. G. Young.

Polyspilota insignis, n. sp.

♂. Head 1½ times as broad as long; facial shield pentagonal, also about 1½ times as broad as long; ocelli all oval and equal and rather close together, the two posterior being not much further from one another than either of them from the anterior; antennæ black, concolorous with the head at base.

Posterior lobe of pronotum about 3½ times as long as the anterior, strongly roof-shaped with a prominent but smooth raised dorsal ridge; supracoxal dilatation well-developed, rounded, on either side of which the margins of the pronotum are tolerably finely denticulate for about half the length of each lobe.

Organs of flight very long, extending by about one-fourth of their length beyond the extremity of the abdomen. Tegmina semicoriaceous, ferruginous-brown, the posterior margin and the anal gusset being alone membranous and pale smoky or sordid; marginal field with a large opaque black-fuscous blotch at the base followed by another and by six (including the apical one) fuscous-black transverse bands all commencing at the costa and extending to the middle of the discoidal field, growing paler as they go, and finally blending insensibly with the sordid of the posterior moiety; anal gusset with its transverse veinlets pale and lined with hyaline.

Wings dark smoky-quartz-coloured, with the longitudinal veins much darker and the transverse veinlets much paler and very narrowly lined with

hyaline on both sides; with the apex of the anterior area and six bands all commencing at the anterior margin and extending successively from the base of the organ further and further into the posterior area (where they pass insensibly into the paler ground-colour) very much darker smoky-quartz-colour; with the venation and membrane between these bands much lighter than elsewhere, so that the organs appear alternately banded with light and dark; and with the outer margin of the posterior area very narrowly semihyaline.

Fore femora and coxæ bifasciated externally with fuscous, the latter furnished with 8—9 minute, slanting, sharp, conical spinules on the upper crest, the former black on the inner side from the base nearly to the apex; fore tibiæ armed with 10 + 15 spines on their two inferior edges; the femora of the four posterior legs present obscure traces of transverse fasciæ.

Abdominal terga black-fuscous with the lateral margins paler.

Total length 85 millims.; of pronotum 31·5, of which the anterior lobe is 7, width of pronotum at supracoxal dilatation 7·75; height of head 7, breadth of head 9 5; length of fore coxa 16, femur 19·5; of intermediate femur 20, tibia 18·5; of posterior femur 24, tibia 25; length of tegmina 67, breadth of tegmina (across middle) 12·5; length of wings 59.

Hab. Cameroon Mountains, West Africa.

The female differs from the male in her larger size and stouter build, and in her shorter and broader organs of flight, the tegmina being only about 1½ times the length of the pronotum and the wings reduced nearly to the form and proportions of a quadrant of a circle.

Genus Mesopteryx, Sauss.

Bull. Entom. Suisse. vol. iii, 1870, pp. 234, 235.—Mél. Orthopt. 3me fasc. p. 188.

Mesopteryx alata.

Saussure, op. supra. cit.

Hab. The Philippines. Manilla.

Mesopteryx platycephala.

Tenodera platycephala, Stál, Syst. Mant. 1877, p. 56 ♀.

♂. Much slenderer than the female.

Pronotum smooth and rounded, carinate only for a short distance from the base; slightly enlarged at the insertion of the forelegs; the transverse impressed black lines of the underside of its lateral expansions having the form of elongate puncta barely extending half the distance from the base to the margin.

Organs of flight when closed not extending further than the 8th abdominal somite, hyaline with horn-coloured (? green in the living insect) veins everywhere except in the marginal field of the tegmina (which is coriaceous opaque and bright-green margined posteriorly along and behind the principal vein with semiopaque horn-brown (? green) concolorous with the veins and shining stigma), and at the anterior margin of the wings, which is obscured with horn-brown (? green).

The cerci are long and compressed from the middle of their length to the tip, in both sexes, but especially in this sex, in which they are narrowly foliaceous at the extremity.

Total length 97 millims.; length of pronotum 35·5, of which the posterior lobe is 29; length of head 5, width of head 8·5; length of tegmina 51; length of fore coxa 16, femur 18·5; of intermediate femur 19, tibia 17; of posterior femur 25, tibia 25.

The above description has been drawn up from a specimen captured by any native collector between Moulmein and Meetan in 1877.

Another specimen from Nazeerah measures pronotum 33·5 and tegmina 48, and a third, obtained by Mr. S. E. Peal in the Sibsagar district, Assam, pronotum 34 and tegmina 50 5 millims.

Specimens of the female differ a good deal in the degree of development of the organs of flight, two specimens from Moulmein measuring—total length about 100—105 millims.; length of pronotum 37·75–39, of which the posterior lobe is 30·5—31·5; length of head 6·75—7, width of head 10—10; length of tegmina 51·5—55·5, width of tegmina 11—11, of marginal field 3—3; length of fore coxa 19·25—20, femur 21—21·75; of intermediate femur 20—20·5, tibia 19—20·5; of posterior femur 26—27, tibia 29—31; one from the Himalayas—total length 110 millims.; length of pronotum 42, of which the posterior lobe is 34; length of head 7·5, breadth of head 10·5; length of tegmina 55; of fore coxa 21, femur 24; of intermediate femur 23, tibia 21; of posterior femur 30, tibia 33; one from Sibsagar—total length 108 millims.; of pronotum 42, of which the posterior lobe is 34; length of head 7, breadth of head 10·5; length of tegmina 40; of fore coxa 21·5, femur 24; of intermediate femur 22·5, tibia 21·25; of posterior femur 29·5, tibia 32; and the specimen described by Stål having the tegmina scarcely longer than the pronotum.

Hab. One male from the banks of the Houngdarau, on the road from Moulmein to Meetan, Upper Tenasserim; another from Nazeerah (Dr. Foster), and a third from Sibsagar (*S. E. Peal*), Assam. Two females from Moulmein (*Captain Hood*), a third from the 'Himalayas,' belonging in all probability to the Asiatic Society's collection, and a fourth from Aideo, Sibsagar (*S. E. Peal*).

MESOPTERYX ROBUSTA, n. sp.

♀. Prothorax longer and more robust than in *M. platycephala*, Stal, and slightly dilated at the insertion of the fore legs; its dorsal arc roof-shaped, with the raised median longitudinal line coarse and prominent throughout, and with the free edges of its relatively narrower foliaceous expansions straight posterior to the supracoxal dilatation instead of slightly convex and the under surface coarsely rugose-punctate, with the puncta translucent instead of black.

Organs of flight when closed reaching just to the extremity of the last, abdominal somite. The tegmina green with the marginal field coriaceous, the rest of the organs being membranous. The wings hyaline with the anterior margin alone clouded with green.

Legs rather more robust. The fore tibiæ armed with 12 blunt teeth on the outside and with 18 on the inside below.

Cerci only slightly compressed.

Total length 118 millims.; length of pronotum 45·5, of which the posterior lobe is 36·5; length of head 7 5, breadth 11; length of tegmina 65, breadth of tegmina 14·5, of marginal field 3 5; length of fore coxa 24, femur 27·25; of intermediate femur 23, tibia 21·25; of posterior femur 29·25, tibia 31·75; of cerci 12·5.

HAB. A single specimen obtained probably by myself on South Andaman Island in 1872, but possibly by one of the Museum collectors under Captain J. Butler in the Naga Hills, Assam.

JOURNAL

OF THE

ASIATIC SOCIETY OF BENGAL.

Part II.—PHYSICAL SCIENCE.

Nos. II and III.—1882.

VI.—*Some new or rare species of Rhopalocerous* Lepidoptera *from the Indian region.*—*By* MAJOR G. F. L. MARSHALL, R. E.

(With Plate IV.)

[Read January 4th, 1882.]

1. MYCALESIS SURKHA, n. sp.

Plate IV, fig. 1 ♂.

♂. With a tuft of hairs on *hindwing* just above the base of the subcostal nervure, and another placed in a slit or pouch near the middle of the submedian nervure, the opening on the upperside. *Wings* above bright yellowish rufous shading off into a dark brown outer border most broadly at apex of forewing where the dark brown is continued along the costa, and at the anal angle of the hindwing; a single round small black spot on the *forewing* with an indistinct iris of paler rufous situated above the first median nervule at the inner edge of the dark border. UNDERSIDE pure glossy brown, a narrow lilacy-white transverse line continuous across both wings, even, narrowly edged internally with very dark brown, the brown ground-colour deepens from the base to this line, and outside the line it is abruptly and uniformly paler. *Forewing* with two submarginal ocelli, small, white pupilled, and ringed with lighter brown. *Hindwing* with seven ocelli, the three upper small, the fourth, sixth, and seventh minute, the fifth only prominent.

Length of forewing 1 inch, whence expanse = 2·1 inches.

Taken by Captain C. T. Bingham in the Donat range in Upper Tenasserim in January. The type specimen, which is unique and much mutilated, has been deposited in the Indian Museum. The female is unknown. It is closely allied to *Mycalesis* (*Loesa*) *oroatis* Hewitson, from Java, and of which it is the continental form.

2. Zophoessa dura, n. sp.

Plate IV, fig. 2 ♂.

♂. *Wings* above dark velvet brown, with a faint purple gloss and in some lights a golden sheen, the outer margin of both wings abruptly paler, the pale margin widening on the hindwing where it occupies nearly half the wing. *Forewing* with an indistinct similar submarginal line on the pale ground; *hindwing* with four round blackish spots on the pale ground, and beyond them a dusky marginal line followed by the usual outer yellowish lines divided by a fine dusky line. Underside as in *Z. sura*, Moore, to which it is closely allied, but the silvery grey and chesnut markings are less prominent, and the grey zigzag lines at base of the hindwing are much more convex in outline.

The spots on the upperside of the hindwing are much smaller than in *Z. sura*, the two on the median interspaces are prominent, the other two are obsolescent.

Length of forewing 1·35 inches, whence expanse = 2·8 inches.

Taken by Captain C. T. Bingham in the lower Thoungyeen forests in Upper Tenasserim in May. The type specimen, which is unique, has been presented to the Indian Museum, Calcutta.

3. Hipparchia shandura, n. sp.

Plate IV, fig. 3 ♀.

♀. Allied to *H. briseis*, Linnæus, from northern and western Asia, but smaller and notably differing in having a large white patch in the discoidal cell of the forewing completely filling the cell except at its extremity; and in this feature approximating to the species of *Melanargia* (*galathea*, *lachesis*, *psyche*, *clotho*, &c.) in colouring.

Wings above dull black with creamy white markings. *Forewing* with the costal margin streaked and mottled with grey and black; a large blotch of creamy white in the discoidal cell, filling it completely from the base to near the extremity where it ends abruptly, and a discal series of longitudinal creamy white streaks, consisting of a short streak above the subcostal nervure, a very long one below it bearing a round black spot in the centre, a very short narrow streak between the discoidal nervules, a larger streak below

the third median nervule, a larger one still below the second median nervule divided transversely by a large blackish spot, a shorter streak filling the whole width between the first median nervule and submedian nervure and bearing a blackish spot near its outer upper end, and a short streak below the submedian. Cilia long, white, broadly interrupted with black at the ends of the nervures. *Hindwing* with a broad discal transverse band of creamy white longitudinal streaks completely coalesced, widest at the middle where it extends half way into the discoidal cell and narrowest at the margins especially the costal margin; cilia long, white, scarcely perceptibly interrupted with black. UNDERSIDE. *Forewing*, costal margin and apex whitish finely mottled with brown; cell white mottled with brown at upper edge, and with a blackish bar near extremity; the discal series of streaks as above but all larger, completely coalescing, and sharply defined with dark brown internally and externally except at the apex where they merge into the mottled ground, the two black spots of the upperside reappearing as black ocelli with white pupils. *Hindwing* white mottled with brown, the mottlings deepening into three irregular dark brown mottled transverse bands darkest at their outer edges, one submarginal, one near the base of the cell, and one between these two.

Length of forewing 1·15 inches, whence expanse = 2·4 inches.

Taken by Major John Biddulph on the Shandur plateau in Northern Kashmir. The type, which is unique, has been deposited in the Indian Museum, Calcutta.

4. ZEUXIDIA MASONI, Moore.

This species was described from a specimen of the female taken in the Limborg expedition at Meetan in Upper Tenasserim in April, at an elevation of 3,000 feet, in the following terms. "Allied to *Z. amethystus*, Butler, from Sumatra. *Female*, differs in the paler colour of the wings, and in the greater breadth of the yellow oblique band; the band entire and terminating at the middle median branch, below which are two similar-coloured spots; a small pale patch before apex of the wing; *hindwing* pale cinnamon-brown broadly along outer border. Expanse 4·5 inches."

A male specimen of a *Zeuxidia* has recently been taken by Captain C. T. Bingham in the lower Thoungyeen forests which evidently belongs to this species, the male of which has not as yet been described. It differs from *Z. amethystus* ♂ on the *forewing* in having the lilac band extending to the hinder angle; and in the *hindwing* in having the lilac patch extending from just above the third median nervule to the submedian nervure: instead of extending from just below the body to the fold between the second and third median nervules.

Description, ♂, UPPERSIDE velvety blackish brown, paler at the outer margin and glossed with purple about the disc of each wing; *forewing* with a broad whitish purple transverse band suffused with darker purple at the edges and extending from the costa, where it is broadest, outside the cell to the hinder angle where it narrows to a point; *hindwing* with the outer margin broadly pale purple extending from the fold above the third median branch to the submedian nervure, the extreme margin and tail being brownish. UNDERSIDE bright golden brown, deepening outwards towards a narrow dark brown almost regular line which crosses both wings just at the end of the discoidal cell from the costa of forewing to a little short of the anal angle of hindwing near which this line is abruptly and acutely angled back towards the base. *Forewing* with three lilac grey bars across the cell, and the transverse dark line outwardly and the costal half of the wing outwardly irregularly suffused with lilac grey. *Hindwing* with the dark transverse line outwardly and the basal half irregularly suffused with lilac grey, and with two moderate sized ocelli, one between the subcostal nervules brown, with a yellowish pupil and yellowish and narrow dark brown rings; the other between the first and second median nervules dull yellow finely ringed with dark brown and excentrically marked with a brownish spot bearing a yellowish pupil.

Length of forewing 2 inches, whence expanse = 4·2 inches.

This species is manifestly very closely allied to the Sumatran *Z. amethystus*, but both are extremely rare, and in the absence of specimens of the latter, we must retain the Indian species as distinct.

The specimen was caught between March and May, but the exact date is uncertain, and adds one more to the numerous and valuable discoveries which we owe to Captain Bingham's careful research.

5. THAUMANTIS LOUISA, Wood-Mason.

The male of this species was described and figured by Mr. Wood-Mason in the Journ. A. S. B., Vol. XLVII, part II, p. 175 (1878), from two specimens in the Limborg collection, taken in Upper Tenasserim on the Taoo plateau at an elevation of 3,000 to 6,000 feet. Captain C. T. Bingham has recently captured a fine specimen of the female, hitherto undescribed, in the lower Thoungyeen forests which are also in Upper Tenasserim, and not far from the Taoo plateau but at a considerably lower elevation.

T. louisa ♀ differs from the figure of the male, in the following particulars. UPPERSIDE with the fulvous ground-colour on the hindwing extending completely up to, and embracing the heads of, the hastate border spots, the ground-colour of the outer portion of the wings being not white but pure french grey, the only traces of pure white being on

the forewing, at the middle of the costal margin and outside the median transverse line and decreasing from its costal end. The dusky tipping at the apex also extends below the subcostal nervure. UNDERSIDE with the fulvous portions not luteous, but strongly suffused with grey and altogether of a far colder tone; the hastate border spots of the upperside pale but perfectly distinct and complete; *hindwing* with the outer submarginal lunular line obsolete, the inner one slender and incomplete, whereas in the figure of the male both these lunular lines are complete and prominent.

Length of forewing 2·8 inches, whence expanse = 5·8 inches.

The specimen from which the description is taken was captured between March and May, exact date not recorded. It of course lacks the tuft of erectile hairs on the hindwing which is present in the male.

6. POLYOMMATUS ELLISI, n. sp.

Plate IX, fig. 4 ♂.

♂. UPPERSIDE dark greyish black, the basal portion of both wings powdered with metallic greenish golden scales, the outer half with a bronzed sheen; *Forewing* with a dark centered white spot at end of the cell, and a discal series of four prominent white spots sometimes dark centred; *Hindwing* also with a white spot at end of the cell, and a small white one above it near the costa; a discal series of four white spots, corresponding with those on the forewing.

UNDERSIDE creamy white, *Forewing* brownish on the disc with the outer margin broadly paler, the spots of the upper surface large, indistinct and paler still. *Hindwing* with the base metallic greenish golden deepening into brown up to the discal row of spots, the outer margin creamy white, the spots of the upperside large, indistinct, white.

The female appears to differ in lacking the brilliant metallic scales.

Expanse 0·9 to 1·05 inches.

The type specimen (which has been presented to the Indian Museum) was taken on the Sánch pass in Pangi, N.-W. Himalayas, at an elevation of 14,000 feet above the sea in August by Mr. Robert Ellis, after whom I have named it. Several other specimens were taken at the same time all corresponding with the type specimen. Others were taken in Pangi in June at an elevation of 12,000 feet which have less of the metallic sheen, and have the white spots on the upperside considerably smaller; these latter evidently belong to the same species, but whether they are seasonal or geographical varieties is uncertain.

7. Papilio claræ, n. sp.

Plate IV, fig. 5 ♂.

♂. Wings above velvety brown, almost black in some specimens, paling at the outer margin broadly at the apex and decreasing towards the hinder angle. *Forewing* with four short streaks of powdery blue at the end of the cell, behind which are four longer and narrower streaks toward the base, also a discal series of eight bluish streaks increasing in length from the costa and each extending from near the outside of the cell to the edge of the paler outer border, the two lower streaks between the submedian and median nervures, the remainder one between each pair of nervules. *Hindwing* with a prominent submarginal row of pure white longitudinal streaks one on each side of each nervule leaving a wide brown margin beyond on which in some specimens indications of the continuation of the white streaks to the margin show through from the underside; a rounded yellow spot at the anal angle bordered inwardly by a blackish lunule. *Body* black, spotted with white.

Underside uniform paler brown of the same tint as the margin on the upperside, the *forewing* unspotted except with faint traces of whitish at the hinder angle; *hindwing* with the row of white streaks as on upperside but continued up to the margin, the yellow anal spot and black lunule as on upperside and a round white spot at base above the costal nervure.

Length of forewing 1·9 inches, whence expanse = 3·9 inches.

Habitat.—Upper Tenasserim.

P. clarœ is closely allied to *P. hewitsonii*, Westwood, from Borneo, of which it may possibly be only a permanent geographical variety. It differs from *P. hewitsonii* in the presence of the blue streaks on the forewing which are visible more or less in all the thirteen specimens examined, in some very prominent in others partially obsolete, but none are without blue at the end of the cell and in the interspaces immediately beyond it. It also differs in the paling of the margin of the forewing; and in the hindwing in the single row of prominent white streaks. Its northern ally *P. slateri*, Hewitson, differs in the shape of the forewings having them narrower and more acuminate, and also entirely lacks the white streaks on the upperside of the hindwing. In shape of this wing *P. clarœ* corresponds with *P. hewitsonii*.

The difference between Assam and Tenasserim species in regard to the absence or presence of white spots on the hindwing has curious parallels among the *Euplœas* which are mimicked by this group of *Papilio*, *E. deione*, Westwood, and *E. kopei*, Felder, from Assam lack the white border spots on the hindwing, while their representatives in Tenasserim

E. limborgi, Moore, and *E. grotei*, Felder, have the white spots prominently developed.

Four specimens were taken by Captain C. T. Bingham on the Donat range in January. Three were taken by Captain C. H. E. Adamson in the Thoungyeen forests in February, and six in the same locality by Captain Bingham in May.

8. Papilio papone, Westwood.

This species was described by Westwood in 1872 in the Trans. of the Ent. Soc. Lond., with "habitat in India orientali," and no subsequent notice has been recorded of its occurrence so far as I know. A specimen has now been taken by Captain C. T. Bingham in Upper Tenasserim, which satisfactorily establishes the exact locality for this rare butterfly; the capture was made in the Thoungyeen forests on the 12th March.

It will be seen that the materials for the foregoing paper are almost entirely due to the careful researches of Captain C. T. Bingham, whose investigations as an ornithologist are already well known, and to whom I have been indebted for most valuable and generously rendered assistance in the getting together of data for the handbook of the "Butterflies of India," &c., the first part of which has been published; Captain Bingham has succeeded during the past two seasons in capturing nearly every species formerly recorded from Tenasserim, besides numerous species and sexes of species new to science and some new to the Indian list, and I take this opportunity of warmly acknowledging not only his labours but the generous way in which he has placed the whole of his collection at my disposal.

Explanation of Plate IV.

Fig. 1. *Mycalesis surkha*, Marshall, ♂.
Fig. 2. *Zophoessa dura*, „ ♂.
Fig. 3. *Hipparchia shandura*, „ ♀.
Fig. 4. *Polyommatus ellisi*, „ ♂.
Fig. 5. *Papilio claræ*, „ ♂.

VII.—*On an abnormality in the horns of the Hog-deer*, Axis porcinus, *with an amplification of the theory of the evolution of antlers in Ruminants.*—*By* John Cockburn, *Offg. 2nd Asst. to Supdt. Indian Museum, Calcutta.*

[Read March 1882.]

The specimen exhibited to the meeting is a frontlet of the Hog-deer in which the left horn is abnormally developed as in a stag of the elaphine group. The frontlet is a specimen that belonged to the Asiatic Society's collection and is without history. There is, however, fair presumptive evidence that the horns belonged to a feral animal.* Before proceeding to any explanation of the variation a description is necessary.

The right horn is normal and measures 14″ from burr to tip along the curve. The brow tine $3\frac{1}{2}$″, the external tine 5″, internal tine $2\frac{1}{4}$″. Circumference at burr $5\frac{1}{2}$ of beam midway $2\frac{6}{8}$. The left horn has five tines on it, as in a stag of ten, and the beam describes a sweeping curve posteriorly. The burr and brow tines are normal, though the latter is slightly curved inwards; an inch and a half further up the beam is a tine measuring $3\frac{1}{4}$″ in length which I take to be representative of the bez tine. This tine, though otherwise justly proportioned, is curved inwards and backwards. Three and a quarter inches further up the beam is a third snag measuring $2\frac{1}{2}$″ along the curve; this snag though flattened and distorted I take to be analogous to the royal tine. Lastly the tip is bifurcated, its appearance being that of the sur-royal in *Cervus canadensis*. These snags are palmated and the inner furcation, which has lost its tip, grows parallel to the inner tine C on the opposite horn.

Abnormalities in Cervine horns are not uncommon. Judge Caton in his recent work "On the Antelope and Deer of America" discusses the question and attributes these growths to accidental injury to the horn, while tender and growing. Admitting that the majority of abnormal horns come under this category, I am nevertheless inclined to think that the specimen under review is to be otherwise explained. As a disciple of the doctrine of evolution it appears to me more rational to attribute the condition of the left horn to reversion or atavism. The circumstance of the variation being unilateral does not invalidate my hypothesis; polydactylism, the occurrence of supernumerary mammæ, and other phenomena of this nature being very frequently unilateral.

* The horns are bleached as if by exposure, and the polish where visible appears to me rather that of a feral than domestic animal.

The fact, however, that reversion to an extinct ancestor implies degradation in the *Rusinæ* is I confess a difficulty. The Rusine type of antler prevailed in Pliocene times, and is a comparatively elementary state. Nevertheless *Cervus dieranos*, whose antlers are described by Boyd Dawkins as "so complicated as to defy description," existed during that epoch.

The question of the atavism of these Hog-deer antlers is an important one, and as it is notoriously difficult to assign a clear and true value to certain conditions which would entail the destruction of a fancied discovery, I shall first attempt to put in as strong a light as possible the opposite argument to my view, *viz*, that the horns here described are accidental productions.

It may be advanced: *Firstly*, that of four of the so-called tines only one, the bez, bears any resemblance to a well formed tine, and the fact of its turning down at the tip seems to point to an inherent tendency which the inner tine has (in this species) of curving downwards; that it is in fact nothing more than the inner tine C arrested in its growth at the lower portion of the beam. *Secondly*, that the so-called royal tine is on the inner side of the beam. Finally that the terminal bifurcation is due to a law announced by myself further on, that all terminal portions are capable of furcation. Other abnormalities doubtless exist in private collections of horns and this paper, if it results in no further good, may possibly have the effect of leading to the description of some of these.

The evolution of antlers in Ruminants appears capable of being brought under a theory of development. The honour of being the first to apply a definite law to the development of the horns of the *Cervidæ* belongs to the late Prof. A. Garrod, who published a paper on the anatomy of the Ruminants in the Proceedings of the Zoological Society for January 1877.

Garrod's law may be most briefly stated in his own words. "What may be called the typical antler is composed of a bifurcate beam, with a brow-antler springing from the front of its basal portion. These three parts may be termed A, B, and C as in the accompanying diagram (fig. 1.)

"They occur, uncomplicated, in the genus *Rusa*, in *C. porcinus*, *C. axis* and *C. alfredi* (fig. 1). On the assumption that most of the complicated many-pointed antlers that occur are the result of the exaggerated development of one or other, or both of the extremities B and C, their special features may be explained. For instance imagine both B and C bifurcate, remaining of equal size, and we arrive at the condition found in *Cervus schomburgki* (fig. 2). *C. duvaucelli* differs in that B is extra developed at the expense of C (fig. 3). ..... Following out the ingenious hypothesis of Mr. Blyth, P. Z. S. 1867, p. 835, *C. eldi* only differs in the still greater development of the anterior branches of B (fig. 4). ..... In *Cervus dama*, and in the species included in the genus *Pseudaxis* ..... a different condi-

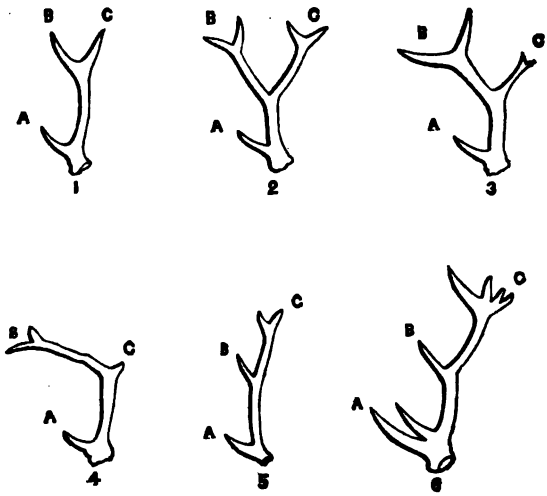


Diagram of Antlers of Deer.

tion obtains, B being greatly reduced and C correspondingly enlarged (fig. 5). In the Elaphine Deer this is carried further, the continuation of the beam C being divided terminally into many points (fig. 6). ..... With reference to the brow-antler A, it is evident that its duplication (the bez tine) is more associated with the actual size of the antlers than with any other peculiarity." (This last assertion is by no means evident.)

Although Prof. Garrod's theory satisfactorily explains the development of a large number of Cervine antlers, it is powerless to explain the horns of the *Elaphinæ* those of *Elaphurus davidianus*, *Cervulus*, *Coassus*, *&c.* It is apparent that his so-called typical antler is already a complex organ possessing as it does 3 tines, while there are existing species of deer whose antlers never proceed beyond the condition of a simple spike, *Coassus rufus* for example. It therefore appears more philosophical to assume the typical antler to be a simple spike, a condition which all cervine horns exhibit in the first year's growth.

Some months after the publication of Prof. Garrod's paper on the anatomy of the Ruminants, Prof. Boyd Dawkins published a most important paper in the Quar. Jour. of the Geol. Society (Vol. XXXIV—Read 19th Dec. 1877) "on the history of the Deer of the European Miocene and Pliocene strata." The general conclusions he arrived at regarding the palæontological history of the development of antlers are given below in an abstracted form.

"In the mid-Miocene age, the cervine antler consisted of a simple forked crown only. In the Pliocene it becomes larger and longer and altogether more complex, some forms, such as the *Cervus dicranios* of Nesti, being the most complicated antlers known either in the living or fossil state. These successive changes are analogous to those which are to be observed in the development of the antlers in the living deer, which begin with a simple point and increase their number of tines until their limit be reached." More recently (Nature Nov. 1881) he has repeated the same generalization in slightly different language which I here quote, "In other words the development of antlers indicated at successive and widely separated pages of the geological record is the same as that observed in the history of a single living species."

Boyd Dawkins regards the antlers of the extinct *Procervulus*, which is the simplest type hitherto met fossil, as the starting point of the antlered ruminants both in the old and new worlds. But the antlers in this genus were more or less branched, and bearing the existing *Coassus rufus* in view, they can hardly be regarded as quite elementary. Considering the imperfect state of the Geological record it may be foretold that an antlered ruminant with simple deciduous spikes for horns will yet be discovered fossil.

Prof. Dawkins has not attempted to apply his theory to an explanation of the horns of existing deer as Garrod had done, but Sir Vincent Brooke who published an elaborate paper on the classification of the Cervidae, with a synopsis of the existing species, in the P. Z. S. for 1878 p. 883, has followed Garrod's theory closely.

There is therefore room for an amplification of Dawkins' phylogenetic law, which I would state thus, as bearing on both extinct and existing cervines.

The development of the antlers of individual species of cervines is a recapitulation of the history of the development of antlers in the group.

I would assume the typical antler to be a simple spike, as in *Coassus rufus*, capable of extensive furcation, reduplication, arrest and redundancy of growth in parts.

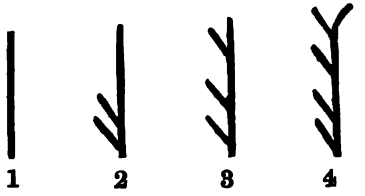
In certain species the terminal portions of the main stem, when the limit of length has been reached, have a tendency to develop an almost unlimited number of snags, possibly referable to palmation of the horns in an extinct ancestor. This tendency is markedly manifest in *Cervus elaphus* and *Panolia eldi* and in a lesser degree in *Rucervus*.*

I shall take up the development of the horns of the Wapiti, *Cervus canadensis*, to illustrate my theory.

* The fine horns of *Rucervus duvaucelli* figured by Blyth, P. Z S. 1867, fig. 3, show this character, and also a tendency to palmation. The horns are yet in the Museum.

The growth of the antlers in the Wapiti has been carefully described by Judge Caton whose observations extended over a period of 15 years and included over 100 deer.

The horns of the 1st year are usually spikes, a condition I illustrate by fig. 1.



The second antlers have both brow and bez tines, this condition I therefore regard as a double furcation, fig. 2. The third antlers almost invariably have the Royal tine, see fig. 3. The fourth and fifth year may or may not produce the sur-royal, fig. 4.

The horns of *Cervus elaphus* and its numerous races are, I consider, the most difficult of comprehension in the whole group, and the above is I believe the first rational explanation of their development that has as yet been offered. *Capreolus caprea* and *Elaphurus davidianus* are both primitive types. In these two genera the primary bifurcation takes place on the beam at some distance from the burr. The development of the horns of *Capreolus* offer so admirable an instance of furcation from a simple beam, that the marvel is that the theory I have brought forward has not occurred to some one before.

The horns of *Elaphurus davidianus* which were a stumbling block to Prof. Garrod, who states that they were "quite beyond his comprehension," are easily explained by the same theory. The primary furcation takes place some distance up the beam, the forward branch (brow tine) subsequently furcates again, while the posterior branch, which in the stag (*Elaphus*) has hitherto been considered the beam, remains simple tapering and pointed. It thus becomes obvious that superiority of growth in either the anterior or posterior branches of the primary furcation would constitute the main stem or beam.

The tendency towards furcation of the anterior branch or brow tine is yet manifest in various existing cervines. In an extinct species of deer, *Megaceros hibernicus* the brow tine was constantly furcate at the extremity, and a tendency to this order of things is to be observed throughout the Rusine family. I would in this manner explain the studs and snags so commonly present in the brow tine of *Axis maculatus*. I observe that it exists in 8 out of 15 heads, and such being the case, it appears doubtful

whether it should not be rather considered the normal condition, and the typical antler of Garrod the reverse. In the majority of instances there is a small conical snag at the base of the brow tine, but in more than one specimen there is a double snag, and in one of these specimens the anterior snag measures 3½ inches in length.

The extreme of this form of development is to be observed in *Panolia eldi* where the brow tine has commonly 3 snags (trifurcate). It is of less common occurrence in *Rucervus duvaucelli*, and in *R. schomburgki* exhibits the same type as in *Megaceros*, viz., a well marked furcation of the extremity of the brow tine. *R. schomburgki* has probably the most exuberant horns of any existing cervine.

The Sambar of India, *Rusa aristotelis*, can, as a rule, be distinguished from other races by the circumstance of the tines B and C being of nearly equal length, and the posterior being set on immediately behind the other. It is thus in the same plane as the furcation at the brow. In the Assam and Burmese races the outer tine B is, as a rule, longer than B which is set on the beam in a transverse direction pointing inwards and upwards. It thus approaches the horns of *Axis porcinus*. I would throw out the suggestion that as both these animals frequent grass jungles, the more or less transverse direction of the posterior tine has been produced through the resistance offered to the growing horn by the grass and that this cause operating similarly on both species through a series of generations has resulted in a permanence of the type.

With reference to the horns of *Panolia eldi*, an examination of a large series of horns in every stage of growth has convinced me that Prof. Garrod's diagram is incorrect. (P. Z. S. 1877, p. 16, fig. 4.) The tine C has no existence in the position assigned to it in any specimen I have seen. Horns of the 2nd year's growth are in the form of a C without the top stroke. The next stage is furcation of the anterior extremity. Mature horns of *P. eldi* often have as many as 9 or 10 small snags on the main beam, in addition to a terminal furcation.

This is particularly to be noticed in the Siamese race of brow-antlered deer named *Cervus platyceros* by Gray. Good figures of these Siamese horns are given by Blyth, P. Z. S. 1867, p. 841. The palmation of the extremity is evident (hence the name), and the numerous snags are, I consider, of the nature of the spillers in *Dama* and *Alces*. I cannot at present offer an explanation of these spillers beyond that already given.

VIII.—*On the habits of a little known Lizard,* Brachysaura ornata.—*By* John Cockburn, *2nd Assistant to Superintendent Indian Museum.*

[Received 26th January; Read 1st February.]

BRACHYSAURA ORNATA.

Blyth, J. A. S. B. Vol. XXV p. 448.
Günther, Reptiles of Brit. India, p. 161.
Jerdon, P. A. S. B. 1870, p. 78.
Stoliczka, P. A. S. B. 1872, p. 77.

Very little is known of this lizard. It was originally described by Blyth in the J. A. S. B. Vol. XXV from specimens procured by Dr. Jerdon at Saugar in Central India Dr. Günther includes it in an appendix to the Reptiles of British India, and remarks that it is just possible that this animal may be recognized when re-discovered, but from the description alone it is impossible to characterize the new genus *Brachysaura* or to fix its position in the family of the *Agamidæ*.

In the P. A. S. B. for 1877, Dr. Jerdon in his Notes on Indian Herpetology remarks that all his endeavours to procure specimens for a more minute examination of this curious form had hitherto failed and "till some one with sufficient scientific proclivities examines these districts we must rest satisfied with our incomplete information." The type appears at this time to have been lost. In 1872, five specimens were procured in Kachh by that enthusiastic naturalist Dr. Stoliczka, and described in the Proceedings for May, 1872.

During the last rainy season I found *B. ornata* excessively common in the vicinity of the town of Banda and was enabled to send more than twenty living specimens to the Zoological Gardens, Calcutta, as well as to present a series to the Indian Museum. The results of my observations show how much of interest there may be in the life history of a small lizard.

There are certain anomalous sexual characters about this lizard, the females being larger than the males. The superiority of the female in size appears to occur irregularly throughout the province *Sauropsida*. The female of *Sitana minor* is a third larger than the male, but in *Calotes versicolor* the reverse is the case. In *Brachysaura*, which is closely allied to *Calotes*, not only is the female larger, but she is normally more brilliantly coloured than the male. Certain peculiarities in the behaviour of the females leads me to suspect that they seek and attract the males. In more than one instance I observed a female make decided advances towards a male. She sidled up to him in a most insinuating way, with a crouching wriggling motion and open jaws, and seized him by the nuchal crest.

Dr. Stoliczka P. A. S. B. 1872, p. 72 remarks that the head-quarters of *Brachysaura* appear to be westward. This is not strictly correct, but even in ignorance of Stoliczka's paper I fell into a similar mistake and in a

letter to Dr. Anderson, wrote, "*B. ornata* appears to be essentially a Central Indian species. The black volcanic soil of these provinces seems its peculiar habitat. I, however, once (in 1873), captured a pair on the north bank of the Jumna at Allahabad near the mouth of the Sussor Kuderee, *Sitana* is plentiful in this locality, but I never found another pair of *Brachysaura*. It is unknown in the Duab, and the probability is that these individuals were the offspring of others brought down in some flood from Bundlekhand." It now appears likely that *Brachysaura ornata* will be found in arid tracts throughout the Gangetic provinces, from the confluence of the Jumna westward to the extreme limits of the Empire. It would appear to range with *Psammophis condanurus*, and *Sitana minor*. Its southern limit beyond Saugar is yet unknown.

There are several points in which my specimens appear to differ from Dr. Stoliczka's and I have therefore described the lizard anew.

Brachysaura ornata, Blyth, ♂. A squat thick-set pot-bellied ground lizard, with a large head and short tail. Scales on the upper surface of body, limbs and tail strongly keeled, this character being less defined on the lower surface of the abdomen and thighs. The scales of the body are in nearly vertical series down the flanks, following the line of the ribs, and gradually inclining upwards in the direction of the costal cartilages on the ventral surface. Counted round the body at the 30th spine they are 55 in number in an adult. From the 1st nuchal spine to the extremity of the tail are 110 scales.

A dorsal and nuchal crest of sharp spines is present in the male sex only; the nuchal portion of this crest, composed of 9 scales, is most developed, there is then a hiatus of 8 strongly keeled scales, when the spines again occur. They are continued in the form of a strong median series of keels to the tips of the tail.

Total length.	Head and body. to centre of vent.	Tail from centre of vent.
♂ 6½	3⅜	3⅛
♀ 5½	3⅜	1⅝ (Imperfect.)
♀	3 1/10	2·42.

The fore limb when laid backwards reaches the inguinal region, and the hind limb laid forward extends to the angle of the lower jaw, all four limbs are strongly keeled to the extremities of the digits. The keels are very strongly marked on the scales of the tail, so much so as to impart to it a polygonal appearance in its lower half. They diminish in a binumeral ratio from 12 in number at the basal half of the upper third, to 6 at the extremity. No preanal pores have been observed.

Head large, with a prominent and overhanging superciliary ridge composed of 8 inflected scales, counted between the nostril and the posterior

margin of the orbit where it abruptly terminates. Nostril round, in a single large inflated shield, its position being immediately above the 3rd and 4th labials. Labial formula, $\frac{12,\ R\ 12}{12,\ M.\ 12}$.

The lips are thick and fleshy and there are two rows of scales, similar to the upper labials, covering the lip. Both upper and lower labials are perforated with pores varying from 1 to 5 in number on each scale; the loreal region also exhibits these pores. The upper surface of the head requires minute description; it is more or less covered with tuberculated and keeled scales. Beginning from the rostrum it will be seen that the 4th and 5th scales on the mesial line from this shield are tuberculated and enlarged into a rudimentary nasal appendage. The number of scales in transverse series at this point are 2 on each side, or, including the tubercle, 5 in all. In other specimens, particularly in females, this character may be described as a rosette-like group of tuberculated scales. These scales are not so strongly marked in immature specimens. Posterior to this region are the convexly prominent superior surfaces of the orbit, characterized by a deep mesial groove, and also covered with enlarged tubercular scales. In the centre of the vertical region, which may be defined by an imaginary line drawn across the head from the posterior termination of the superciliary ridges, is a large round scale with a central depression and white horny central point. Separated from it by a single scale are two small conical isolated spines, and a few enlarged keeled scales. Further beyond, on the posterior edge of the temporal region, are two groups of spines as in *Calotes*. These groups are made up of from 5 to 7 elongate conical spines, a central spine being always more developed than the others. There is one other character of importance in the head. This consists of a ridged cheek piece of much enlarged and keeled scales which extends from below the hinder angle of the orbit to the tympanum. The number is not constant, and from 6 to 12 may sometimes be found.

The normal colour of the females consists of various shades of earthy brown, with three rows of rhomboidal or circular blotches—one median, which is the largest and extends down the tail, and two lateral rows of smaller size. The blotches have a pale straw or flesh-coloured edging. Females taken under sexual excitement are either wholly crimson, or crimson, with the exception of the back, which is dusky olive. The gular fold is deep black. In this stage the female does not exhibit any markings or blotches whatever, and at the least provocation or excitement becomes quite crimson. The prominent and pendulous abdomen in this sex is evidently connected with the stowage of ova.

The males are normally of an uniform dusky brown. In this sex the blotches are not so well marked as in the female, and much smaller. The

flesh-coloured edging might in them be rather described as an interrupted flesh-coloured line. The general colour assimilates itself to the black cotton soil which this lizard particularly affects. I have never captured a male in the crimson state, but have observed that they can assume a faint rosy tinge and also a bright green. The males have a distinct physiognomy, slenderer bodies, but stouter limbs than the females. The tail is bulbous and thick at the base, with the usual sexual projection, and suddenly tapers. It is always a third longer than in the female. The gular sac is developed in both sexes, but is more massive and has a distinctive masculine outline in the male. These notes on colouration present the sexes in breeding livery, August and September.

The tissue below the nuchal and dorsal crests would appear to be of an erectile nature. These crests I observed much developed in a male during a paroxysm of excitement when it acquired a distinctly arched outline. Many of the females when captured were entirely scarlet and evidently under strong sexual excitement. Their behaviour is then remarkable and most amusing. A female under these circumstances twirls the tail, inflates her gular sac, and gives the body a peculiar wriggle.

Brachysaura is a sluggish lizard. with a dull and heavy habit of body, and grows much larger than any specimens I have sent to the Museum. Both *B. ornata* and *Sitana minor* are ground lizards, but I have observed them hanging in an awkward fashion from nearly bare stalks 3½ feet above ground. Though both frequent the open by choice, their holes are usually at the roots of a Spurgewort (*Calotropis*) or a Bair bush (*Zizyphus*); a deserted rat burrow is often used. They do not seem to be very prolific, laying from eight to ten eggs, yet they are numerically abundant in certain spots; for I captured no less than 50 within a mile of my house, chiefly on the Banda race-course. This lizard must be considered decidedly stupid. Large, and heavy specimens are hardly able to run, and in fact do not attempt it; but if pressed show fight with open jaws, actually leaping at an offending object. It can give a sharp nip and holds on like a bull dog.

I am at a loss to conceive how *Brachysaura* maintains itself in such numbers against the numerous predacious animals that prey on lizards. The genera *Corvus*, *Milvus*, *Poliornis*, *Herpestes*, *Felis*, *Canis*, *Ptyas*, *Naja*, *Varanus* and a host of other enemies all abound in the localities where it is found; *Calotes* and *Uromastix* are an important item in the food of these animals. *Sitana* I have often observed impaled on a thorn by a *Lanius*.

The only explanation I can offer is, that it has some objectionable flavour or poisonous protective quality which renders it secure from attack. I was in hopes that the experiment of offering one to some Raptor would have been made at the Zoological Gardens here, but the subject seems to have escaped attention. I may mention that the natives of Banda firmly

believe this lizard to be poisonous and get out of its way at once; I was also informed that if eaten they would produce insanity. The circumstance of its feeding with impunity on insects that are themselves protected in this way seems in favour of this theory. The contents of the stomach of one I killed on purpose were, (1st), fragments of a small species of *Julus*; (2nd), one small carnivorous beetle; (3rd), fragments of other *Coleoptera*. It is very easily kept alive, feeding readily on flies, grasshoppers and beetles, and all kinds of stinking bugs. These bugs and *Julus* have a protective odour, and I have found all birds reject them.

When caught or frightened this lizard emits a short but not unmusical squeak. The facully of voice has not been observed before in the *Agamidæ*. It appears to be nocturnal in its habits, and it is only in the evening, or when their holes are flooded, that they are to be seen in numbers.

IX.—*Second List of Butterflies taken in Sikkim in October*, 1882, *with notes on habits, &c.*—*By* Lionel de Nicéville.

[Received 29th November; read 6th December, 1882.]

In the second part of this Journal for 1881, vol. l, p. 49, I contributed a list of the Butterflies taken by me during five days collecting at different elevations in Sikkim in the month of October, and enumerated 129 species. This is but a very small portion of the Rhopalocerous fauna to be met with even in one month in the vicinity of the Station of Darjiling, as I therein indicated, and as the list that follows shews. The whole of the species now enumerated were not taken by myself, as I was accompanied on several occasions by Mr. Otto Möller (an enthusiastic collector, who has most generously placed the whole of his extensive collections of Sikkim Butterflies at Major Marshall's and my disposal for examination in the preparation of our work on "The Butterflies of India"), and a party of five Lepchas, who make what they can by catching insects and selling them to visitors. These men were very glad to sell us what we wanted of the specimens they caught at a pice a piece; especially as we told them that we required small species more especially, these latter, unless very bright-coloured, they never take any notice of. On two different days they took us to two parts of the same hill stream ("Jora"), and shewed us their principal hunting grounds. These chiefly consist of open sandy spaces by the side of the stream which attract vast numbers of Butterflies to settle, and to suck up the moisture. In one place upon a large flattish stone near the middle of the stream, the men had put some sand and kept it

watered, and it was surprising the numbers of Butterflies that came to their 'trap' and were caught. Judging from what I there saw, I am of opinion that nearly all the Butterflies which are bought from the common Lepcha boxes at Darjiling are caught in this way, and in the low valleys averaging perhaps 2,000 feet elevation above the sea. Here Butterflies in immense variety literally swarm, and in one fine day a man can easily fill a box with large and showy species.

For facility of reference I have repeated, with the addition of an asterisk, the names of all the species given in my first paper which we did not meet with on this trip, commencing the numbering of the fresh species at 130. The latter were all taken between the elevations of about 4,000 and 2,000 feet above the sea. The species that were met with on this as well as on the first occasion have no number prefixed.

LEPIDOPTERA RHOPALOCERA.

Family NYMPHALIDÆ.

Subfamily DANAINÆ.

Danais (*Parantica*) *aglea*, Cramer.

130. *Danais* (*Caduga*) *tytia*, Gray.

Danais (*Caduga*) *melaneus*, Cramer.

Danais (*Tirumala*) *septentrionis*, Butler.

In the neighbourhood of Calcutta *D. limniace* alone occurs, in Sikkim it is replaced by *D. septentrionis*, but at Simla and in the neighbouring hills and in many other localities both species occur together.

4. **Danais* (*Salatura* and *Limnas*) *chrysippus*, Linnæus.

5. *Danais* (*Salatura*) *genutia*, Cramer.

This is the *D. plexippus* of my former list.

131. *Euplœa* (*Salpinx*) *rogenhoferi*, Felder.

One male only of this rare Butterfly was caught by a Lepcha.

132. *Euplœa* (*Salpinx*) *rhadamanthus*, Fabricius.

One male only at 2,000 feet.

Euplœa (*Trepsichrois*) *midamus*, Linnæus.

**Euplœa core*, Cramer.

133. *Euplœa* (*Stictoplœa*) *hopei*, Felder.

One female was taken by a Lepcha. It is by no means a common Sikkim butterfly.

Subfamily SATYRINÆ.

134. *Anadebis himachala*, Moore.

Not very common in deep forest.

Mycalesis (*Gareris*) *gopa*, Felder.

Mycalesis (*Virapa*) *anaxias*, Hewitson.

135. *Mycalesis* (*Orsotriæna*) *runeka*, Moore.

Two males only.

136. *Mycalesis* (*Calysisme*) *perseus*, Fabricius.

A single male. It is evidently rare in Sikkim, Mr. Ot to Möller has taken hundreds of the variety *M. visala*, but only a few of the true *M. perseus*. The latter is at once known by the rounded apex to the forewings.

Mycalesis (*Calysisme*) *perseus*, var. *visala*, Moore.

Common everywhere amongst trees and bushes. The markings on the underside are infinitely variable, but the "sharply angled, almost pointed, apex of the forewing" (Elwes, Proc. Zool. Soc. Lond., 1882. p. 406) distinguish it from the preceding.

Mycalesis (*Samanta*) *malsara*, Moore.

Not uncommon amongst bushes and undergrowth.

Lethe kansa, Moore.

Both sexes, males not uncommon, one female only.

**Lethe mekara*, Moore.

Lethe chandica, Moore.

Both sexes in forest.

**Lethe europa*, Fabricius.

Lethe rohria, Fabricius.

Males common everywhere, females less so.

137. *Lethe* (*Tansima*) *verma*, Kollar.

Far less common than the preceding. Occurs in the same localities.

Lethe sidonis, Hewitson.

Common at about 6,000 feet elevation, not seen much lower.

Neope bhadra, Moore.

Ypthima philomela, Johanssen.

Ypthima sakra, Moore.

Ypthima nareda, Hewitson.

**Zipaëtis scylax*, Hewitson.

138. *Melanitis leda*, Linnæus.

One example at 2,000 feet elevation.

139. *Melanitis ismene*, Cramer.

Common in forest.

140. *Melanitis zitenius*, Herbst.

Common at low elevations.

Subfamily ELYMNIINÆ.

Elymnias undularis, Drury.

141. *Elymnias leucocyma*, Godart.

Common around villages at about 2,000 feet elevation.

Dyctis patna, Westwood.

142. *Dyctis vasudeva*, Moore.
One male at a low elevation.

Subfamily MORPHINÆ.

143. *Discophora tullia*, Cramer.
Discophora celinde, Stoll.
Thaumantis diores, Doubleday.

Subfamily ACRÆINÆ.

Pareba vesta, Fabricius.
This is the *Acræa vesta* of my former paper.

Subfamily NYMPHALINÆ.

Cethosia biblis, Drury.
Cethosia cyane, Drury.
Not nearly as common as *C. biblis*.
Cirrhochroa aoris, Doubleday, Hewitson.
Cirrhochroa mithila, Moore.
Cynthia erota, Fabricius.
144. *Argynnis* (*Acidalia*) *niphe*, Linnæus.
Common at about 4,000 feet elevation.
Symbrenthia hippoclus, Cramer.
Very common. It is one of the comparatively few butterflies that live amongst the tea, to be accounted for probably by its food-plant (nettle) growing there more commonly than in uncultivated ground.
145. *Symbrenthia hypselis*, Godart.
Both sexes taken, but it is not nearly as commonly met with as *S. hippoclus*. Mr. Moore has described two allied forms from Sikkim, *S. niphanda* (P. Z. S., 1872, p. 559), and *S. cotanda* (P. Z. S., 1874, p. 569, pl. lxvi, fig. 9 ♂). The examples referred to above as *S. hypselis* are probably *S. cotanda*.
146. *Vanessa charonia*, Drury.
A single male was taken by Mr. Möller at about 2,000 feet elevation.
147. *Vanessa caschmirensis*, Kollar.
Very common in the tea-gardens.
Pyrameis indica, Herbst.
Junonia lemonias, Linnæus.
**Junonia laomedia*, Linnæus.
**Junonia asterie*, Linnæus.
Precis iphita, Cramer.
Common. I recorded this species under the genus *Junonia* in my former paper.
Pseudergolis wedah, Kollar.

This is the *Precis veda* of my first paper.

Kallima inachis, Boisduval.

148. *Doleschallia bisaltide*, Cramer.

Ergolis ariadne, Linnæus.

Cyrestis thyodamas, Boisduval.

Cyrestis risa, Doubleday, Hewitson.

Stibochiona nicea, Gray.

Hestina nama, Doubleday.

Males very common, one female taken by a Lepcha, the first specimen of this sex I have seen, and therefore new to the Museum collection. Our largest ♂ measures 3·7 inches in expanse, this ♀ is half an inch (4·2) larger. The wings are broader, and the ferruginous outer margin of the upper and undersides of the hindwing lack the series of very dark brown lunules between the nervules which are present in the male.

149. *Hestina persimilis*, Westwood.

One male only at a low elevation.

150. *Euripus cinnamomeus*, Wood-Mason.

One fresh female taken, which agrees with the type specimen described in the J. A. S. B., vol. l, pt. 2, p. 272, pl. iv, fig. 4, (1881), from Shillong.

Euripus halitherses, Doubleday, Hewitson.

Males only seen.

Lebadea ismene, Doubleday, Hewitson.

Limenitis procris, Cramer.

**Limenitis daraxa*, Doubleday, Hewitson.

Rahinda hordonia, Stoll.

The *Neptis hordonia* of my former list.

151. *Neptis miah*, Moore.

Not rare at low elevations. I took it settled to drink on damp sand.

152. *Neptis radha*, Moore.

One very worn male at about 3,000 feet elevation.

**Neptis viraja*, Moore.

Neptis varmona, Moore.

One male. This agrees with the specimen I named *N. aceris* in my former list and which I subsequently sent to Mr. Moore for correct identification. It was returned with "? *varmona*" placed on a ticket beneath it. The underside is bright ochreous, with the white bands and spots clearly defined outwardly with black.

Neptis emodes, Moore.

These specimens have been named by Mr. Moore. They are smaller than *N. varmona*, the underside is dark tawny, not ochreous, the bands are narrower and the spots more separated. The dark edgings to the spots and bands are less prominent owing to the ground-colour being much darker. One of the specimens is the *Neptis amba* of my former list.

153. *Neptis soma*, Moore.

The Sikkim specimens named by Mr. Moore have the streak in the cell on the upperside of the forewing very narrow, as also is the spot beyond it, the discal series of spots on that wing small, rounded and well separated; underside tawny, not so deep a shade as in *N. emodes*, the bands and spots not outwardly defined with black.

Neptis susruta, Moore.

Specimens of this species from Sikkim identified by Mr. Moore may be known from the preceding by the streak in the cell and spot beyond it being wider, as also is the anterior band on the hindwing. The bands and spots on the underside are slightly defined with black.

154. *Neptis nandina*, Moore.

Several specimens at low elevations.

Neptis cartica, Moore.

Mr. Moore has confirmed my identification of the specimens of this species I took in Sikkim. It may perhaps be best identified by noticing that only the discal band on the upperside is pure white, all the other markings are more or less sullied, the discoidal streak is narrow and hardly separated from the triangular spot beyond it, and the submarginal waved lines are very distinct in the forewing. Underside tawny, markings undefined with black.

155. *Neptis vikasi*, Horsfield.

One specimen at 2,000 feet.

156. *Neptis columella*, Cramer.

Two females at low elevation.

Athyma leucothoë, Linnæus.

Athyma selenophora, Kollar.

Males common, one ♀ (= *A. bahula*, Moore) only observed.

157. *Athyma zeroca*, Moore.

Males as common as *A. selenophora*. The female has yet to be discovered. It will probably differ from the female of the preceding species in having the streak in the cell of the forewing undevided.

Athyma inara, Doubleday, Hewitson.

Both sexes taken at low elevations.

**Athyma mahesa*, Moore.

158. *Athyma cama*, Moore.

Both sexes taken.

159. *Athyma chevana*, Moore.

A single specimen of this rare species was taken by a Lepcha.

160. *Euthalia garuda*, Moore.

161. *Euthalia lubentina*, Cramer.

A single female at 2,000 feet elevation.

Euthalia kesava, Moore.

**Euthalia sananda*, Moore.

Euthalia apiades, Ménétriés.

Note. The three last species appeared in my former list under the genus *Adolias*.

37. *Rohana parysatis*, Westwood.

Males common. *Rohana* is a new genus lately defined by Moore in his "Lepidoptera of Ceylon." The species formerly appeared under the genus *Apatura*.

162. *Apatura namouna*, Doubleday.

Males not uncommon below 3,000 feet elevation.

163. *Apatura bolina*, Linnæus.

Very common, but all the examples taken were much worn.

164. *Sephisa chandra*, Moore.

One female only was taken by a Lepcha. The female of *S. chandra* has never been described I believe. It differs from the male in the outer margin of the forewing being far less emarginate, in the male it is deeply incised between the lower discoidal and third median nervules. The hindwing is also broader and far less denticulate. On the upperside the rich orange colour of the male has entirely disappeared except the spot in the cell of the forewing, which however is much reduced in size. Beyond the cell in that wing in the Sikkim specimen above referred to, but hardly observable in another Sikkim example and one from Nepal both in the Museum collection, there are four longitudinal white streaks between the nervules, decreasing rapidly from the anterior one placed between the costal nervure and upper discoidal nervule and the posterior one between the third and second median nervules. The discal white spots in the male are smaller in the female, the anterior ones whitish, the posterior bright steel-blue. There are also other similarly coloured spots and streaks between the nervules just beyond the cell and below it. In the hindwing the ground-colour is black with a marginal and submarginal row of spots, the outer the smaller, and a discal series of streaks between the nervules all steel-blue. In the Nepal specimen they are sullied with tawny. On the underside the orange spot in the cell of the forewing is much larger than above, and in the hindwing there is a round orange spot on the middle of the costa and a similar one in the cell, the submarginal spots are yellowish and all the steel-blue markings of the upperside much paler.

In *S. dichroa*, the North-West Himalayan representative of *S. chandra*, there is hardly any sexual differentiation.

165. *Dichorragia nesimachus*, Boisduval.

One male at 2,000 feet elevation.

Eulepis athamas, Drury.

Both sexes of the pale greenish-white (almost pure white), and males of the sap-green variety were taken. The latter is by far the commonest form of this species, but both occur in the same localities and are equally partial to sucking up the moisture from damp sand.

Haridra polyxena, Cramer.

Numerous varieties taken. They have the same habits as the preceding species but are seldom found but at low elevations, while *E. athamas* occurs up to 6,000 feet elevation to my knowledge. These two last species appeared in my former list under the generic name *Nymphalis*, but Mr. Moore has lately made new genera for their reception.

Family LEMONIIDÆ.

Subfamily NEMEOBIINÆ.

Zemeros flegyas, Cramer.

Common everywhere. As far as my personal knowledge goes all the species contained in the subfamily *Nemeobiinæ* (*apud* Kirby) have a quick flight, but only for a short distance, when they settle usually on the upper surface of leaves with wings half open, often in the shade, and frequently *walk* over and about the leaf, a habit peculiar as far as I have seen to this subfamily, all other Butterflies when settled remain quite still till they take their next flight.

Abisara fylla, Doubleday, Hewitson.

Dodona ouida, Moore.

Family LYCÆNIDÆ.

166. *Spalgis epius*, Westwood.

Both sexes at low elevation in forest.

167. *Pithecops hylax*, Fabricius.

Females only at low elevations in deep forest. They agree with Horsfield's description of the species rather than with *P. dharma*, Moore, from Ceylon, or *P. zalmora*, Butler, recorded from the N.-W. Himalayas.

Curetis bulis, Doubleday, Hewitson.

Common at low elevation.

Cyaniris puspa, Horsfield.

The *Lampides puspa* of my first list.

168. *Niphanda tessellata*, Moore.

One female at about 1,500 feet elevation. It is rather smaller than the specimen described by Mr. Moore from Penang, and the upperside is entirely unglossed with blue.

169. *Zizera maha*, Kollar.

Common amongst grass from 1,500 to 4,000 feet elevation.

**Zizera sangra*, Moore.

The *Polyommatus sangra* of my former paper.

**Castalius rosimon*, Fabricius.

Placed under the genus *Lampides* in my former paper.

Castalius decidia, Hewitson.

Placed under *Lampides* previously.

Everes parrhasius, Fabricius.

Placed under *Lampides* previously.

170. *Jamides bochus*, Cramer.

One male at 3,000 feet elevation.

Lycænesthes bengalensis, Moore.

Placed under *Pseudodipsas* in former list.

171. *Lycænesthes lycænina*, Felder.

Two males, agreeing with the description of the species by Mr. Moore in his "Lepidoptera of Ceylon," page 87, except in the absence on the upperside of the hindwing of the "indistinct dusky spots with whitish outer border from anal angle."

172. *Nacaduba macrophthalma*, Felder.

One male at low elevation.

Nacaduba ardates, Moore.

This species appeared under the genus *Lampides* in my former list.

**Catochrysops strabo*, Fabricius.

The *Lampides kandarpa* of my former paper.

173. *Catochrysops pandava*, Horsfield.

At low elevation.

174. *Polyommatus bæticus*, Linnæus.

Common at low elevations.

Lampides ælianus, Fabricius.

Lampides elpis, Godart.

Lampides' malaya, Horsfield.

Ilerda epicles, Godart.

**Ilerda androcles*, Doubleday, Hewitson.

175. *Ilerda brahma*, Moore.

Both sexes common from 4,000 to 5,000 feet elevation. The female differs from the male in having none of the brilliant gold colour on the upperside, but has an oblong patch of orange on the disc of the forewing. Underside as in male.

176. *Horaga ciniata*, Hewitson.

One male at 1,500 feet elevation.

**Deudorix petosiris*, Hewitson.

177. *Virachola perse*, Hewitson.

A single female was taken by a Lepcha.

178. *Aphnæus lohita*, Horsfield.

One male at low elevation.

**Aphnæus syama*, Horsfield.

179. *Camena ctesia*, Hewitson.

One male was taken at 1,500 feet elevation sucking up moisture on damp sand on the brink of a mountain stream.

Hypolycæna erylus, Godart.

180. *Hypolycæna othona*, Hewitson.

One male taken on the banks of a stream sucking up moisture from wet sand.

Hypolycæna etolus, Fabricius.

Both sexes taken. Common at about 2,000 feet elevation.

181. *Iolaus anysis*, Hewitson.

One male taken by a Lepcha at low elevation.

182. *Cheritra acte*, Moore.

One female at about 3,000 feet elevation.

183. *Loxura atymnus*, Cramer.

Common amongst clumps of bamboos.

Surendra quercetorum, Moore.

Nilasera centaurus, Fabricius.

Common. This species appeared in my first list under the generic name *Arhopala*.

184. *Nilasera eumolphus*, Cramer.

One male taken by a Lepcha.

185. *Amblypodia paraganesa*, n. sp.

(*Amblypodia ganesa*, Hewitson, *nec* Moore.)

I propose the name *paraganesa* for the species figured by Hewitson in his "Cat. *Lycænidæ* Brit. Mus., pl. vii, fig. 72, under the name *ganesa*, as it differs entirely from the *A. ganesa* of Moore which occurs in the N.-W Himalayas; the hindwing is tailed, and the markings of the underside are quite different.

One male taken at about 3,000 feet elevation.

Family PAPILIONIDÆ.

Subfamily PIERINÆ.

**Nychitona xiphia*, Fabricius.

The *Pontia xiphia* of my first list.

Terias hecabe, Linnæus.

186. *Terias harina*, Horsfield.

187. *Catopsilia catilla*, Cramer.

188. *Catopsilia crocale*, Cramer.

Catopsilia pyranthe, Linnæus.

Ixias evippe, Drury.

Hebomoia glaucippe, Linnæus.

Appias hippo, Cramer.

Catophaga indra, Moore.

The *Tachyris indra* of my former list.

Huphina nadina, Lucas.

The *Pieris nadina* of my first list.

Huphina nerissa, Fabricius.

Papilio amasena, Cramer, pl. xliv, fig. A, ♂.

This is the *Pieris nerissa* of my former list.

Mancipium canidia, Sparrman.

Common amongst gardens at about 4,000 feet elevation. Previously recorded under the genus *Pieris*.

Nepheronia avatar, Moore.

The *Eronia avatar* of my first list.

Delias pasithoë, Linnæus.

189. *Delias thysbe*, Cramer.

Delias agostina, Hewitson.

190. *Prioneris thestylis*, Doubleday.

191. *Dercas verhuellii*, van der Hoeven.

One male only was taken by a Lepcha.

Subfamily PAPILIONINÆ.

Papilio (*Ornithoptera*) *pompeus*, Cramer.

Not uncommon at low elevations.

**Papilio* (*Byasa*) *philoxenus*, Gray.

Gray first named this species, not Westwood as stated in my first paper, though the latter figured it.

192. *Papilio* (*Byasa*) *dasarada*, Moore.

Frequently seen sailing over the tea gardens.

Papilio (*Achillides*) *paris*, Linnæus.

Papilio (*Dalchina*) *sarpedon*, Linnæus.

Papilio (*Zetides*) *agamemnon*, Linnæus.

193. *Papilio* (*Orpheides*) *erithonius*, Cramer.

Papilio (*Charus*) *helenus*, Linnæus.

Papilio (*Laertias*) *polytes*, Linnæus.

Papilio (*Menelaides*) *aristolochiæ*, Fabricius.

Papilio (*Iliades*) *androgeus*, Cramer.

Papilio astorion, Westwood.

Family HESPERIIDÆ.

194. *Choaspes harisa*, Moore.

Common at low elevations.

**Choaspes benjamini*, Guérin.

**Choaspes amara*, Moore.

These two last species were placed under *Ismene* in my first list.

195. *Hasora badra*, Moore.

At low elevations.

Astictopterus diocles, Moore.

196. *Telegonus thrax*, Linnæus.

One specimen was taken by a Lepcha.

197. *Baoris oceia*, Hewitson.

One pair taken at a low elevation.

Suastus eltola, Hewitson.

The *Hesperia eltola* of my first paper.

198. *Suastus toona*, Moore.

Common.

Parnara colaca, Moore.

This is the *Hesperia chaya* of my first list.

Telicota bambusæ, Moore.

The *Pamphila augias* of my first paper.

Padraona dara, Kollar.

The *Pamphila mæsa* of my first paper.

**Padraona gola*, Moore.

The *Pamphila gola* of my first paper.

? Halpe zema, Hewitson.

? Halpe homolea, Hewitson.

My Sikkim specimens agree exactly with the figure and description of this species, the type of which came from Singapore. It is the *Hesperilla luteisquama* of my first list.

Tagiades menaka, Moore.

Common at low elevations. This species appeared under the genus *Pterygospidea* in my first list.

199. *Tagiades gana*, Moore.

Sarangesa dasahara, Moore.

The *Tagiades dasahara* of my first list.

200. *Udaspes folus*, Cramer.

One male at a low elevation.

Plesioneura alyssos, Moore.

Plesioneura sumitra, Moore.

201. *? Isoteinon cephala*, Hewitson.

Two males taken at a low elevation. Flight very swift, but settles frequently on an outer leaf of a bush.

202. *Parnara assamensis*, Wood-Mason and de Nicéville.

This species will be fully described hereafter, but it may be briefly

characterised as follows:—Forewing with ten spots (sometimes eleven in the female), *viz.*, two oblong at the end of the cell, disjunct in the male, but connected at their inner and opposite ends in the female, three apical, and five discal in the male (sometimes six in the female) forming an oblique series extending from the submedian nervure to the discoidal nervule in the male (but sometimes to the subcostal nervure or first discoidal nervule in the female) of which spots the first is subtriangular, touches the submedian nervure and is subequal to the fourth, the second in the same space with the first, is equal to the first subapical, and lies close to, but does not touch, the first median nervule, the third the largest of all, is equal to or rather larger than the first and fourth put together, and acute angled at its outer end, the fourth is rhomboidal, the fifth rather larger than the second and the sixth sometimes present in the female is shaped somewhat like one of the strokes of a section sign (§). Hindwing above with a small oval discal spot sometimes accompanied by a very minute dot in front of the third median nervule. On the underside of this wing there are four or five discal spots. Wings above and below rich dark vandyke brown, the spots lustrous, semitransparent white. Expanse 2·2 to 2·4 inches.

Nisionades salsala, Moore.

203. *Thanaos stigmata*, Moore.

One female at 3,000 feet elevation.

**Satarupa bhagava*, Moore.

*? *Hesperia semamora*, Moore.

Since the publication of my first paper, Mr. Moore in his "Lepidoptera of Ceylon" and elsewhere has defined many new genera and altered the synonomy of several species, all of which I have tentatively adopted here. This will account for the frequent changes in nomenclature that I have been obliged to make in this list.

JOURNAL

OF THE

ASIATIC SOCIETY OF BENGAL.

Part II.—PHYSICAL SCIENCE.

No. IV.—1882.

X.—*A new Species of Hipparchia* (Lepidoptera Rhopalocera) *from the N. W. Himalayas.*—*By* Major G. F. L. Marshall, R. E.

[Received 12th December 1882; Read January 3rd, 1883.]

Hipparchia digna, sp. n.

Upperside brown, with a broad well defined submarginal fulvous band bearing a single subapical black spot on the forewing and none on the hindwing; the band outwardly defined by a dark lunulate line, and further removed from the margin than in any other Indian *Hipparchia*, leaving a broader brown border to the wing. Underside forewing fulvous, the band of the upperside outwardly distinctly defined by a dark dentate line, inwardly faintly defined except near the costa, ochreous at the costa and inner margins; the black subapical spot of the upperside but with a distinct white pupil; the inner margin dark brown, the outer and costal margins very pale brown, mottled throughout with dark brown, and on the costa with irregular brown striæ, extending into the cell. *Hindwing* pale whitish brown clouded with brown and mottled throughout with darker brown; the band of the upperside but inwardly whitish, outwardly clouded with brown, and defined on both sides by dark dentate lines; also a subbasal dark line between which and the band the ground colour is darker, forming an inner dark band.

This species was found by Major J. Biddulph on the Shandur plateau in Northern Kashmir and only two specimens were taken, both females.

This makes the tenth species of the genus known to occur in the N. W. Himalayas; and strangely enough out of the ten, in four cases

only the females are known, and in the fifth the male has only recently been discovered.

XI.—No. 2. *Notes on and Drawings of the animals of various Indian Land Mollusca* (Pulmonifera).—*By* Lt.-Col. H. H. Godwin-Austen, F. R. S., F. Z. S., &c.

(With Plate V.)

[Received December 15th, 1882;—Read January 3rd, 1883.]

In continuation of a former contribution, I now forward another lithographed Plate from the original Drawings left to us by Ferd. Stoliczka. I only trust that they may lead some of our members to look more closely at the animals of the Land Shells of their districts, or collect them in spirits for the Museum in Calcutta, where they are sure to be sooner or later fully examined and described. In some parts of the country, and particularly during the rains, they may be found with very little search. The Slugs are quite unknown from many parts of India.

One object in publishing these drawings is to bring about a more natural and accurate classification of the Indian *Helicidæ*, and I would here refer to Mr. W. T. Blanford's continuation of the "Contributions to Indian Malacology" No. XII.* All Indian conchologists will be glad to peruse it, for no one possesses greater knowledge of the subject, than the author of that work, and I trust it will be followed by other parts; it carries me back to the time when I first collected for him, Henry Blanford and Ferd. Stoliczka, and the many pleasant hours passed in their society. I quite agree with what Mr. Blanford has written concerning classification in pages 184 and 185, particularly as to the importance of the sections *Helicarion*, *Macrochlamys*, *Ariophanta*, *Euplecta*, &c. The rules of Nomenclature must be adhered to quite as much in Conchology as in other branches of Natural History. The genus *Ariophanta* was created in 1829, vide my last paper in this Journal, and therefore it takes precedence of *Nanina* by 5 years, and can be used exactly in the same sense as *Nanina*, which, as Mr. Blanford truly remarks, "is utterly bad, it offends "every law, the name had been previously used by Risso, the type is the "same as that of Benson's genus, *Macrochlamys*, and the term is objec-"tionable on account of its signification." I am inclined therefore to adopt it for all species that up to the present time are known only superficially, (1) by the shell, and (2) the animal possessing a mucous gland at the extremity of the foot. *Ariophanta* will eventually, when the anatomy of all are known, and their sub-generic value established, be retained for *A. lævipes*, and its allies.

* J. A. S. B., Vol. XLIX, Part II, p. 181.

OXYTES BLANFORDI. Theobald. Plate V, fig. 1.

[Darjiling] (Stol. MS. drawing. No. 47.)

Vide Nevill's Handlist (1878) p. 48. No. 265, as *Hemiplecta*?

For notes on this genus *vide* last paper, J. A. S. B. Vol. XLIX. 1880, p. 151.

OXYTES, KOONDAENSIS (Juv.?) W. Blf. Plate V, fig. 2.

[? Young *Kunderensis*.] Stol. MS. Drawings, fig. 4.

"Botanical Gardens, Calcutta."

"Dull white, pinkish on neck and end of foot, small horn, sole not furrowed" (Stol.).

Nanina Koondaensis, W. Blf. J. A. S. B. (1870), p. 16, Plate III, fig 12. from Sispara in Koonda Hills. South India. The young specimen now figured is referred to, as probably imported with plants from South India. It is said to be allied to N. *indica*, Pfr. and *N. Shiplayi*, Pfr. I would remark that this species measures when fully grown 25·0 mm. in major diam. The drawing which is natural size is only 12·0, and possesses 5 whorls, which is the same number as in adult shell. There is certainly wrong identification here. It has more the appearance of young *serrula*, Bs. a Khasi Hill form.

MACROCHLAMYS TUGURIUM, Bs.

"*Tugurium*, Bs." Plate V, fig. 4.

["Darjiling." (Stol).] fig. 22 of MSS. Drawings.

In pencil by G. Nevill. "Rotula fide Stol."

Nevill's Handlist (1878) p. 30, No. 94, as *Nanina*. The animal is described from this drawing as follows: "Tail very pointedly truncate with a nearly upright unusually large horn-like projection above; body of an earthy brown colour."

From the position in which this has been drawn, it would be impossible to see either of the shell lobes. A specimen of *tugurium*, from Darjiling in spirit given me by Mr. W. T. Blanford, proved to belong to *Macrochlamys*. Fig. 46 of these drawings, would represent this species, for the shell lobes are delineated. Mr. Nevill has written over this *mainwaringiana* in pencil; it is very different from fig. 21, also bearing this MS. title.

BENSONIA (?) MAINWARINGI, G. Nevill, MS.

Plate V, fig. 3.

["Darjiling, *lubrica* ?" (Stol.)] fig. 21 of the MS. Drawings.

This is the species referred to in Nevill's Handlist, 1878, p. 49. No. 272, under *Nanina* (*Bensonia?*) n. sp. with the following note: "Perhaps better classed near *N. tugurium*. From a drawing of Dr.

"Stoliczka's the animal appears to be of a brick red colour, with a pointedly "truncate tail and remarkably developed nearly vertical horn above,—20 sp. "Darjiling, coll. Dr. F. Stoliczka and Col. G. B. Mainwaring." In the MS. book of Drawings, Mr. Nevill has written in pencil, "This is not *Macro. lubrica?* is it *Mainwaringi* or an ally? It is a species of *Rotula*, fide Stol."

Sub-Genus RHYSSOTA, Albers, *Die Heliam*, p. 61, (1850).

Type *N. ovum*, from Luzon.

RHYSSOTA CONFERTA, Pfr. Plate V, fig. 6.

["*Haughtoni*. Andamans. Animal dark brown reddish at the pedi- "cles. Mantle thick, greyish brown, freckled with white, body very rough, "look like shielded? (*sic*) pedal row very distinct and the elongated tuber- "cles whitish, basal edge pale greyish brown. Tail gland distinct sur- "rounded by a swollen edge." (Stol.)]. Fig. 38 (uncoloured) of MSS. Drawings.

Nevill's Handlist (1878), p. 46, places it in the Sub-genus *Rhyssota*, which I follow until an anatomical comparison shall be made with *R. ovum* the type of the genus by Albers. Nevill says (l. c.) "The "animal very closely resembles that of *N. ligulata*,* in a less degree *N.* "*orobia* the tail of which is less truncate &c., and some species of *Ario-* "*phanta*."

H. conferta, Pfr. P. Z. S. p. 828 (1856). Hab.? type in Brit. Mus. Compared with Andaman specimens by Mr. Edgar Smith and myself.

H. haughtoni, Bs. A. M. N. H. Vol. XI, p. 87, (1863).

H. chambertinii, Tryon, Amer. J. Conch. Pt. II, Vol. V, p. 109, Pl. X, fig 2 (1869).

As RHYSOTA *haughtoni* by Theobald in Sup. Cat. Conc. Ind. (1876), p. 23.

EUPLECTA ORNATISSIMA, Bs. Plate V, fig. 8.

[Darjiling (Stol.)] Fig. 50 of MSS. Drawings.

Placed in Sec. B of *Machrochlamys* by Theobald—but it has no shell lobes to the mantle. It is no doubt a close ally of *E. vidua*, Blanford, described in J. A. S. B. 1880, p. 190, where he shows (taking *subopaca* from Ceylon as the type) how very similar it is in the odontophore and form of the animal to that species.

To the list of species of *Euplecta* given on page 193, should be added *partita*, Pfr. from Ceylon, and I would add also *camura*, Bs. Darjiling; *tugurium*, Bs. has I find from a spirit specimen give me by Mr. Blanford, shell lobes to the mantle, and will therefore come into the sub-genus *Macrochlamys*.

* Vide J. A. S. B. (1880) Pl. XI, fig. 3.

EUPLECTA? CAMURA. Plate V, fig. 5.

(Not named) ["Darjiling, Stol."] fig. 49 of MSS. Drawings.

In pencil by Nevill. "I think *N. camura*."

In Nevill's Handlist, (1878) p 30, No. 95. *Nanina camura*, Benson. "Animal ashy-grey, no projecting lobe above the caudal gland; sole doubly "and broadly margined. This mollusk precisely resembles *N. indica*, to which it is evidently closely allied" [W. T. B.] 15, Darjiling, coll. Dr. F. Stoliczka and Col. G. Mainwaring.

"1. Darjiling 7000 ft. Dr. F. Stoliczka.

"In a drawing which I take to be of this species there is a pointed horn-"like projection on the lobe above the mucous gland not so large, however, "as in *N. tugurium*; the tail is also more abruptly truncated." This last description no doubt refers to this drawing fig 49, and William Blanford's description from life does not at all agree as regards the horn above the mucous gland, and we therefore cannot be at all certain what species has been drawn.

EUPLECTA? CROSSEI, Pfr. Plate V, fig. 10.

[No Genus, "*Crossei*, Singapur," Stol.] Fig. 34 of MSS. Drawings.

Nevill's description of animal is probably taken from this drawing. Handlist (1878) p. 32, No. 111, as *Nanina crossei*, Pfr.

"Tail abruptly truncate, gland relatively rather small, surrounded "with a broad swollen margin; it is evidently congeneric with *N. ligu-*"*lata*, the animal of which it closely resembles," 20 sp. from Sinkip Island ex. col. J. Wood-Mason, 20 sp. "Singapur, coll. Dr. F. Stoliczka."

EUPLECTA? Plate V, fig. 7.

[*Pedina* but query. Bombay (Stol).] Fig. 31 of MSS. Drawings.

EUPLECTA? Species unknown. Plate V, fig. 9.

[Kandale, Stol.] Fig. 18 of MSS. Drawings.

Is this Khandala, Bombay? This carefully executed drawing represents a very remarkable species. The very yellow colouring being characteristic and the mucous gland peculiar in form, there being scarcely any overhanging lobe. It may be related to *pedina*, if from the Bombay side.

EXPLANATION OF PLATE.

Fig 1. *Oxytes blanfordi*, Theobald.
2. *Do. koondaensis*, W. Blf.
3. *Rotula mainwaringi*, G. Nevill MS.
4. *Macrochlamys tugurium*, Benson.
5. *Euplecta camura*, Benson.
6. *Rhyssota conferta*, Pfr.
7. *Euplecta? pedina*.

8. *Euplecta ornatissima*, Benson.
9. *Do.* unknown.
10. *Do.* *crossei*, Pfr.

XII.—*Some further results of sun-thermometer observations with reference to atmospheric absorption and the supposed variation of the solar heat.* —*By* HENRY F. BLANFORD, F. R. S., *Meteorological Reporter to the Government of India.*

[Received 28th December, 1882.]

In 1875, I read a paper before the Society, in which I discussed the temperatures observed with the sun-thermometer, at eleven Indian stations, during the years 1868-1874, and arrived at the conclusion that the solar heat had undergone a rapid increase from 1868 to 1871, and a less rapid decline afterwards, up to 1874.

The data were discussed according to various methods, but that on which I chiefly relied, as taking count of the largest amount of data, and being the best calculated to exclude the disturbing influence of atmospheric variation, was to select days on which there was either no cloud, or on which the cloud canopy, on the average of the 10 A. M. and 4 P. M. observations, did not exceed one-fifth of the sky expanse; and having taken the monthly averages of all the sun-thermometer readings on such days, to compare these averages for homonymous months at each station, in each pair of consecutive years. The months June, July, August and September were excluded from this comparison, inasmuch as, at nearly all the stations, the registers of which were discussed, these months are too cloudy to furnish a sufficient number of available readings. For the remaining months, the mean progressive variation of all the stations was taken, for each pair of years; and finally, the mean of the eight months gave the adopted variation for the consecutive years.

In order to ensure that such comparison should be valid, the investigation was restricted to stations, at which the same instrument had been in use in each pair of years compared, exposed in the same way, and on the same site. The curve of annual variation, resulting from these data, coincided, in a marked manner, with the sun-spot curve; but, in reality, striking as it was, this result was vitiated by errors from two sources, both of which tended to disturb and diminish the coincidence. One of these was the inclusion of the Silchar registers, which, as I afterwards discovered, had not been kept under similar conditions throughout; so that those of all the earlier years gave too low a temperature; and hence a marked *increase* of insolation temperature, shewn by this station in the later years, (when, according to the general result, that temperature was falling,) was not real. The other, the effect of which was however small, was an error of method:

the figures discussed were the actual readings of the sun-thermometers, readings which notoriously depend, not only on the intensity of the sun, but also on the temperature of the air; and it has been shewn by Köppen and others, that there is a cyclical variation of air temperature, of the opposite character to that disclosed in the curve, resulting from the registers of insolation temperatures. Hence it is at least probable that, the deduction of the air temperatures, and the discussion of the residual excess of temperature due to the solar action would have resulted in a curve of the same type, and of still greater amplitude.

Since this paper was published, I have attempted to carry on the comparison of the insolation temperatures, from year to year, by a rough and ready method; but as I am now convinced, one of very precarious validity. In the first place, all sun-thermometers are compared before being issued, with a common standard, by actual exposure to the sun, side by side, for 30 or 40 days, and their registers are corrected for the differences thus determined. All readings are recorded as excess temperatures (above those of the maximum thermometer in the shade), and in order to avoid the tedious process of picking out days of comparative clearness, I have taken simply the highest difference recorded at each station in each month, and the average of all these monthly maxima, as representing the solar intensity for the year. This method is, however, open to many objections, which I need not here specify; and I have therefore now reverted to my former method, (with one essential improvement), as the only one which is calculated to yield any trustworthy information, on the question of the supposed variation of the solar heat.

In the present paper, which is to be regarded only as a first instalment, I have taken the registers of eight stations, representing a great variety of climates, and which fulfil the three essential conditions, that the register of each station is that of the same instrument throughout; that it is exposed in the same manner, and also at the same place. Those of one and the same station are therefore as rigorously comparable in consecutive years, as can be ensured by the ordinary arrangements of our observations. The selected readings are those of days, on which the average estimated cloud at 10 A. M. and 4 P. M. did not exceed one-fifth of the sky expanse; and the figures compared, are those of the excess temperature, shewn by deducting the self-registered maximum shade temperature, for each day, from the reading of the maximum black-bulb thermometer *in vacuo*,* on the same day. It is unnecessary to give these first results *in extenso*. As an example of the data thus obtained for one year at a single station, I reproduce the following, which is a fair specimen of the whole:

* Except in the case of Vizagapatam, where the thermometer is not enclosed in an exhausted tube.

TABLE I.—*Observed differences of shaded and exposed (blackened bulb in vacuo) maximum thermometers, and cloud proportion, at Allahabad during the year* 1878 *on clear days.*

Date.	JANUARY.			FEBRUARY.			MARCH.			APRIL.			MAY.		
	Cloud Proportion.		Excess temperature, Radiation.	Cloud Proportion.		Excess temperature, Radiation.	Cloud Proportion.		Excess temperature, Radiation.	Cloud Proportion.		Excess temperature, Radiation.	Cloud Proportion.		Excess temperature, Radiation.
	10 h.	16 h.		10 h.	16 h.		10 h.	16 h.		10 h.	16 h.		10 h.	16 h	
1	0	0	63·1	...	...	...	0	0	64·2	0	0	58·4	...	...	...
2	0	0	61·9	0	0	63·1	0	0	64·2	...	...	...	...	...	...
3	0	0	65·0	...	...	...	0	0	52·6	...	...	...	...	...	...
4	0	0	64·8	0	0	59·4	0	0	61·8	...	...	...	0	0	57·5
5	...	...	...	0	1	61·5	0	0	61·4	0	0	63·6	...	...	...
6	0	0	62·9	..	...		0	0	61·2	0	1	62·3	0	0	60·0
7	...	...	...	...	...	...	0	2	62·6	...	...	...	0	1	57·5
8	1	0	64·2	...	...	...	0	2	63·7	...	...	...	...	...	...
9	..	...	...	...	...	...	0	0	63·8	0	2	60·3	0	0	58·6
10	...	...	..	...	...	...	0	0	61·3	0	0	58·6	3	0	58·1
11	...	...	...	...	...	...	0	1	59·9	0	0	57·3	0	0	57·7
12	...	...	...	0	0	*70·4	0	1	60·0	..	...	...	0	0	58·5
13	...	...	...	0	0	61·6	1	0	59·4	...	...	...	...	...	...
14	...	...	...	1	0	60·3	0	4	60·5	...	...	...	...	...	...
15	...	...	...	0	0	59·6	2	2	59·5	...	..	...	2	0	60·7
16	0	4	60·0	0	1	61·5	...	...	...	0	0	62 9	0	0	58·8
17	...	...	...	0	0	60·8	...	...	..	0	0	61·7	0	0	58·9
18	...	...	...	0	2	58·5	...	...	..	0	0	60·3	0	0	59·4
19	4	0	60·7	...	...	..	...	...	...	..	...	...	0	0	58·0
20	...	...	...	..	...	...	...	...	...	...		...	0	1	57·9
21	0	0	60·2	...	...	...	...	...	...	...	...	..	...	...	...
22	...	...	...	.	...	...	0	0	61·6	0	4	60·5	.	...	...
23	..	...	...	4	0	58·8	1	1	61·8	...	...	...	0	1	60·6
24	...	...	...	0	0	59·7	..	...	...	...	...	...	0	2	58·3
25	...	...	...		...	...	2	1	62·3	...	...	...	..	...	...
26	...	..	...	...	...	...	...	...	...	0	0	60·6	0	0	56·8
27	...	...	...	...	...	...	...	...	...	0	1	60·8	0	1	56 9
28	...	...	...	0	0	65·0	...	...	...	...	.	..	0	1	56·8
29	0	0	59 4	...	...	...	0	0	58·3	0	1	57·5	0	0	57·4
30	0	0	62·5	...	...	...	0	0	58·4	0	4	61·2	3	0	60·6
31	4	0	64·2	...	...	...	0	2	58·4	...	...	...	0	0	57·6
Means.	...	...	62·4	...	...	60·8	...	...	61·3	...	...	60·4	...	...	58·4

* There seems no reason to question this reading. A little rain had fallen the previous evening.

Date.	June.			September.			October.			November.			December.		
	Cloud Proportion.		Excess temperature, Radiation.	Cloud Proportion.		Excess temperature, Radiation.	Cloud Proportion.		Excess temperature, Radiation.	Cloud Proportion.		Excess temperature, Radiation.	Cloud Proportion.		Excess temperature, Radiation.
	10 h.	16 h.		10 h.	16 h.		10 h	16 h		10 h	16 h.		10 h.	16 h.	
1	0	0	57·4	...	...	...	...	...	..	0	1	64·0	0	0	59 0
2	0	0	54·5	...	...	...	...	..	...	0	0	60·3	0	0	60·1
3	0	0	54·3	...	...	...	...	..	...	0	0	61·3	2	0	59·5
4	0	0	53·6	..	...	...	2	0	58·4	...	...	...	0	2	59·4
5	0	0	53 9	...	...	...	0	0	?	...	...	..	2	0	?
6	0	0	53·7	...	...	...	0	0	55·8						
7	0	1	53·3	...	...	...	0	0	56·1						
8	0	0	53·4	...	..	...	0	0	55·6	...	...	...	0	0	59·0
9	...	...	...	...	...	...	0	0	56·6	0	0	58·8	0	0	58·6
10	0	4	53 5	...	...	...	0	0	57·1	0	0	59·5	0	0	58·7
11	4	0	53·4	.		...	0	0	57·6	0	0	58·1	0	0	62 9
12	0	2	52·1	...	...	...	0	0	57·4	0	0	59·8	0	0	62·9
13	...	...	...	...	...	...	0	0	58·9	0	0	58·6	0	0	61·1
14	0	2	54·0	...	...	...	...	..	...	0	0	57·8	0	0	62·2
15	...	...	..	...	...	...	...	...	...	0	0	59 8	0	0	64·3
16	0	0	51 4	...	..	...	...	...	...	0	0	60·0	0	0	61·4
17	0	4	53·9	..	...	...	1	1	61·2	0	4	60·6	0	0	60.8
18	...	...		...	..	...	0	1	58 0	..	...	...	0	0	60·3
19	0	4	54·8	...	...	...	0	0	58 2	..	...	...	0	0	64·3
20	...	...	...	...	..	...	0	3	57·4	..	...	...	3	0	61·8
21	0	0	50·9	...	...	...	0	0	56·7	0	0	59·2	0	0	64 4
22	...	...	...	...	.	...	0	0	57 6	0	0	59·5	0	0	64·8
23	...	...	...	...	...	.	0	0	59·0	0	0	55·2	0	0	65·1
24	...	...	..	1	2	56·7	0	0	59·5	3	0	60·6	0	0	63·0
25	..	.	...	...	..	...	0	0	59·4	0	0	60·0	0	0	61·9
26	...	...	...	...	..	...	0	0	60·1	0	0	61·3	0	0	63·1
27	...	...	...	..	...	...	0	0	60·5	0	0	60·0	0	0	63·5
28	...	...	...	...		...	0	0	61·3	1	0	59·7	0	0	64·0
29	..	...	...	2	2	66·6	...	..	.	0	1	66·4	0	0	62·8
30	.	...	...	...	...	...	1	2	59·7	0	1	66·2	0	0	60 6
31	...	...	...	...	...	...	0	1	59 2	..	..	...	0	0	59·4
Means	...	..	53·6	...	...	...	...	...	58 3	...	..	60 3	..	...	61·7

Peshawar, being situated in a very dry region, affords sufficient comparable observations for every month of the year; Jessore and other stations, within the reach of the heavy monsoon rains, do not afford a sufficient number of valid observations from June to September, and these months are accordingly excluded. Allahabad and Sirsa hold an intermediate place.

The mean value for each month of each year, obtained from such data as the above, is given in the following Table (II) for each station separately.

TABLE II.—*Monthly mean values of the excess of sun over shade temperatures at eight stations.*

		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Vizagapatam.	1875	34·3	38·1	31·2	29·1	25·4	...	...	..	...	27·6	31·0	36·4
	76	34·6	37 3	31·0	26·8	29 7	...	...	...	...	31·3	35·7	32 6
	77	28 2	27 1	27·6	28·1	28·5	...	...	...	...	28·3	32·4	32 2
	78	32·6	23·9	21·7	22·6	21·0	...	...	.	..	27·9	32·8	31 3
	79	30 0	28·1	26·1	21·9	23·4	...	..	...	..	26 3	26·0	27·8
	80	25 0	25·8	22 3	20·8	21·8	...	...	...	...	26 7	28·3	27 0
	81	26·1	23·9	22·1	20·8	21·3	...	...	...	...	28·9	27·5	27·7
	Mean	30·1	29·2	26·0	24·3	24·4	...	...	...	...	28·1	30·5	30 7
Sironcha.	1876	?	?	?	59·6	59·5	...	...	...	...	66·5	68·9	65·2
	77	64 8	63 1	59 7	60 5	59 9	...	...	...	...		57 3	48·7
	78	50 7	50·3	53 6	56·8	56·1		...	...	...	60 2	59·7	61·4
	79	58 8	56·9	53·8	52·0	53·1	...	...	...	...	57 6	59·4	58·2
	80	56·5	57·1	53 7	53·7	55·2	...	...	...	..	60 2	59 9	55·8
	81	54·8	54·3	52·9	53·9	52 3	...	...	..	...	56·1	57·1	55·7
	Mean	57·1	56·3	54·7	56 1	56·0	...	...	...	...	60·1	60 4	57·5
Bombay.	1876	?	?	?	?	?	...	...	...	...	61·6	61·4	61·7
	77	62·8	63·9	62·5	62·0	60·0	...	...	...	...	60·4	59 9	63 3
	78	62·0	62·7	61·4	60·1	59 1	...	...	...	...	57·0	55·4	58 5
	79	58·3	60·1	58·2	56·4	54·8	...	...	...	...	57·9	56·7	56·6
	80	57·0	56·7	55·2	54·5	54·8	...	...	...	...	55·7	55·9	55·7
	81	55·8	56·8	56·6	56·2	54·7	...	...	...	...	56·7	55·9	55·8
	Mean	59·0	60·0	58·8	57·8	56·7	...	...	...	...	58·2	57·5	58·6
Jessore.	1875	?	?	?	?	?	...	...	...	...	56·7	56·5	54·6
	76	55·0	55 7	55·0	53·4	54·3	...	...	...	...	64·0	58·2	60 0
	77	54 9	57·8	57·0	54·3	53·1	...	...	...	...	59·9	55·7	57·2
	78	56·0	53·9	52·2	53·5	56·9	...	...	...	...	56·5	57 6	55 1
	Mean	55·3	55·8	54·7	53·7	54·8	...	...	...	...	59 3	57·0	56·7
Hazaribagh.	1875	?	?	?	?	?	...	...	...	...	57·5	55·2	54·4
	76	54·1	55·2	56·0	55·0	56·6	...	...	...	...	59·2	57 6	58·2
	77	58·8	57·6	56·4	60·4	56·7	...	...	...	...	57·7	55 7	54·9
	78	57·0	54 1	55·3	55·8	58·0	...	...	...	...	58·8	57·8	57·2
	79	56·5	57 9	57·0	?	?							
	Mean	56 6	56·2	56·2	57·1	57·1	...	...	...	...	58·3	56·6	56·2
Allahabad.	1876	62·6	62 2	60 0	56 5	52·6	53·1	...	...	...	59·0	59 6	61·1
	77	59·5	63·2	59 7	58 3	56 1	53·2	...	...	...	58·5	58·6	60 5
	78	62·4	60 8	61·3	60·4	58 4	53 6	...	...	...	58 3	60 3	61·7
	79	60·7	60 4	59·8	58·5	57 9	56·8	...	...	...	59·8	60 5	60 6
	80	59·5	60 3	56·4	55·8	58·1	57·3	...	...	...	57·0	58·1	57·7
	81	58 8	57·4	58·0	56 3	56·4	58 8						
	Mean	60·1	60·7	59·2	57 6	56 6	55·5	...	...	...	58·5	59·4	60·3

Sirsa.	1877	...	64·0	61·6	61·7	61·2	57·0	56·1	...	57·5	59·8	57·9	59 3
	78	61·4	63·5	62·7	64·2	61·0	56·9	57·8	...	59·2	59 3	60·0	60 7
	79	61·3	62 2	63·6	62·6	61·5	56·8	59·9	...	60·5	58·7	62·2	60·0
	80	60·1	60·2	61·9	61·9	60·4	57·9	59·8	...	62·4	59 9	58 7	59·1
	81	61 0	61·9	66·6	63·2	60·5	59·4	63·3	...	62·1	58 8	60 7	59·0
	Mean	60·9	62·4	63·3	62·7	60 9	57·6	59·4	...	60·3	59 3	59·9	59·6

		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Peshawar.	1877	...	63·6	65 3	64·0	61·6	58·6	57·4	57·2	57 7	58 7	58·8	58·0
	78	59·9	61·9	61 1	61·6	58 9	52·5	48·8	48 7	54·6	55·7	54 9	55·1
	79	56 1	59·2	62·7	55 5	48·9	47·3	46 9	50·6	53·5	53·2	53·5	53·5
	80	57·5	64 9	59 6	60·2	55·7	51·3	50 5	54 8	57·8	58·4	55 2	57·2
	81	58·4	61·4	64·5	62 6	55·9	48·0	50·2	56·9	56·7	55·1	53·1	50·8
	Mean	58 0	62·2	62·6	60·8	56·2	51·6	50·4	53·6	54·9	56 2	55·1	54·9

It is evident, on a simple inspection of the above table, that the intensity of the insolation, on days apparently equally clear, undergoes a distinct annual variation. And moreover, that this variation is not determined by the thickness of the atmosphere traversed by the sun's rays, as the sun varies in declination; since it is different in character at different stations; and at some stations, *viz.* Allahabad, Vizagapatam and Bombay, is greatest in the winter, when the sun is at or near its lowest altitude, and the absorbing atmospheric layer, therefore, at its thickest. Its character, at the several stations enumerated in Table II, is best shewn in Table III, which exhibits the monthly anomaly of each station, computed on the general average of the months under consideration; *i. e.*, not an annual mean, but the mean of as many monthly mean values as are shewn in Table II.

TABLE III.—*Annual variation of insolation excess temperature on clear (or but slightly clouded) days.*

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Mean.
Vizagapatam	+2.2	+1·3	—1·9	—3·6	—3·5	...	...	...	...	+0·2	+2 6	+2·8	27·9
Sironcha ..	—0·2	—1·0	—2 6	—1·2	—1·3	...	...	...	...	+2·8	+3 1	+0·2	57·3
Bombay ..	+0·7	+1·7	+0·5	—0·5	—1·6	...	...	...	...	—0·1	—0·8	+0 3	48·3
Jessore ..	—0·6	—0·1	—1 2	—2·2	—1·1	...	...	...	..	+3·4	+1·1	+0·8	55·9
Hazaribagh .	—0·2	—0·6	—0·6	+0·3	+0·3	...	...	...	...	+1·5	—0.2	—0·6	56·8
Allahabad ..	+1·4	+2·0	+0 5	—1·1	—2·1	—3·2	...	...	...	—0·2	+0·7	+1·6	58·7
Sirsa ..	+0·3	+1·8	+2·7	+2·1	+0 3	—3·0	—1·2	...	—0·3	—1·3	—0·7	—1·0	60·6
Peshawar ..	+1 6	+5·8	+6·2	+4·4	—0·2	—4·8	—6·0	—2·8	—1 5	—0·2	—1·3	—1·5	56·4

This table shews that, under a sky apparently clear, the atmosphere is most and least diathermanous, respectively, in the following months at the stations enumerated; it being borne in mind that, except at the Punjab stations, and, in part, at Allahabad, the months of the summer monsoon are left out of consideration.

	Insolation.	
Stations.	Greatest.	Least.
Vizagapatam.	November, December	April, May.
Sironcha.	October, November.	March.
Bombay.	February.	May.
Jessore.	October.	April.
Hazaribagh.	October.	Decr., Feby., March.
Allahabad.	February.	June.
Sirsa.	March, April.	June.
Peshawar.	February, March.	July.

The results of the laboratory investigations of Professor Tyndall, as well as Mr. S. A. Hill's discussion of Mr. Hennessey's actinometric observations at Mussooree, obviously suggest the vapour constituent of the atmosphere as the variable element on which the actinic absorption of the atmosphere, may be expected to depend. And, on comparing the above results with the monthly averages of vapour tension, humidity and cloud proportion, (the last being regarded as an index of the relative humidity of the higher atmospheric strata), this expectation is confirmed in the case of the two coast stations Bombay and Vizagapatam; at least, with a near approximation. The results of the comparison in the case of these two stations are as follow: (Table IV, A). The maximum phase of each element is indicated by an (*) the minimum by a (†).

Table IV.—*Comparison of the annual variation of insolation temperature on clear days with those of vapour tension, relative humidity and cloud proportion.*

A.—*Coast stations.*

		Jan.	Feb.	Mar.	April.	May.	Oct.	Nov.	Dec.
Vizagapatam.	Insolation	30·1	29·2	26·0	24·3†	24·4	28 1	30·5	30·7*
	Vapour Tension	·586	·644	·754	·853	·916*	·818	·663	·553†
	Relative Humidity	65	64†	66	68	69	72*	66	64†
	Cloud	1·74	1 44†	1·76	2·66	4·18	4·50*	3·23	2 31
Bombay.	Insolation	59·0	60·0*	58 8	57·8	56·7†	58·2	57·5	58·6
	Vapour Tension	·583†	·616	·720	.822	·886*	·850	·700	·627
	Relative Humidity	70†	70†	78	75	75	81*	71	70†
	Cloud	1·60	1·38†	1·91	2·38	4·12	4·42*	2·22	1·76

The chief point in which the inverse variation of insolation and humidity, otherwise distinctly indicated, seems to fail is, that the minimum of the former, at both stations, occurs in April or May, while the maximum of the latter as tested by *relative* humidity and cloud proportion falls in October; but, as regards the *absolute* humidity of the lower atmosphere, the coincidence holds good. And it will presently be seen that there is good reason why, other things being equal, the atmosphere should be somewhat more diathermanous after than before the beginning of the rains.

When, however, we turn from the coast stations to those in the interior of the country, where moreover, the range of insolation temperature is in some cases greater, this concomitance of absolute humidity and atmospheric absorption, which holds good at maritime stations, fails more or less completely; and it is evident that the latter is mainly determined by some condition of a very different nature.

TABLE IV.—B. *Interior.*

		Jan.	Feb.	Mar.	Apr	May.	June.	July.	Aug.	Sep.	Oct.	Nov.	Dec.
Cossore.	Insol.	55·3	55·8	54·7	53·7†	54·8	...	...	...	...	59·3*	57·0	56·7
	Vap.Ten.	·416†	·470	·631	·797	·890*	...	...	...	...	·857	598	·495
	Rel.Hum.	60	55†	55†	62	72	...	...	...	...	78*	68	63
	Cloud	1·50	1·76	2 74	3·36	4·73*	...	...	...	..	4·66	2·10	1 32
Hazarib.	Insol.	56 6	56·2†	56 2†	57·1	57·1	..	...	...	...	58·3*	56 6	56·2†
	Vap.Ten.	·257†	·267	·288	·325	·523	...	...	...	...	552*	346	·266
	Rel.Hum.	51	44	36	32†	44	...	...	...	...	66*	53	52
	Cloud	2 36	2·11	2 58	2 62	3·25	...	...	...	...	4·11*	2·03	1 92†
Sironcha.	Insol.	57·1	56·3	54·7†	56·1	56·0	...	...	...	...	60 1	60·4*	57·5
	Vap.Ten.	·445†	·484	·510	·570	·627	...	...	...	...	·727*	·564	·462
	Rel Hum.	60	54	45	41†	43	...	...	...	...	72*	67	64
	Cloud	1·26†	1·54	1·60	1·75	2·61	...	...	...	...	3·46*	2·64	1·55
Allaha.	Insol.	60·1	60·7*	49·2	57·6	56·6	55·5†	...	...	...	58·5	59·4	60·3
	Vap.Ten.	336†	·359	·404	·449	586	·765*	...	...	...	·645	414	·345
	Rel.Hum.	67	60	46	36†	42	52	...	...	...	68*	63	68*
	Cloud	1·93	2·22	1·89	1·43†	1 61	4·39*	...	...	...	1·48	0·93	1 63
Sirsa.	Insol.	60·9	62·4	63·3*	62·7	60·9	57·6†	59·4	...	60·3	59·3	59 9	59·6
	Vap.Ten.	·221†	·254	·312	357	·455	·597	787*	...	·660	·375	·249	·233
	Rel.Hum.	52	50	42	36	35†	40	58	...	53	38	39	62*
	Cloud	2·76	4·33*	4·17	3 70	2·93	3·24	5·20	..	2·87	1·03†	1·46	2·53
Peh'war.	Insol.	58 0	62·2	62 6*	60·8	56·2	51·6	50·4†	53·6	54·9	56·2	55·1	54·9
	Vap.Ten.	·209†	·227	·333	·407	·450	·527	667	·746*	·573	·367	·258	·230
	Rel.Hum.	59	57	57	54	43	40†	49	59	53	47	55	62*
	Cloud	3·73	4 33	4·50*	4·12	2·84	2·15	2 16	2 98	1 57	1·44†	2 08	3·43

A feature common to all these stations, and, at first sight, sufficiently remarkable, is that, at all, the month in which the maximum insolation, (or the least atmospheric absorption) occurs, is one characterized by a high proportion of cloud, indicating comparatively high humidity in certain of the higher atmospheric strata. In the case of Hazaribagh and Peshawar, the most cloudy months of the whole year, (or as far as is shewn in the tables,) are also those in which the insolation is greatest; at Sironcha and Sirsa, the greatest insolation occurs in the month immediately following that of most cloud; and, both at Sirsa and Jessore, the average cloud proportion, at the epoch of the former, differs by only an insignificant amount from the maximum. At Allahabad, the maximum insolation temperature coincides with a secondary cloud maximum, (that of the winter rains). It appears, therefore, that the rule, at stations in the interior of the country, is, in a measure, the reverse of that which we have found to hold good for the coast region; and that a humid state of the cloud-forming strata of the atmosphere, as indicated by the cloud proportion, is coincident with more than average diathermancy.

The association of a high degree of insolation with a highly humid state of the atmosphere has been prominently noticed both by the late Baron Hermann von Schlagintweit* and Mr. J. Park Harrison,† and each has suggested an explanation. That put forward by Mr. Park Harrison is based upon experimental results, which, as far as they go, appear to be perfectly valid. He finds that, when clouds are clustered about the sun, without obscuring it, the (probably reflected) heat, from the illuminated clouds, raises the equilibrium temperature of the sun thermometer, sometimes by several degrees; and moreover, that "the action does not appear to be confined to days on which there is *visible* cloud, for even on cloudless days, (so called) very high readings of solar radiation appear to be due to the presence of opalescent vapour," and that "an apparent increase of solar radiation occurs, as the sun enters a white cloud, of sufficient tenuity to allow free passage to its rays." Now with respect to the effect of visible clouds about the sun, it is very probable that many cases, which may be observed in the original registers, in which the maximum insolation temperature exceeds by several degrees that attained on other days in the same month, may be due to this cause. But observation with the actinometer shows that diffused amorphous cloud, which simply lowers the tint of the sky, making it pale and sometimes almost colourless, far from increasing the insolation, greatly reduces it.‡ And it is the frequent presence of

* Proc. Roy. Soc. vol. XIV, p. 111.

† Proc. Roy. Soc. vol. XV, p. 356; also vol. XVII, p. 515 and Phil. Mag. 4th Ser. vol. 39, pp. 70 and 299.

‡ Abundant evidence of this is afforded by the actinometric observations made at Alipore and printed by the Solar Physics Committee of the Royal Society in Appendix of their report.

this amorphous cloud, in the driest weather, to which I would attribute, in part, the low average temperatures of the (as recorded) cloudless months; but there is another absorptive agent, which has not been noticed by either of the authorities above quoted, and which is certainly much more powerful in dry than in damp weather, and to observers on the plains of India, is not easily separable from what I have above termed amorphous cloud; since, when seen from below, it has, like the latter, the effect of lowering the tint of the sky. This is the impalpable haze, which, as a general rule, and always in the dry season, rests on the plains of India, extending frequently to heights much exceeding 7,000 feet, and sometimes extends over the outer Himalaya, in such density, that, at Simla in the months of May and June, at a height of more than 7,000 feet, the hills, four or five miles distant only, are sometimes almost or quite invisible. The independence of these two absorbing agents is only observable at considerable elevations, and in certain states of the atmosphere; and the following observation, communicated to me by Mr. J. B. N. Henessey, M. A, F. R. S., whose experience in actinometric work invests his observations with unusual importance, is therefore especially interesting. "You remark" he writes on "the paleness" of the sky at Calcutta. Now, last April and May, having coached three of my assistants to use the actinometer exactly as I do, I left them to do the bulk of the observing. The sky, at first, was quite blue; and standing on the Mussoorie ridge, the Dehra valley with the Sivaliks beyond, and the plains, still further away, were all well seen. As the dry weather progressed, fires, as usual, appeared in the Doon, giving rise to smoke; and this, aided by dust, gradually filled the valley and dimmed objects in that direction by means of what may be called a *smoke* haze. The actinometer however stood at 6,940 feet above the sea, while Dehra station is only 2,200 feet. The haze lay a long way below us; at a guess, say 3,000 feet, and, to all appearances, hanging over the Doon only. At the time however a brisk south wind blows here daily, increasing in strength as the day advances, so that, at first, I paid little attention to my assistant's remarks as to the rising of the smoke, until, at last, the observations began to shew inconsistencies, which, however, were complicated by the fact, proved in previous years, that actinometric maximum radiation occurs *before* apparent noon. On watching the phenomena, I saw this. Far above me, at a guess, not under a mile, very thin and very light yet defined clouds were being driven northwards as the wind blew. I say *clouds*, from want of any other name; they were *white*, not brown or yellow, as if of steam, with soft graceful outlines along the advancing edges, which could be seen by watching against the blue sky. Imagine something between a mist and a cumulus, very thin and quite white. Now this steam-cloud (a mere phrase) was, say, a mile above, and the smoke ½ a mile below, and there was nothing

to show that the former was fed by the latter. No doubt my steam-cloud would induce *paleness* of sky, an evil which you speak of as prevailing at Calcutta; and it is highly probable that such steam-clouds, not by any means prominent, were driven over Mussoorie for days and days in the dry weather at least. What were they composed of? not smoke and not dust as far as I could judge.

"As to the haze, to all appearances, *dust* haze, being visible *between showers*, as you mention, we have noticed that here too. I have water barrels at the corners of our house; they are fed exclusively by iron pipes from a clean iron roof. *After* a few showers had fallen, I had the barrels well cleaned in my presence; the water was clear. Subsequently a heavy fall of rain occurred, I examined the barrels, expecting the water to be quite clear; instead, the water was charged with yellow clay; and yet, after the first showers, I should have thought that the air was too saturated with moisture, not to arrest dust a long way below 7,000 feet.

"Again last year, in the dry weather, I was watching day after day for actinometric weather; the hills were obscured or dimmed by haze, obviously dust haze. I can see the *Chor* where I write; between that mountain and this, the dust haze was quite plain; suddenly there was a change in the haze about 2 P. M. one day, it *was* a *sheet;* it began to roll about in waves and I may say visibly changed into clouds of vapour, which rose like ordinary clouds, leaving me a clear view of the *Chor*, &c., looking *quite blue*. Note there *was no rain*."

It results from what has been said above, that (excepting on the coast) up to a certain point, which cannot be strictly defined, a humid condition of the atmosphere tends to increase the readings of the sun-thermometer and the actinometer; indirectly by reducing the (dust?) haze which in dry weather forms a absorbing stratum of many thousands of feet in thickness, and directly by causing the formation of cloud masses which when clustering round the sun, reflect the solar rays and add the effect of the reflected to the direct radiation. On the other hand the amorphous cloud which exists at great elevations in dry weather and especially in the winter and spring months, and is generally only appreciable by its lowering and blanching the sky tint, is also a potent absorber. The sheets of *Pallio-cirrus* and *pallio-cumulus* which are result of a highly humid condition, and are especially the clouds of the rainy season, are of course the most impervious of all solar screens.

Since then, the athermancy of the atmosphere is enhanced by such opposite conditions of dryness and humidity, and, at present, we have no such records of these conditions as might enable us to frame a law of numerical concomitance, and thus apply an empirical correction to our actinometric results, it might seem almost hopeless to seek for evidence of any variation

of the intensity of the solar radiation, in the registers of insolation temperatures, or even those of actinometric observations on the plains of India; but this I think would be a hasty conclusion. The effect of cloud reflection may be pretty well eliminated by careful selection, and even although the effect of the solar variation (supposing such to exist) may be small in comparison with those effects which depend immediately on atmospheric absorption, since in comparing the registers of different years, the former must affect all stations simultaneously and similarly, whereas the latter vary indefinitely at different stations, it may yet be possible by taking the mean result of a large number of stations in different parts of the country, to eliminate such atmospheric effects, as continue to manifest themselves prominently in the individual registers, after taking such obvious precautions as have been specified above; and I am the more encouraged to entertain this view, by the very striking coincidence between insolation and sun-spot frequency which resulted from my former investigation. And the results of the present attempt, though less striking than the former investigation had led me to anticipate, are, still, not such as to discourage further enquiry in this field. They must however be regarded, at present, as provisional only; and, indeed, the number of stations here considered is too small to admit of any other estimate of their validity.

TABLE V.—*Progressive differences of insolation temperatures on clear days from the monthly means of Table II.*

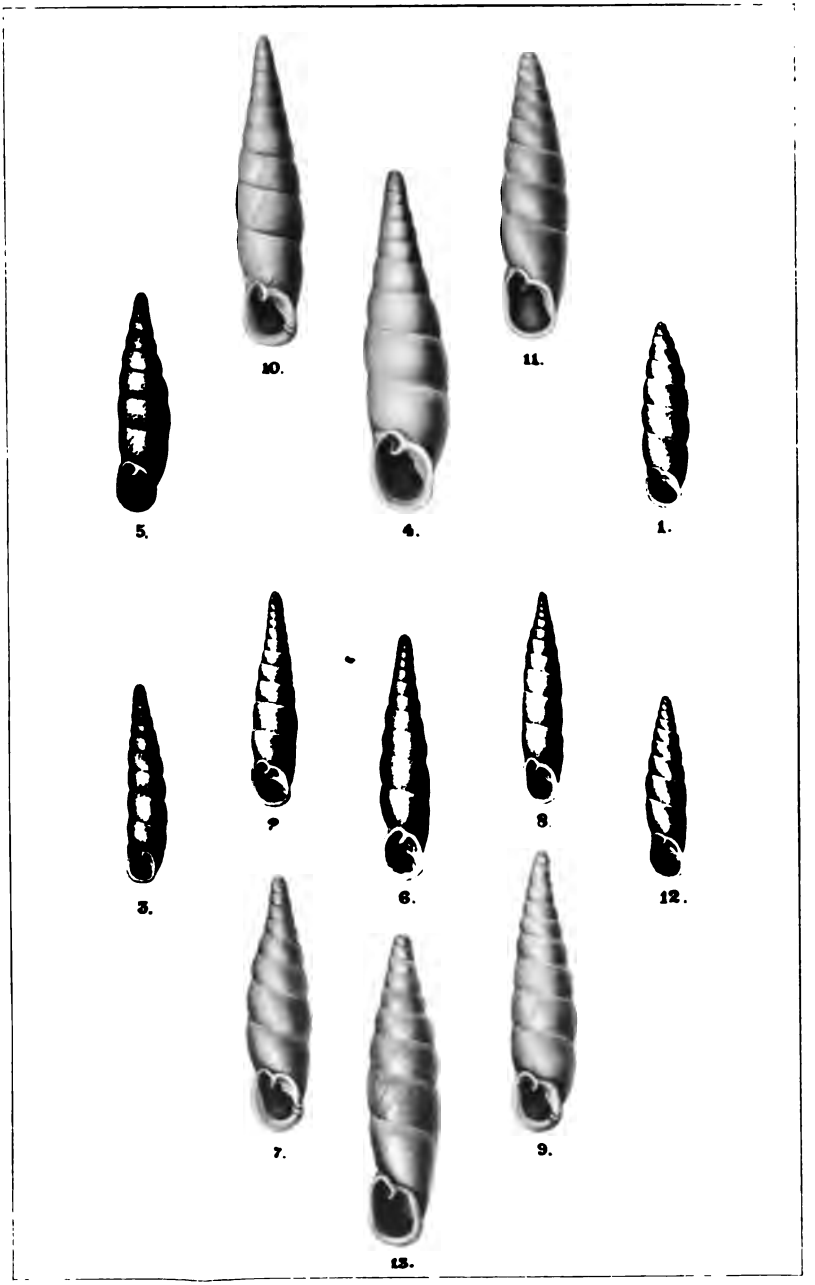
	1875-6.		1876-7.		1877-8.		1878-9.		1879-80.		1880-81.	
	Stations.	Differences.	Stations.	Differences.	Stations.	Differences.	Stations.	Differences.	Stations.	Differences.	Stations.	Differences.
January	1	+ 0·3	4	— 4·9	6	— 8·3	7	— 4·3	6	— 9·6	6	— 0·7
February	1	— 0·8	4	— 4·7	8	—29·2	7	+ 6·6	6	— 1·9	6	— 9·3
March	1	— 0·2	4	— 1·3	8	—20·5	7	+ 4·1	6	—18·1	6	+11·6
April	1	— 2·3	5	+10·3	8	—14·3	6	—18·8	6	0	6	+ 6·1
May	1	+ 4·3	5	+ 1·6	8	— 7·7	6	—14·9	6	+ 5·6	6	— 9·4
June	0	...	1	+ 0·1	3	— 6·6	3	— 2·1	3	+ 5·6	3	— 0·3
July	0	...	0	...	2	— 6·9	2	+ 0·2	2	+ 3·5	2	+ 3·2
August	0	...	0	...	1	— 8·5	1	+ 1·9	1	+ 4·2	1	+ 2·1
September	0	...	0	...	2	— 1·4	2	+ 0·2	2	+ 6·2	2	— 1·4
October	3	+12·7	6	—13·4	8	—13·0	6	— 4·9	6	+ 4·4	5	— 5·3
November	3	+ 8·8	6	—21·8	8	+ 2·2	6	— 4·8	6	— 2·2	5	— 3·7
December	3	+ 5·4	6	—22·0	8	+ 7·9	6	—10·7	6	— 5·5	5	— 5·8
Sums	14	+28·2	41	—56·1	70	-106·3	59	—47·5	56	— 7·8	53	—12·9
Means	...	+ 2·0	...	— 1·4	...	— 1·5	...	— 0·8	...	— 0·1	...	— 0·2

The data, being those given in Table II, have been summarized in the above Table to shew the mean variation, from year to year, in the following manner. The differences of the corresponding months, in each pair of consecutive years, being first taken out and tabulated, the sums of these differences in the same pair of months and years is computed from as many stations as are represented. These monthly sums and the number of stations yielding them, in each case, are shewn in the table, and the annual sums and means of the whole given at foot.

If the first pair of years be rejected as furnishing insufficient data, the table would seem to shew a continuous fall of solar intensity; rapid from 1876 to 1879, and subsequently only just appreciable. As is well-known, the sun-spot minimum occurred in the 1st quarter of 1879, so that it cannot be said that the present table shews a decided concomitance of the solar intensity and sun-spot frequency such as resulted from the former discussion. At the same time, if not conclusively favourable, still less is it conclusively adverse to the former conclusion, and the enquiry appears to be well worth following up with such further evidence as the Indian registers may yield. This I propose to do.

INDEX.

☞ Names of new genera and species have an asterisk (*) prefixed.



NEW JAPANESE & INDIAN CLAUSILIÆ.

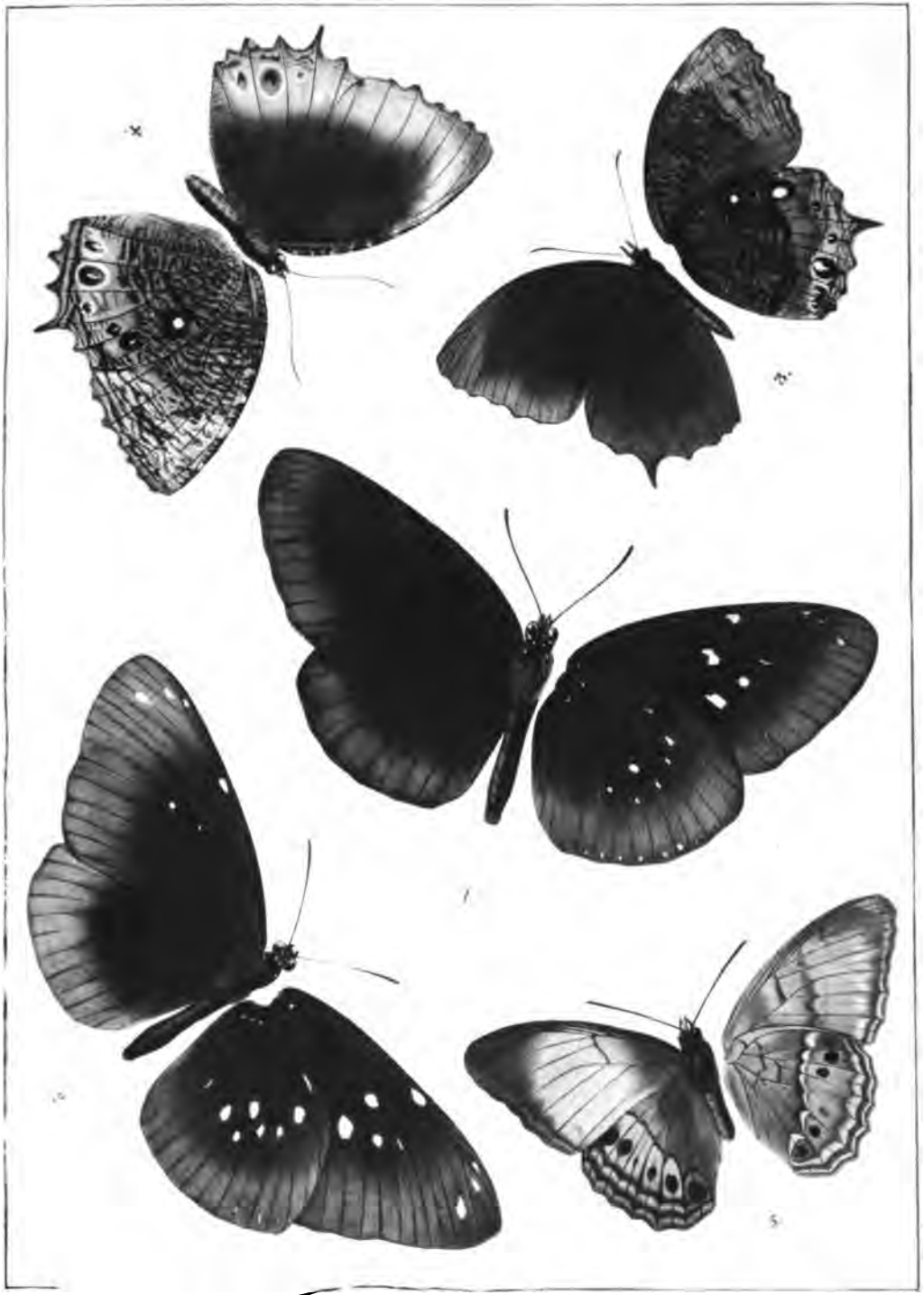


Fig. 1. EUPLŒA SIMULATRIX. ♂. Fig. 3. ELYMNIAS MIMUS. ♂.
Fig. 2. EUPLŒA SIMULATRIX. ♀. Fig. 4. ELYMNIAS MIMUS. ♀.
Fig. 5. CHARAXES NICOBARICA. ♂.

Girish Chunder Chuckerbutty del. West, Newman & Co. chr. lith.

Fig.1. CALESIS SURKHA. ♂. 3. RIPPARCHIA SHANDURA. ♀.
Fig.2. PHORESSA DURA. ♂. 4. POLYOMMATUS ELLISI. ♂.
Fig.5. PAPILIO CLARAE. ♂.

INDIAN LAND SHELLS

H. H. Godwin Austen del et lith

Maclure & Macdonald lit

a