156

I

29

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY,

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

(BEING A CONTINUATION OF THE 'ANNALS' COMBINED WITH LOUDON AND CHARLESWORTH'S 'MAGAZINE OF NATURAL HISTORY.')

CONDUCTED BY

PRIDEAUX JOHN SELBY, Esq., F.L.S.,
CHARLES C. BABINGTON, Esq., M.A., F.R.S., F.L.S., F.G.S.,
J. H. BALFOUR, M.D., Prof. Bot. Edinburgh,

AND

RICHARD TAYLOR, F.L.S., F.G.S.

VOL. XVIII.—SECOND SERIES.

LONDON:

PRINTED AND PUBLISHED BY TAYLOR AND FRANCIS.

SOLD BY LONGMAN, BROWN, GREEN, LONGMANS, AND ROBERTS; SIMPKIN, MARSHALL, AND CO.; PIPER AND CO.; BAILLIÈRE, REGENT STREET, AND PARIS: LIZARS, AND MACLACHLAN AND STEWART, EDINBURGH: HODGES AND SMITH, DUBLIN: AND ASHER, BERLIN.

1856.

"Omnes res creatæ sunt divinæ sapientiæ et potentiæ testes, divitiæ felicitatis humanæ:—ex harum usu *bonitas* Creatoris; ex pulchritudine *sapientia* Domini; ex œconomiâ in conservatione, proportione, renovatione, *potentia* majestatis elucet. Earum itaque indagatio ab hominibus sibi relictis semper æstimata; à verè eruditis et sapientibus semper exculta; malè doctis et barbaris semper inimica fuit."—LINNÆUS.

"Quelque soit le principe de la vie animale, il ne faut qu'ouvrir les yeux pour voir qu'elle est le chef-d'œuvre de la Toute-puissance, et le but auquel se rapportent toutes ses opérations."—BRUCKNER, *Théorie du Système Animal*, Leyden, 1767.

. . . . The sylvan powers
Obey our summons; from their deepest dells
The Dryads come, and throw their garlands wild
And odorous branches at our feet; the Nymphs
That press with nimble step the mountain thyme
And purple heath-flower come not empty-handed,
But scatter round ten thousand forms minute
Of velvet moss or lichen, torn from rock
Or rifted oak or cavern deep: the Naiads too
Quit their loved native stream, from whose smooth face
They crop the lily, and each sedge and rush
That drinks the rippling tide: the frozen poles,
Where peril waits the bold adventurer's tread,
The burning sands of Borneo and Cayenne,
All, all to us unlock their secret stores
And pay their cheerful tribute.

J. TAYLOR, *Norwich*, 1818.

ALERE FLAMMAM.

CONTENTS OF VOL. XVIII.

[SECOND SERIES.]

NUMBER CIII.

NUMBER CIV.

NUMBER CV.

Page

NUMBER CVI.

NUMBER CVII.

NUMBER CVIII.

PLATES IN VOL. XVIII.

ERRATA.

Page 405, line 13 from bottom, *for* Zirhut *read* Tirhut.
,, 407, line 22, *for* eundum *read* eundem.
,, ,, line 11 from bottom, *for* hot-water courses *read* hill water-courses.
,, 420, line 20, *for* ponds *read* ghauts.

Vol. xvii. page 501, last line, *for* June *read* May.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SECOND SERIES.]

"................. per litora spargite muscum,
Naiades, et circùm vitreos considite fontes :
Pollice virgineo teneros hìc carpite flores :
Floribus et pictum, divæ, replete canistrum.
At vos, o Nymphæ Craterides, ite sub undas ;
Ite, recurvato variata corallia trunco
Vellite muscosis e rupibus, et mihi conchas
Ferte, Deæ pelagi, et pingui conchylia succo."
N. Parthenii Giannettasii Ecl. 1.

No. 103. JULY 1856.

I.—*Monograph of the genus* Catops. By ANDREW MURRAY, Edinburgh*.

NOTWITHSTANDING Mr. Spence's able Monograph of the British species of this genus, and the excellent works of Erichson, Sturm, Redtenbacher, Kraatz and others, its study is still attended with so much difficulty, that I imagine the following attempt to clear up the synonymy, and to make the species more easily recognizable, will be welcome, particularly to British entomologists.

When I commenced my examination of the genus, with a view to publishing the results, I applied to my entomological friends for their assistance both in the way of information and communication of specimens, an application which was cordially responded to. I have thus had the advantage of carefully examining Mr. Waterhouse's collection, which I believe to be the best representative of the Spencian species extant ;—the determination having been submitted to and approved by Mr. Spence himself, with this qualification, that he (Mr. Spence) had described some of his species from specimens belonging to others, to whom they had been returned, so that the type specimens

* Read before the Royal Physical Society of Edinburgh, Jan. 1856.

were scattered, and the certainty of accuracy derivable from the actual comparison of specimens with the types was in these instances no longer attainable. It is on the faith of Mr. Waterhouse's collection therefore that I principally depend for the identity of the names with the species described by Spence, where the descriptions themselves have failed me.

From Mr. Stephens's collection now in the British Museum I have in like manner endeavoured to identify the species described by him, and as his specimens of Spence's species in a majority of instances correspond with Mr. Waterhouse's, they so far confirm the authority of that gentleman. I have further had the advantage of examining the species in the Jardin des Plantes;—those of M. Lucas and of M. Chevrolat (who left the whole of his large collection of *Catops* for months in my hands), and those of M. Fairmaire, M. Javet, and other French entomologists. To M. Kraatz of Berlin, whose elaborate and admirable revision of the European species of the genus shows the attention he has bestowed upon the subject, I owe especial thanks. Besides favouring me with his opinion upon my ideas, he has furnished me with a nearly complete series of his species, and entrusted those he could not spare to me for examination, so that I have in general the advantage, when speaking of any view entertained by him, of knowing with certainty the identity of the species under discussion. In relation to the North American species I beg particularly to record my obligations to Dr. Leconte of Philadelphia, Dr. Asa Fitch of Salem, and Mr. Calverly of New York. To our British entomologists, Dr. Power, Mr. J. T. Syme, Mr. Hislop, Rev. W. Little, Rev. Hamlet Clark, Mr. Guyon, Mr. Bates, Dr. Lowe and others, I also owe many thanks. They have entrusted to me the whole of their species for as long a period as I chose to retain them, and the whole of the gentlemen I have named have liberally placed their duplicates at my disposal. I take this opportunity to tender to each of them individually my best thanks for their kindness.

With this acknowledgement of my obligations and explanation of the sources of my information, I shall now in the first place cast a rapid glance at what has been done by previous authors, first in the European species and afterwards in the exotic; I shall then give detailed descriptions of all the different species which have been described or have come under my notice (among which will be found one or two new species), and lastly conclude by giving a short dichotomous table of the characters of the European species of the genus.

The species which compose this genus were scattered by ancient authors among several other genera. DeGeer placed one species under *Dermestes,* and Geoffroy another under *Silpha.*

Fourcroy placed the only one he knew under *Peltis,* Panzer under *Helops,* Fröhlich under *Luperus,* Fabricius under *Cistela* and *Hydrophilus,* Marsham under *Mordella,* and Linnæus (possibly) under *Chrysomela.* Latreille was the first who in his 'Précis des Caractères Génériques des Insectes,' established the genus under the name of *Cholera.* This was in 1802, and about two years after it was also recognized first by Paykull, and afterwards by Knoch, who each gave it another name—Knoch that of *Ptomaphagus* which was adopted by Illiger, and Paykull that of *Catops* which was adopted by Fabricius, and has been retained by most subsequent authors. By the rule of priority therefore the name should be *Choleva,* but I am glad that I have a sufficient apology for not disturbing the almost universally adopted name of *Catops.* Latreille himself appears at first only to have applied his name to one section of the genus. This appears from his 'Histoire Naturelle des Crustacés et des Insectes,' where in speaking of his constituting the genus, he says, "Its appearance, says Geoffroy, resembles that of the *Mordellæ,* that is to say, it has long legs with which it walks as if it limped. It is from that character that I have taken my generic denomination: *Choleva* in Greek means 'lame.'" The long legs here referred to apply to the first section of the genus, which was subsequently erected into a separate genus by Stephens, and may, I think, be properly maintained as a subgenus, to which Latreille's name may be restricted.

The number of species at first described was small. Latreille in his 'Hist. Nat.' only describes three, and in his 'Genera Crustaceorum et Insectorum,' published in 1807, he describes five. He there breaks the genus into two groups, one corresponding to the subgenus *Choleva,* of which he describes the species *agilis* and *angustatus,* auct., and the other including the rest of the genus.

Gyllenhal in 1808 published six species in the first volume of his 'Insecta Suecica.'

It is unnecessary to enter into any examination of the synonymy of the species described by these authors. Their descriptions are for the most part too vague and applicable to too many species subsequently described to allow us to rely greatly upon them. Gyllenhal in his 4th volume, which was not published till 1827, acknowledges that in his 1st volume he had included five different species under one name.

Mr. Spence was the first author who brought the genus into something like order.

In his Monograph (published in the Linnæan Society's Transactions in 1815) he divided the genus into three main sections, dependent upon the antennæ being filiform or clavate, the posterior angles of the thorax obtuse or acute, and the elytra striate or not striate; the dilatation or non-dilatation of the first article of the middle tarsi in the males was also made a subordinate character. Of these, the first and last are the only ones which have been adopted as sectional characters by subsequent authors; but the form of the hinder angles of the thorax, although not a good sectional character by itself, will, I think, if taken in conjunction with the base of the elytra, be found to furnish good characters for natural subdivision. Mr. Spence groups his species under the above sectional characters (to each of which I shall attach the synonym now most in use) as follows, viz.:—

* *Antennæ subfiliform; posterior angles of thorax obtuse* (=Subgen. *Choleva,* Steph.).

C. oblonga=*angustata,* Fab., Erich.
C. agilis=*agilis,* Ill., Erich.

** *Antennæ clavate; posterior angles of thorax acute; elytra for the most part striated* (=Subgen. *Catops,* Steph.).
(*Anterior thighs for the most part thickened at the apex in the males, and first article of middle tarsi dilated.*)

a. *Basal margin of thorax excised near the angles.*

C. nigricans=*nigricans,* Erich.
C. sericea=*fuscus,* Panz., Erich.*

* Erichson, and after him Kraatz, give *C. picipes,* Fab., as the synonym of Spence's *sericea,* but I think this is a mistake. The description better accords with *fuscus,* and I believe that *picipes* has not yet been found in Britain. I recorded it in my 'Catalogue of Scottish Coleoptera' as found by myself in Scotland, but I am now satisfied that the specimen on which I relied was only a large variety of *nigricans.* If Erichson formed his opinion of the synonymy from not finding any other probable representative of *picipes* among Spence's species, the circumstance of its not being British explains how this may be. If he judged from Spence's description, he may have been misled by the commencing words used by Spence, "Body broader and more convex than in its congeners," which he might apply to *picipes,* which is the largest species in the genus; and by Spence's next words, "shorter than the preceding," viz. *nigricans,* he might have supposed him to mean less elongate in form, which *picipes* is, although certainly not actually shorter—it being longer. The only other resemblance to *picipes* is the black elytra; but Paykull's description of his *C. sericeus,* to which Spence refers as in all other respects identical with his, corrects this incongruity, for Paykull states the elytra of his species to be obscure testaceous. In Stephens's collection *sericea* is represented by a pale variety of *chrysomeloides.*

*C. tristis** = —— ?
C. festinans† = ——? (possibly *grandicollis,* Erich.).

b. *Thorax with the basal margin straight near the angles.*

C. chrysomeloides = *chrysomeloides,* Panz., Lat., Sturm.
C. Leachii ‡ = *tristis,* Erich.
C. Kirbii § = *rotundicollis,* Kellner.
C. Marshami ‖ = —— ? (either *morio,* Erich. or *nigrita,* Erich.)
C. dissimulator ¶ = —— ? (probably *morio,* Erich.)

*** *Antennæ clavate ; posterior angles of thorax acute ; elytra not striated.*
(*Anterior thighs alike in both sexes, the middle tarsi with the first joint rarely dilated.*)

C. villosa = *sericeus,* Fab. (*villosa,* Lat.) (*Ptomaphagus truncatus,* Steph.)
C. velox = *velox,* Erich.
*C. fumata*** = ——? (probably *scitulus,* Erich.)
C. Watsoni = *fumatus,* Erich.
C. anisotomoides = *anisotomoides,* Sturm.
C. Wilkinii = *præcox,* Erich.
C. brunneus = *Colon* (*Mylæchus*) *brunneus,* auct.

* No species has puzzled British entomologists more to identify than this. The prominence given by Spence and Stephens to the clavate form of the antennæ, and Spence describing it as bearing a close general resemblance to *chrysomeloides,* has had the effect of making most of them attempt to find a representative for it out of narrow-clubbed and small varieties of *chrysomeloides*—and accordingly it is generally so represented in British collections—an error which I have seen continental entomologists fall into in like manner. I cannot ascertain to my own satisfaction what the species was which Spence had in view in describing this. Mr. Waterhouse had adopted the usual British view, but Stephens has his *tristis* wholly represented by *fuscus,* Erichs.

† This species is stated by Erichson and Kraatz to be a synonym of *fuscus,* but from what I have already said in the note upon *sericea,* it appears to me that that synonym is preoccupied. Mr. Waterhouse has not this name represented in his collection. In Stephens's it is represented by two specimens of *tristis* and one of *grandicollis.* Little can be made out from Spence's description.

‡ Represented wholly by *tristis* in Mr. Waterhouse's collection, and in Stephens's collection by two specimens of *tristis* and two of *grandicollis.*

§ Represented by *rotundicollis* both in Waterhouse's and Stephens's collections.

‖ Mr. Waterhouse has this represented by *morio* ; in Stephens's collection it is represented wholly by *chrysomeloides.*

¶ Given as a synonym of *morio* by Erichson. Represented by *tristis* in Waterhouse's collection, and by three specimens of *grandicollis* and one of *nigrita* in Stephens's collection.

** This name (*fumata*) has been universally applied to the species commonly known as the *fumatus* of Erich. and other authors, but a comparison

The next author who went over the genus was Stephens. As he finally left it in his Manual, it contains all Spence's species, besides five of his own, and three which had been described by Mr. Newman in the 'Entomological Magazine,' between the commencement of the appearance of his 'Illustrations' and the publication of his 'Manual.'

The following is the result of my examination of the species standing named in his collection in the British Museum, viz.:—

Ptomaphagus truncatus = *C. sericeus*, Panz. (*truncatus*, Illig.)
—— *velox* = *velox*, Spence.
—— *fumatus* = *fumatus*, Erich.
—— *Watsoni* = *fumatus*, Erich., and *scitulus*, Erich., mixed.
—— *anisotomoides* = *anisotomoides*, Spence.
—— *Wilkinii* = *præcox*, Erich.
Catops nigricans = *nigricans*, Spence.
—— *sericea* = pale variety of *chrysomeloides*, Spence.
—— *tristis* = *fusca*, Erich.
—— *festinans*, represented by two specimens of *grandicollis*, Erich., and two of *tristis*, Erich.
—— *affinis* = *nigrita*, Erich.
—— *chrysomeloides* = *chrysomeloides*, Spence.
—— *Leachii*, represented by two specimens of *grandicollis*, Erich., and two of *tristis*, Erich.
—— *Kirbii* = *rotundicollis*, Kellner.

of Spence's description of it and his next species, *Watsoni*, shows that the latter is what is now known as *fumatus*, and that the former is most probably *scitulus*, Erich. In his description of *Watsoni* Spence says, "In colour this species does not much differ from the preceding, but is furnished with other characters strikingly distinctive. The antennæ are shorter and thicker" (which is the case in the true *fumatus*). He also gives the last joint as pale, while he says nothing of this distinctive character in describing the preceding species. The rest of the description also corresponds with the view I have taken. I am perhaps wrong in using the expression "*true fumatus*." The *true fumatus* should by the rule of priority be what Spence had under his eye when he described it, but I think we are getting out of all bounds in our stickling for priority. If an author describes a species so loosely that it cannot be recognized from his description, so that subsequent authors misapply or ignore his name, while on their part they give a recognizable description, I cannot see on what principle of justice or propriety we are to be called upon to hold by the unrecognizable name instead of the recognizable, nor why an author (be he living or dead, or great or small) should be allowed to supplement his inadequate description by a reference to the typical specimens in his cabinet from which the descriptions were taken,—a practice now in vogue, against which I take this opportunity to enter my protest. Notwithstanding the claims of priority therefore, I do not propose to invert or disturb the generally adopted names of *fumatus* and *scitulus*. I have pointed out how the case obviously stands, and I leave to the advocates of priority the responsibility of introducing the confusion to which I demur.

Ptomaphagus Spencei=rotundicollis, Kellner.
—— *fulvicollis=velox,* Spence.
—— *Marshami=chrysomeloides,* Spence.
—— *dissimulator,* represented by three specimens of *grandicollis* and one of *nigrita.*
Choleva angustata=angustata, auct.
—— *gomphoita=* ditto.
—— *agilis,* represented by three specimens of *agilis* and two of *angustata.*

The other species, or names of species, given in his Manual are not represented in his collection.

I have not had an opportunity of seeing typical specimens of Mr. Newman's three species, *frater, soror,* and *nubifer;* but my friend the Rev. Wm. Little has in his collection specimens which had been named by Stephens as being the two latter, and if we may take that as an indication, we find that *soror=nigricans* and *nubifer=velox.*

Erichson's 'Käfer der Mark Brandenburg' followed in 1837. His division differs from that of Spence. It is as follows, viz.:—

Characters of the first division:—

"*Mesosternum simple* (*without keel*); *body oblong; antennæ and legs long and thin, the former scarcely thickened at the point; legs slender; tarsi of fore-feet dilated in the males, tarsi of middle feet simple in both sexes.*"

This division corresponds to Spence's first section (Stephens's *Choleva*); and Erichson only records two species found in Mark Brandenburg as belonging to it, viz. *angustatus* and *agilis.*

The characters of his second division are—

"*Mesosternum simple; tarsi slender, and anterior tarsi and first joint of middle tarsi dilated in the males.*"

These characters place the following species in this section, viz. *C. fuscus, umbrinus, picipes, nigricans, grandicollis, tristis, nigrita, fuliginosus, morio, fumatus,* and *scitulus,* of which *grandicollis, fuliginosus,* and *scitulus* are given as new. *Fuliginosus* is said by Kraatz to be a variety of *nigricans* (though, from the description alone, I should not have supposed this), and *scitulus,* as already mentioned, had been described by Spence under the name of *fumatus.* Erichson does not record *chrysomeloides* as found in Mark Brandenburg, but from the differences which he points out between it and *tristis,* I am not sure but some confusion exists even in Erichson relating to *tristis.*

His next division is characterized thus:—

"*Mesosternum simple; body oval; antennæ somewhat thickened at* *the point: tarsi slender: anterior tarsi widened in the males; middle tarsi simple in both sexes."*

Velox and *præcox* (Spence's *Wilkinii*) are Erichson's only species falling under this division.

The last division has the

"*Mesosternum keeled; tarsi strong; anterior tarsi in the males very broad, widened in the middle in the females; middle tarsi of both sexes equal."*

The only species recorded by Erichsòn is *sericeus* (*truncatus*, Illig. and Steph.).

The above list is instructive both negatively and positively, both for what it does and for what it does not contain. Erichson was celebrated not only for his marvellous acumen in distinguishing species, but also for his success in collecting and for the extent of his collection. Mark Brandenburg too may be taken as fairly representing the rest of Northern Germany; and unless where the species are of a local character, we may pretty safely assume that the same species which occur in Mark Brandenburg will be found in the rest of Northern Germany. These premises should teach us to use great caution in admitting any new species from that district not described by Erichson, as they lead to the probable conclusion, first, that such new species might have been already found in Mark Brandenburg; secondly, that Erichson might have seen them; and lastly, might not have considered them distinct. Of course I do not make any further use of the great weight of his opinion, than to bespeak caution in determining upon such new German species as he has passed over.

Sturm next took up the group in his 'Deutschlands Fauna' in 1839. He added two new species to the first group (*Choleva*)—*spadiceus*, Dahl. *in litt.*, and *castaneus*, Andersch. *in litt.*—both of which have been adopted by subsequent authors, although, for reasons which I shall afterwards give, I think the latter is only a variety of *angustatus*. He also added the *badius* of Meg., the *brunneus* of Knoch, and the *anisotomoides* of Spence to the list of species found in Germany.

In 1841 Prof. Heer (in his 'Fauna Helvetica') described besides most of those already known, two new species, *montivagus* and *ambiguus*, and reproduced the *alpinus*, Gyll. The descriptions of the two former are too short and vague to allow of their being satisfactorily identified from the book, and I have not seen authentic specimens. M. Kraatz in his revision also states, that he has been unable to make them out, but holds that the *alpinus* of Gyllenhal has been rightly revived.

Several detached descriptions of individual species also appeared from time to time.

In 1832 a species from the Morea was described by Brullé in the 'Expédition Scientifique de Morée' under the name of *C. humeralis*, which seems to belong to the subgenus *Choleva*.

Chaudoir (Bulletin de Moscou, 1845, iii.) described two new species as being found in the neighbourhood of Vienna, *longipennis* and *sericatus*. M. Kraatz does not consider these to be distinct species, but joins them respectively to *nigricans* and *sericeus*.

Kellner in 'Stettin Ent. Zeit.' 1846, No. 6, described four new species, *C. longulus, rotundicollis, coracinus*, and *subfuscus*. As already mentioned, *rotundicollis* is the *Kirbii* of Stephens. Kraatz observes that *subfuscus* is not distinguishable from *alpinus*, Gyll.; and from a specimen of *longulus* submitted to me by M. Kraatz, I am satisfied that it is only a variety of *tristis*.

Rosenhauer (Beiträge zur Insectfauna Europas) in 1847 described *C. abdominalis* (considered by Kraatz to be a variety of *tristis*) and *C. varicornis*, which, although very close to *sericeus*, appears to be a good species.

Redtenbacher in his 'Fauna Austriaca' (1849) gives a synopsis of the species of the genus, but without adding any new species. Dr. Aubé in 1850 added *C. meridionalis* and *quadraticollis*, besides *Catopsimorphus orientalis*, to the list. All three appear to be good species.

The only works remaining to be noticed are M. Kraatz's revision of the genus published in parts in the 'Stettin Ent. Zeitung' in 1852, and the 'Faune Entomologique Française' now in course of publication by MM. Fairmaire and Laboulbène. Although the latter work is subsequent in date, I shall notice it first; partly because none of M. Kraatz's new species are to be found in it, and partly because M. Kraatz's revision contains a full summary of all the European species hitherto described, and is therefore well suited for closing this part of my paper.

The authors of the 'Faune Ent. Franç.' adopt the name *Choleva*, Lat., in deference to priority, instead of *Catops*. They do not introduce any new species. They adopt the four subdivisions laid down by Erichson, and in addition attempt to break up the second subdivision into smaller sections. These subdivisions are—

1. "*Posterior angles of corselet obtuse*," in which they place *C. picipes, grandicollis*, and *alpina*.

2. "*Posterior angles of corselet right-angled, more or less pointed*," containing *C. fusca, morio, nigrita, quadraticollis, tristis, chrysomeloides, rotundicollis*, and *fumata*.

3. "*Posterior angles of corselet pointed, a little produced behind*," which contains *umbrina, nigricans*, and *scitula*.

These divisions appear to me to group the species in too unnatural a manner to be of service even as an artificial mode of arrangement in facilitating the determination of species. For instance, *picipes* in the first section has most affinity with *nigricans* in the third, *grandicollis* in the first with *tristis* in the second (indeed I propose to show presently that they are the same species); and *alpina* in the first has very close affinity with *fumata* in the second, and *scitula* in the third should join them. *Umbrina* undoubtedly ought to go beside *velox*, which is not in this section at all;—Erichson's character of the dilatation of the first joint of the middle tarsi in the males separating them. Their affinity otherwise however is so great, that I think that character must be disregarded to allow these species to take their proper place beside each other.

I now come to Kraatz's revision, in favour of which I cannot speak too highly. I differ from him in opinion in one or two instances, but wherever I do so I must beg the reader to take my opinion with caution and examine it with suspicion, as the well-known acumen and accuracy of that gentleman stamp his views with a *primâ-facie* authenticity which only very strong evidence can overthrow.

He divides the genus into five sections, the first three and the last of which are Erichson's; the fourth is new.

In the first section he has *spadiceus*, a new species which he calls *intermedius*, *angustatus*, *castaneus* (or *cisteloides*, Fröhl.), and *agilis*. In speaking of Sturm I have already expressed my opinion that *castaneus* and *angustatus* were varieties of the same species, and I cannot come to a different opinion as regards *intermedius*. When I go over the species *seriatim*, I shall give my reasons for this as well as for any similar views I may have adopted regarding other species.

In the second section he includes *acicularis* (a new species, which from the description seems distinct, but which I have not seen in nature), *umbrinus*, *fuscus*, *picipes*, *meridionalis*, *nigricans*, *coracinus*, *morio*, *nigrita*, *grandicollis*, *chrysomeloides*, *longulus*, Kelln. (which, as already mentioned, I think only a variety of *tristis*), *tristis*, *rotundicollis*, *neglectus* (a new species nearly allied to *tristis*), *alpinus*, *fumatus*, *brevicollis* (a new species which I have not seen, but which appears from the description to be good), and *scitulus*.

The third section is confined to *velox*, *badius*, *præcox*, *brunneus*, and *anisotomoides*.

The fourth section is characterized as follows, viz.:—

"*Mesosternum feebly keeled; body oblong, smooth and shining; antennæ strong, scarcely thickened towards the point; difference of sexes unknown.*"

This section is erected by Kraatz to receive a single species named by him *lucidus,* and described from a single specimen found in Dalmatia.

The fifth section has received the greatest increase. Hitherto it had only contained the two species *sericeus* and *varicornis,* but Kraatz has added three new species, *strigosus, validus,* and *colonoides.* I have not seen *validus,* but the others appear to me good and distinct species.

Catopsimorphus orientalis he retains as forming a separate genus.

The number of exotic species which have been described is not great.

Three species from Algeria, *C. marginicollis, C. celer* and *C. rufipennis* have been described in 1849 by M. Lucas in the 'Exploration de l'Algérie.'

M. Motschoulsky described a species from Georgia, *C. pusillus,* in the Bulletins of the Imperial Society of Moscow for 1840.

Kolenati described in the 'Meletemata Ent.' a species, *C. fungicola,* from the Russian Province of Elisabethopoleos.

Menetries described a species (*C. pallidus*) from Bakon in the Caucasus in his 'Catalogue raisonné des Objets de Zoologie recueillis dans un voyage au Caucase,' &c. He also described in the Mem. Acad. Imp. Sciences de St. Pétersbourg, 6 sér. vi. 1849, two species, *C. lateritius* and *C. fuscipes,* found at Novaïa Alexandrovskaïa.

One species, *C. australis,* from Van Diemen's Land, has been described by Erichson in Wiegmann's 'Archiv für Naturgeschichte,' 1842.

The North American species hitherto described are *C. basilaris, C. opacus* and *C. simplex,* described by Say in the Journal of the Academy of Philadelphia, vols. iii. & v.; *C. Spenciana* described by Kirby in the 'Fauna Bor. Americ.'; *C. cadaverinus, C. Frankenhauseri, C. cryptophagoides, C. brunnipennis,* and *C. luridipennis* described by Mannerheim in the 'Bull. of the Imp. Soc. of Mosc.' in 1843, 1852 & 1853; *C. terminans* described by Leconte in Agassiz's 'Lake Superior,' and *C. clavicornis, C. californicus, C. strigosus, C. consobrinus, C. oblitus* and *C. parasitus,* described by the same author in the 'Proceedings of the Academy of Philadelphia,' 1853.

So much for the past history of the genus. We shall now proceed to the examination of the different species *seriatim.*

In doing so I shall first take the European species of each section, and then give the descriptions of the exotic species. I shall not attempt to intercalate the latter among the European species, because there are a number which I have not seen. I shall content myself with classing them according to their geographical distribution.

Genus Catops.

Mentum square, transverse, a little narrowed in front. Ligula of the breadth of the mentum at its base, widened and deeply emarginate in front. *The internal lobe of the maxillæ terminated by a corneous nail or hook. The maxillary palpi* decidedly larger than the labial; *their third article formed like a reversed cone, the fourth much more slender, conic and acuminated.* The third article of the labial palpi oval, a little longer than the second. Mandibles short, furnished with a molar tooth at their base, arched, sharp at the end and unidentate before their summit. Labrum short, rounded, and a little sinuated in the middle in front. Head declining, obtuse in front. Eyes nearly rounded, moderate in size and not prominent. *Antennæ* at least of the length of the thorax; their first six articles of variable length, subcylindric, the last five forming a club, which is sometimes so elongated and slender as to be scarcely observable, and sometimes very distinct; *the eighth joint shorter than the seventh and ninth.* Prothorax of variable form. Elytra oblong or oval, arched above. Legs long and slender, the first four joints (and more especially the first two) of the anterior tarsi, and sometimes the first joint of the intermediate tarsi, dilated in the males and provided with brushes of hair below. Mesosternum sometimes keeled. Body oblong or oval, clothed with a very fine silky pubescence*.

The first division which I shall adopt is the same as Erichson's, and I preserve Latreille's name *Choleva* for it as a subgenus; but I shall drop the dilatation of the anterior tarsi and the first joint of the middle tarsi in the males as a character.

It is a detraction from any character that it requires an examination of both male and female to recognize it; and although the character is perfectly true in this group, it cannot be used in contrast to the subsequent divisions which I am going to propose, as in them exceptions to such a rule occur. I think the following short characters sufficient.

Group I. (Subgenus Choleva.)

Mesosternum not keeled; body oblong; antennæ almost filiform; legs long and thin, posterior trochanters more or less developed in the males.

1. *C. angustatus*, Fab.

Cistela angustata, Fab. Syst. El. ii. 20. 23.
—— *agilis*, Fab. Syst. El. ii. 20. 27.

---

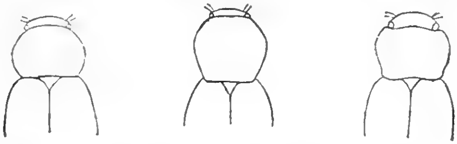
* This description of the characters of the genus is copied with some modifications from that given by Prof. Lacordaire in his admirable work the 'Genera des Coléoptères."

Catops elongatus, Payk. Faun. Suec. i. 345. 3; Gyll. Ins. i. 281. 6.
Ptomaphagus rufescens, Illig. Käf. Pr. 87. 1.
Catops rufescens, Duft. Faun. Aust. iii. 72. 1?
Choleva oblonga, Lat. Gen. Crust. et Ins. ii. 27. 1; Spence, Linn. Trans. xi. 138. 1.
Catops angustatus, Erich. Käf. d. Mark Brand. i. 233. 1; Sturm, Deutschl. Faun. xiv. 5. 1. taf. 272. M. m; Heer, Faun. Helv. i. 378. 1; Redtenb. Faun. Aust. 143. 4; Fairm. & Laboulb. Fn. Ent. Franç. i. 299.

Oblongus, fuscus vel nigro-piceus; *thorace postice non latiore*; elytris substriatis; antennis pedibusque ferrugineis.
Long. $2\frac{1}{2}$ lin.

A long thin species. The head dark, the parts of the mouth and the antennæ ferruginous; the latter about the length of the elytra, the eighth joint a little smaller than the ninth, the last joint long and acuminate. The thorax is variable in form, sometimes widest at the middle, as in fig. 1, sometimes widest a little before the middle, as in fig. 2, and sometimes widest at the very front, as in fig. 3, but *never widest behind*; sometimes a little

Fig. 1. Fig. 2. Fig. 3.



broader than long, and sometimes about equal in length and breadth. The sides are rounded. In some examples they are semitransparent or paler than the centre (and are then known as the var. *angustatus*). In others the edges are firm and concolorous (the variety *castaneus*). The posterior angles are nearly right-angled, more or less obtuse. The upper side is very densely and finely punctate in the males, less so in the females, and in both covered with a thin pubescence. The elytra are feebly striated, finely and densely punctate, with a fine pubescence, sometimes rounded, sometimes acuminate at the apex, sometimes wholly ferruginous, sometimes dark chestnut, paler round the borders. The under side is brown, the edges of the abdominal segments and sometimes the apex of the abdomen reddish. The legs ferruginous.

The trochanters and thighs of the hind legs are liable to considerable variation in form in the males. The following varieties are met with.

1. The trochanters are simple, and the thighs have a fine tooth below.

2. The thighs are simple, and the trochanters are armed with a sharp spike.

3. The thighs are simple, and the trochanters lengthened, formed like a gouge-chisel, convex outwards, concave inwards, but with the edge turned inwards at the point.

4. Both thighs and trochanters simple.

It will be seen from the above that I consider this a variable species, and that the variations I have above indicated are nothing more than different forms of the same species. Erichson was of the same opinion, for it was he who first observed and recorded the variations in the form of the trochanters of the hind legs, and in noticing them he remarks—"Of the males I have the following variations before me. These, one cannot with propriety refer to different species, when in all other respects the perfect examples agree." Other authors however have come to a different opinion, and have made distinct species of these different varieties, and as these authors are of high standing and their species have been very generally adopted, it will be right, I think, to give a copy of their descriptions, so that the reader may have before him the means of judging for himself.

I shall therefore quote the descriptions of them given by Kraatz, as being both the most recent and the most ample; but, in accordance with my own opinion, I shall rank them here only as varieties.

Var. *C. angustatus*, Kraatz.

Catops angustatus, Kraatz, Stett. Ent. Zeit. xiii. 401.

"Oblongus, piceus; *thorace minus dense et subtiliter punctato*, ante medium latiore, angulis posticis obtusiusculis, marginibus et angulis posticis dilutioribus; elytris substriatis, rufo-ferrugineis, versus suturam postice interdum infuscatis.

"Long. $2\frac{1}{2}$ lin.

"*Mas*, trochanteribus posticis plerumque scalpiformibus.

"*Fœm.*? elytris apice acuminatis.

"The longest and narrowest species in this group. The antennæ are very slender, longer than the half of the body, *always entirely of a clear ferruginous colour*. First joint somewhat stronger and as long as the second; third nearly twice as long as the joints on each side of it (second and fourth); eighth only a little shorter than the seventh and ninth, which are equal in length; the last joint longer than the preceding, long, cylindrical, and acuminate. The head is blackish brown; the parts of the mouth ferruginous, abundantly and finely punctate. The thorax is a little broader than long, gently rounded at the sides, broadest before the middle, gradually narrowed towards the base, the posterior angles more or less feebly obtuse-angled; the basal margins are depressed for a moderate breadth, and somewhat bent up, so that there is the commencement of a deepened line on each side. The upper side is covered with a moderately dense golden-yellow pubescence, and *tolerably abundantly and finely punctured, pitchy black, the outer edges and the posterior angles reddish brown*, with a more or less distinctly marked dorsal line, slightly impressed on both sides near the base. The elytra are only very feebly expanded, sometimes not wider than the base, pressed flat at the suture, slightly striated, finely and densely punctate, with a fine silken pubescence, ferruginous. The darker individuals are somewhat darker towards the apex near the suture. The legs are ferruginous red.

" *Note* I.—A not unimportant sexual distinction in this and the kindred species is afforded by the formation of the posterior trochanters. I have already (Stett. Ent. Zeit. xii. p. 284 ff.) expressed my opinion upon them, but by persevering investigations I am now able to add something to what has been already said, by way of completion. Male examples both of *C. angustatus*, Fab., and *C. cisteloides*, Fröhl. (*castaneus*, Sturm), occur with slightly developed simple acuminate posterior trochanters, with the difference however, that the trochanters in *C. angustatus* are narrower and longer than in *C. cisteloides*, and their point is far more acuminate. But there are moreover in both species males with very different, strongly developed trochanters. Nevertheless the principle of development is wholly different in the two species. The highest step of the development of the trochanters in the *C. cisteloides*, is that they are armed at the inner side with a projecting tooth more or less curved, and in the *angustatus*, that they are widened and lengthened into a gouge-chisel form; thus it is clear that a male of the *angustatus* can never come before us with a tooth at the inner side of the trochanter, it being impossible to form a transition-step to the gouge-chisel form.

" *Note* II.—I think I have found a second interesting sexual distinction of the females of the *C. angustatus*, F., in the single sharp acuminate posterior angles of the elytra. The specimens of Erichson (to be found in the Royal collection of this place (Berlin)) are represented as females of *C. angustatus*; in the same way a collection of females here agree perfectly with the males, but the latter have rounded elytra. One female taken at Cassels (alas, somewhat injured), which has been kindly surrendered to me by Herr Riehl, has likewise acuminate elytra. A larger series of this generally rare species would be required to allow us to decide without doubt whether perhaps one of the species very similar to *C. angustatus* exists, of which the male likewise may have acuminate elytra. However, I consider this highly improbable.

"*Note* III.—From the near affinity of this species with the following species more minutely described by Sturm (*castaneus*, St.), is it surprising that I yet refer to this species the greatest part of those placed by Erichson under the *C. angustatus*, of the authors referred to by him, without subjecting to a more particular examination the descriptions given by them, and knowing whether or not they had the work of Sturm on *Catops* before them while engaged on their descriptions? Such an examination has been made as far as possible, and leads to the result that those authors who entered upon a more detailed description, such as Gyllenhal, Latreille, Spence, had mostly both species before them, as Gyllenhal without doubt appears to have had."

Var. *C. intermedius*, Kraatz.

C. intermedius, Kraatz, Stett. Ent. Zeit. xiii. 401.

"Oblongus, fuscus; thorace postice angustiore, ante medium latiore, angulis posticis obtusiusculis; elytris substriatis concoloribus; antennis pedibusque ferrugineis.

"Long. $2\frac{1}{2}$ lin.

"*Mas*, trochanteribus posticis scalpiformibus.

"In form this species occupies the middle place between *C. spadiceus*, Dahl., and *angustatus*, Fab.,—shorter and broader than the latter, less robust than the former; well distinguished however by its breadth. It is distinguished at the first glance from *C. spadiceus*, Dahl., by the thorax not being deeply and strongly punctured, as well as by its lighter colour. From *C. angustatus* it differs in the following points:—

"*a*. The whole beetle is shorter, more compressed, less equally broad than the *C. angustatus*, Fab.; the elytra in the middle somewhat bellied out.

"*b*. The antennæ are likewise uniform in colour, clear ferruginous red, but somewhat shorter and stronger, the eighth joint relatively shorter than in *C. angustatus*.

"*c*. The margin of the thorax is somewhat broader, and more bent upwards than in the *C. angustatus*, Fab.; it is also to be distinguished by the deepened lines on each side of the thorax. *The upper side is moderately finely and densely* (*coarsely-shagreen*) *punctured, ferruginous brown, occasionally somewhat darker in the middle.*

"*d*. The elytra are less equally broad than in the *C. angustatus*, Fab., in the middle somewhat bellied out, entirely of one colour, ferruginous brown.

"I have at least half-a-dozen females, but only one male before me, which with greater probability belongs to this species.

It has gouge-chisel-shaped lengthened trochanters in the hinder legs.

"This species has up to this time been collected in the island of Rugen (Erichson!), Königsberg (Hargen!), Leipzig (v. Kiesenwetter!), S. Wehlen (Märkel!), and Düsseldorf (Hildebrand!). It has also been taken in Austria. For the most part it is found under leaves. *C. angustatus*, Fab., is not rarely found under stones."

Var. *C. cisteloides*, Fröhl.

" *Luperus cisteloides*, Fröhl. Naturf. 28. 25. 3. t. 2. f. 50.
" *Catops castaneus*, Sturm, Ins. xiv. 9. 3. t. 273. *a*. A; Heer, Fn. Helv. i. 378. 2; Redt. Fn. Aust. 143. 4; Kraatz, Stett. Ent. Zeit. xii. 284. 4.
" —— *cisteloides*, Kraatz, Stett. Ent. Zeit. xiii. 404; Fairm. & Laboulb. Faun. Ent. Franç. i. 299.

" Oblongus, nigro-piceus; *thorace nigro-piceo*, ante medium vix latiore, angulis posticis obtusiusculis; elytris substriatis, piceis seu castaneis.

" Long. $2\frac{1}{2}$ lin.

" *Mas*, trochanteribus posticis acuminatis seu latere inferiore dente magis minusve curvato extante.

" This is readily distinguished from the *C. angustatus*, Fab., by the darker colour and the form of the thorax. The antennæ are nearly as long as the body*, reddish brown, always darker towards the point. First joint strong, third distinctly longer than the contiguous joints, the fourth somewhat shorter than the third; fifth, sixth and seventh equal in length, eighth nearly half as long as the seventh, ninth somewhat shorter than the seventh, tenth somewhat shorter than the ninth; the last joint almost twice as long as the preceding, sharply acuminate. The head is black-brown, extremely finely and closely punctate. The thorax is formed like that of *C. angustatus*, Fab., but the sides both before and behind are nearly equally strongly rounded, so that the greatest breadth is not before the middle; the margin is by far less raised up, less broadly spread out, so that the line on each side of the thorax is both shorter and less deeply marked; *the upper side is as a rule entirely pitchy black, extremely deeply and finely* (*fine-shagreen*) *punctured*; the deep middle line is frequently wanting. The elytra are moderately arched, lightly striated, *pitchy black, more rarely pitchy brown*. The legs are ferruginous brown.

" It is spread over the whole of middle and southern Europe, and not rare. In France (according to Latreille); in Lombardy

* This is not correctly expressed. The antennæ are longer than the half of the body, but cannot be said to be "nearly as long as the body." They are in no degree longer than the antennæ of the other varieties.

(according to Villa); in Italy (according to Sturm); in Sardinia (Géné, Berlin Mus.); in Sicily (Berlin Mus.)."*

A consideration of the differences here given as characterizing these three species will not, I think, warrant us in looking upon them as more than varieties.

The differences consist in the form and colour of the thorax, the punctuation of the thorax and elytra, the form and colour of the body, the colour of the antennæ, the proportions of the joints of the antennæ, and the form of the posterior trochanters.

Of these, the difference most readily recognizable is that in the form and colour of the thorax; the form of the thorax in the *typical* specimens of *C. castaneus*, Sturm, being that shown in fig. 1, while *C. angustatus*, Fab., is that shown in fig. 2, and *C. intermedius*, Kr., somewhat between them, but nearest to fig. 2. M. Kraatz's description might lead us to suppose that fig. 3 would best represent *C. angustatus*, F., but having had under my eyes typical examples of all three, sent to me by M. Kraatz, I find that none of them have the thorax widened more in front than fig. 2, which, indeed, fairly represents the thorax of M. Kraatz's specimens of *C. angustatus*, F. But I know that there *are* examples which have their thorax widened as much in front as fig. 3. I possess one myself, and Sturm gives that form in his figure of his *C. angustatus*. We must therefore either make a fourth species to receive fig. 3, or else admit that this subgroup is variable in the form of its thorax; and there need be no hesitation in adopting the latter course, as, although I have not met with any specimen exactly filling up the gap between fig. 2 and fig. 3, I have seen all grades of transition between fig. 1 and fig. 2. Another point of difference, where we constantly see a gradual passage between the one and the other, is the colour of the thorax. In the typical *C. castaneus*, St., it is dark pitchy black throughout, and the margins are not paler than the centre, nor semitransparent. In both *C. angustatus*, F., and *C. intermedius*, Kr., the margins are paler, or semitransparent; but I have seen transition specimens where it is almost impossible to say whether the margins are paler or not, in one view looking paler, and in another quite dark and opake. Again, specimens occur very slightly paler on the margins, and so on. The punctuation and depressions, and the spreading out and raising up of the margins of the thorax also vary. I admit that I have never seen the normal or perfect examples of *C. castaneus*, St., with the spread-out and slightly bent-up edges of the *C. angustatus*, F., or *intermedius*, Kr.; but if, as I imagine, the latter are less mature individuals, and *castaneus*, St., the more mature fully-

* Kraatz in *loc. cit.*

coloured and more solidified form, such a circumstance will sufficiently account for the differences to which I have been alluding, whether in punctuation, depression, or colour. Indeed, such a supposition accounts for more; for it is not only in the thorax that these differences exist, but also in the whole of the rest of the body. *C. castaneus*, St., is darker and more deeply punctate on the elytra also, and the deeper colour extends to the antennæ, which are slightly darker at the point; and this is only what might be expected: we always find that where a greater infusion of colour has penetrated through an individual, it is not confined to one part, but pervades the whole system. I also look upon the acuminate sutural apex of the elytra (referred to by Kraatz as being possibly a sexual distinction of *C. angustatus*, F.) as another indication of immaturity. I have never seen this in *C. castaneus*, St., but I have found it indifferently both in the males and females of *C. angustatus*, F. As to the differences in the form of the joints of the antennæ of *C. angustatus*, F., and *castaneus*, St., these are too slight, even adopting absolutely M. Kraatz's own description, to allow us to use them as characters for a species; but I cannot entirely adopt his descriptions without reservation, as, notwithstanding a very careful examination of the specimens he sent me, I have scarcely been able to detect the differences he alludes to. Turning back to his description, it will be seen that the only differences given are the following:—In *C. angustatus*, F., he says, the third joint is nearly twice as long as either the second or fourth. In *C. castaneus*, he says, the third is distinctly longer than either the second or fourth. In *angustatus* the seventh and ninth are said to be equal in length. In *castaneus* the ninth is somewhat shorter than the seventh. In *angustatus* the last joint is said to be "longer than the preceding, long cylindric and acuminate." In *castaneus* it is "almost twice as long as the preceding, sharply acuminate." The differences here given are thus exceedingly minute, so much so as to be inappreciable by an ordinary observer. Now I know that in undisputed species in this genus considerable differences are to be perceived in different individuals in the relative thickness, &c. of the joints of the antennæ; so much so as to make the antennæ appear decidedly more clubbed in the one than the other. This minute measuring of the joints appears to me therefore an unsafe character, not to be adopted. There only remains the difference in the form of the posterior trochanters in *C. angustatus*, F., and *castaneus*, St. On this I shall only observe, that M. Kraatz admits that there is great variation in the development of these parts, but seems to think there is an impossibility in a transition taking place between a trochanter having a projecting curved tooth at the inner side, and a trochanter itself of a gouge-chisel-shaped form without a tooth on the inner side. My readers must judge for themselves as to this; but I agree with Erichson in thinking that the development of that part is variable, and I cannot agree with M. Kraatz in putting bounds to the variation.

The differences we have been considering are almost entirely those between *C. angustatus*, Fab., and *intermedius*, Kr., on the one part, and *C. castaneus*, St., on the other. It is much more difficult to point out those between *C. angustatus*, F., and *intermedius*, Kr.: as to these, I shall confine myself to referring the reader to the distinctions pointed out by M. Kraatz himself in his description of *C. intermedius* above quoted, merely observing that if I am right in joining together the much more dissimilar forms of *C. angustatus*, F., and *castaneus*, St., we can have no hesitation in refusing to make another species on the strength of the almost imperceptible differences relied on by M. Kraatz, a decision which a careful examination of the specimens of *intermedius* so kindly furnished to me by that gentleman has given me no reason to alter. If any of the varieties are to be exalted into separate species, *castaneus*, St., is obviously the one best entitled to this.

Referring back then to my general comprehensive description of this species above given (p. 13), I have only to add, that the extreme examples of the foregoing varieties may be known without much difficulty by the following characters. The less decided examples form intermediate steps, and it will often be found scarcely possible to say to which of the nearest varieties they belong.

1. *Pale ferruginous varieties.*

Var. A. Thorax widest at front, as shown in fig. 3; margins paler than centre.

Var. B. *C. angustatus*, Kraatz. Thorax widest not at the very front, but a little before the middle, as in fig. 2; margins paler than centre; depressions on thorax not deep. Elytra nearly parallel, darker at suture towards apex.

Var. C. *C. intermedius*, Kraatz. Thorax a little broader than in var. B; margins paler than centre, with deeper depressions on thorax. Elytra slightly widened in middle, entirely red ferruginous.

2. *Dark chestnut variety.*

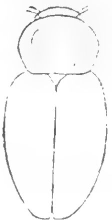
Var. D. *C. castaneus*, Sturm. Thorax widest in middle, as shown in fig. 1, of a more solid consistence than the pale varieties; margins not paler than centre.

This species is found over the whole of Europe, and Gebler mentions it as having been taken in the south-west of Siberia. The whole of the above varieties are found in England and Scotland, but var. D is the commonest and var. A the rarest—(of it I have only seen one example).

2. *C. spadiceus,* Sturm.

Catops spadiceus, Dahl. *in lit.*; Sturm, Ins. xiv. 11. taf. 273. fig. 6 B; Redt. Fn. Aust. 771; Kraatz, Stett. Ent. Zeit. xiii. 399.

Fig. 4.



Oblongus, nigro-piceus; *thorace fortius punctato,* postice angustiore, ante medium latiore, angulis posticis obtusis; elytris castaneis, parum ventricatis, apice obscurioribus, substriatis; antennis ferrugineis, apicem versus obscurioribus. Long. $2\frac{1}{4}$–$2\frac{1}{2}$ lin.

Mas, trochanteribus posticis scalpiformibus.

The most robust species in this group. Head, thorax and under-side in the fully-coloured individuals pitchy black, the elytra fine chestnut-brown. The examples not fully coloured are dirty yellowish brown. The antennæ are tolerably long, scarcely half as long as the body, reddish brown, in the normal state *the last five joints darker*; the first somewhat stronger, third somewhat longer than the adjoining joints; second, fourth and fifth of equal length; sixth somewhat shorter than the fifth, and as long as the seventh and ninth; eighth somewhat shorter than the tenth; tenth somewhat shorter than the ninth; *the last joint is somewhat shorter than the foregoing,* strongly acuminate. The head is pitchy black, the parts of the mouth ferruginous red; the top of the head finely and sparingly, the front more deeply and strongly punctured. The thorax is distinctly narrower than the elytra, a little arched, somewhat broader than long; the sides rounded, and somewhat more so in front than behind, so that the greatest breadth of the thorax is rather before the middle; the posterior angles are obtuse and rounded off, the basal margin straight-truncate; the margin in the posterior half is broadly expanded and a little bent up, so that a somewhat bent and deep line arises on each side, particularly when seen from above. *The upper side is strongly and deeply punctate**, moderately densely covered with a golden-yellow pubescence, with a distinctly impressed line along the middle, about one-third of

* Sturm says, "finely and densely" punctate, but Kraatz properly corrects this; the deep coarse punctuation being one of the most characteristic features of the species.

the thorax in length. The scutellum is triangular, punctate, brown. The elytra are *moderately arched*, chestnut-brown, and a little darker towards the apex; immediately behind the shoulders and a little further back somewhat *bellied out*, but not so that the greatest breadth lies before the middle. The striæ are moderately shallow, but very distinct, and their punctuation is proportionately strong and somewhat wrinkled. *The pubescence on the elytra is long, and not so close or adpressed as in the allied species.* The legs are ferruginous brown.

Kraatz records the male as having chisel-formed posterior trochanters, but in strongly developed specimens there might easily occur gouge-formed trochanters. Sturm only knew the female. I have also only seen the female.

This species is to be distinguished from the preceding by its more robust form, deeper punctuation, more bellied elytra, and by the longer pubescence on the elytra. For a considerable time I was disposed to look upon it as merely another variety of *C. angustatus*, F., but I am now satisfied that it may justly take its place as a distinct species. The stronger punctuation taken by itself might only indicate a variety, but the bellied form of the elytra and the difference in the pubescence are more essential characters; the latter is particularly well seen on the edges of the elytra.

It was first recorded by Sturm as having been found in Austria and Hungary. Chaudoir found it at Kiew. Kraatz records it as having been taken at Halle, Bautzen, Erlangen, Darmstadt, &c. It has been taken by M. Chevrolat in France, and I have one specimen taken in Scotland. Kraatz says, it is generally found under leaves.

3. *C. humeralis*, Brullé.

Choleva humeralis, Br. Exped. Sc. de Morée, iii. p. 162. no. 255.

"Nigricans, punctatus, rufo-villosus; ore, antennis, elytrorum macula humerali, abdominis segmentorum marginibus pedibusque ferrugineis; antennis apice fuscis; elytris profunde punctato-striatis.

"Long. $2\frac{1}{2}$ lin., lat. $1\frac{1}{4}$.

"Head black, finely punctate, with the whole of the mouth and the half of the antennæ ferruginous; the latter slightly pubescent, their five last articles brown. Thorax a little less long than broad, rounded on the sides, raised at the posterior angles, truncate behind, finely punctate, of a blackish brown, lighter on the lateral margins, and covered with a short reddish pubescence. Scutellum triangular, blackish and pubescent like the thorax. Elytra oval, a little broader than the thorax, marked with deep longitudinal striæ formed by large deep punctures, and tolerably strongly punctate in the intervals between the striæ; their colour is of a deep brown, marked with a large ferruginous blotch at each of the anterior angles; they are covered by a reddish adpressed and tolerably dense pubescence. Under side of the body finely punctate, blackish, with the edges of the abdominal segments ferruginous. Legs of this latter colour; posterior thighs partly brown.

"Upon flowers in the month of June. Arcadia*."

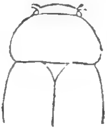
This appears to be the proper place to take in this species. I have not seen it. Brullé did not give a figure of it in his work, and on inquiry at Paris I find that his specimens must have been eaten by the larvæ of the *Anthreni* so destructive to collections on the continent. The only trace or record of the species, therefore, so far as I know, is his description, of which the above is a translation, and which seems to me to show considerable affinity to the preceding species (*spadiceus*, St.).

4. *C. agilis*, Illig.

Ptomaphagus agilis, Illig. Käf. Pr. 882.
Choleva agilis, Spence, Linn. Trans. xi. 1402.
Catops fuscus, Gyll. Ins. Suec. i. 281. 5.
Choleva testacea, Latr. Gen. Crust. et Ins. xi. 28. 2.
Catops agilis, Erich. Käf. d. Mark Brand. i. 234. 2; Sturm, Ins. xiv. 7. 2. tab. 272. n. N; Heer, Fn. Helv. i. 379. 3; Redt. Fn. Aust. 133. 3; Kraatz, Stett. Ent. Zeit. xiii. 405; Fairm. & Laboulb. Fn. Ent. Franç. i. 300.

Oblongo-ovatus; nigro-piceus, vel testaceo-piceus; *thorace transverso, postice latiore*; elytris substriatis, antennis pedibusque ferrugineis.
Long. $2\frac{1}{4}$ lin.

Fig. 5.



Mas, tibiis mediis curvatis; trochanteribus posticis inferiore dente curvato acuminato armatis.

Shorter and somewhat broader than *C. angustatus*, Fab., not very constant in colour, the darkest examples ferruginous brown with lighter antennæ. The antennæ are scarcely half so long as the body; the third joint almost twice as long as the second; the fourth, fifth and sixth are nearly equally long, the remainder (seven to eleven) are somewhat stronger than the preceding; the eighth is half as long as the ninth; the ninth equal to the tenth; the last joint is a half longer than the preceding joint, obtusely acuminate. The head is brown, extremely fine and tolerably sparingly punctured. *The thorax* is almost twice as

* Brullé in *loc. cit.*

broad as long, nearly of the breadth of the elytra, *narrower in front than behind, the broadest part being decidedly behind the middle*; the posterior angles are obtuse and rounded, and *the sides are neither spread out nor bent up, so that the moderately dense and very finely punctate upper side is entirely smooth.* The colour of the thorax is dark ferruginous brown, darker in the middle. Individuals with the thorax entirely blackish occur rarely. The elytra are generally ferruginous or testaceous, sometimes chestnut and sometimes pitchy brown; they are finely and densely punctate; at the base very feebly, towards the apex more distinctly finely punctate striate. The legs are ferruginous brown, *the middle tibiæ of the males are bent strongly inwards,* the posterior trochanters are not distant at the base, and are armed on the inner side with a short strong pointed tooth.

This species is readily distinguished by the form of the thorax, narrowest in front and widest behind. The other particulars which I have printed in *italics* are characters also easily seized.

It is spread over the most part of Europe, in Prussia, Austria, Saxony, Switzerland, France, Sweden, and Britain, but is everywhere scarce.

The only exotic species belonging to this group which I know of is *C. lateritius,* Menet. *C. Frankenhaueseri,* Mann., would also fall into this group, if it is retained in the genus at all, but its pectinate antennæ seem to me to require us to create a separate genus to receive it.

C. lateritius, Men.

Catops lateritius, Menetries, Mem. Acad. Imp. Sciences, St. Petersburg, 6 sér. vi. (1849), p. 52.

"Oblongo-ovatus, pallide rufo-ferrugineus, breviter griseo-pubescens; antennis tenuibus longitudine dimidii corporis; thorace transverso subdepresso postice latiore angulis obtusis, lateribus subreflexis; elytris creberrime punctulatis, substriatis, stria suturali profunde exarata.

"Long. 2 lin., lat. $\frac{3}{4}$ lin.

"Near *C. agilis,* Illig., but proportionately narrower, the thorax is much less broad and flatter, and the antennæ are much longer.

"Described from two individuals taken at Novaia Alexandrovskaia*."

[To be continued.]

---

* Menetries in *loc. cit.*

II.—*On a second new species of* Sphærium *from the Paddington Canal.* By Dr. J. E. Gray, F.R.S. &c.

In company with the *Sphærium pallidum* described in the last Number of the 'Annals,' Mr. Rowse finds another species of the genus which is very distinct from the well-known and generally distributed *Sphærium corneum* in being subtriangular, which gives it much the external appearance of a species of *Pisidium.*

I cannot identify it with any of the species in the British Museum collection, nor can I find any description or figure representing it in any of the works on European freshwater Mollusca; I therefore indicate it as new.

It most resembles some specimens which we have received as *Cyclas tumida* of Pfeiffer, but I do not find any species under that name in Dr. Pfeiffer's work. The Paddington Canal specimens are more inequilateral, longer, and more triangular, having a very distinct hinder slope.

M. Deshayes considers *C. tumida* as only a variety of *S. corneum.*

Sphærium Pisidioides.

Shell ovate, subtrigonal, involucres olive, pale edged, slightly concentrically wrinkled, rather rounded in front, somewhat produced, with a broad subangular slope behind; the umbones subanterior, regularly convex. Siphons united nearly to the end, the upper shorter, subconic; apertures circular, simple, the lower rather larger, about twice the length of the upper when expanded, cylindrical; the opening circular, simple.

Hab. Paddington Canal.

The adult shells are 6 lines long, 5 high, and 4 thick. They have much the appearance of a large swollen *Pisidium,* but have the two distinct siphons of the genus *Sphærium.*

The young shells which were deposited in the glass of water during the night were much compressed and nearly regularly oblong; they varied in size, some being twice as large as the others; the largest were about $1\frac{1}{2}$ line long.

When the siphons are very much extended the difference in length between the two is not so great as above, as it is the basal part of the siphons which appears to be the most extensile, the apical parts keeping the same relative length to each other that they did in the less extended state.

I am informed that some British conchologists consider *Sp. pallidum* to be the *C. lacustris* of Draparnaud: it is very unlike the specimens I have received from France and the rest of Europe under that name.

III.—*On the Habits of the Orang-Utan of Borneo.* By Alfred R. Wallace.

The two species of *Pithecus* which it is believed have now been proved to exist in Borneo, appear to have habits so similar that we shall not attempt to divide them, but shall speak of the *genus* in the following observations, in which we shall for brevity use the native name "Mias" as applied to both species.

There seems little reason to doubt that the Sumatran Orang is identical with the larger Bornean species, or that possessing the lateral cheek-ridges. All these animals confine themselves strictly to the low, level and swampy districts which occupy so large a portion of the surface of both these islands; and this circumstance sufficiently accounts for the peculiarity of their distribution. It seems at first sight surprising, that though they are abundant on almost all the north-west coast of Borneo, and in the south and south-west districts as far north as Sambas, yet in the territory of Sarawak they are quite unknown. But when we know the habits of the animal, we see a sufficient reason for this in the peculiar physical features of the Sarawak district. The Mias frequents those districts only which are so low and level as to be marshy, and are at the same time covered with a lofty virgin forest. In the midst of these plains are isolated mountains, on many of which the Dyaks have settled and planted numerous fruit-trees, which are much sought after by the Mias, which traverses these hills in all directions, but always retires to the swamp at night. Wherever the country becomes slightly elevated, and therefore dry, the Mias is no longer found. Thus, in the lower part of the Sadong River the Mias is abundant; but immediately above the limit of the tides, where the country, though still flat, is just high enough to be dry, it disappears. Now the Sarawak valley has this peculiarity, that the lower portion, though swampy, is not covered with continuous lofty forest, but is principally occupied by the Nipa palm, while at a short distance above the town of Sarawak the country becomes dry and covered with low undulations, the greater portion of which is second-growth jungle, having been at different times cultivated by the Malays and Dyaks. It is probably the vast extent of unbroken and equally lofty forest which is the principal attraction to the Mias. These forests are its open country, the place best adapted to its mode of life, where it can roam in every direction with as much facility as the Indian in the prairie or the Arab in the desert. The dry grounds are more frequented by man, more cut up by clearings and by low second-growth jungle, in which progression is more difficult, where it is more exposed to danger, and where probably its favourite food is less abundant.

It is a singular and most interesting sight to watch a Mias making his way leisurely through the forest. He walks deliberately along the branches, in the semi-erect attitude which the great length of his arms and the shortness of his legs give him: choosing a place where the boughs of an adjacent tree intermingle, he seizes the smaller twigs, pulls them towards him, grasps them, together with those of the tree he is on, and thus, forming a kind of bridge, swings himself onward, and seizing hold of a thick branch with his long arms, is in an instant walking along to the opposite side of the tree. He never jumps or springs, or even appears to hurry himself, and yet moves as quickly as a man can run along the ground beneath. When pursued or attacked, his object is to get to the loftiest tree near; he then climbs rapidly to the higher branches, breaking off quantities of the smaller boughs, apparently for the purpose of frightening his pursuers. Temminck denies that the Orang breaks the branches to throw down when pursued; but I have myself several times observed it. It is true he does not throw them *at* a person, but casts them down vertically; for it is evident that a bough cannot be thrown to any distance from the top of a lofty tree. In one case, a female Mias, on a durian tree, kept up for at least ten minutes a continuous shower of branches and of the heavy spined fruits, as large as 32-pounders, which most effectually kept us clear of the tree she was on. She could be seen breaking them off and throwing them down with every appearance of rage, uttering at intervals a loud pumping grunt, and evidently meaning mischief.

When a Mias is once up a lofty tree, there is no danger of his getting away, as he will not descend to the lower branches, which he must do to pass to another tree. As soon as he feels himself badly wounded he makes a nest, which, if he completes, is so secure that he will never fall from it. I lost two Miases that way, both dying on their nest, when I could not get any one to climb up or cut down the tree till the next day, when putrefaction had commenced. They choose a horizontal forked branch, and breaking off all the branches in its neighbourhood, lay them across one another till a complete leafy bed is made, which quite hides them from below, and from which they will not move afterwards. Their tenacity of life is very great,—from six to a dozen bullets in the body being required to kill them, or make them fall.

Every night the Mias sleeps on a nest similar to that above described, but smaller, and generally placed on a small tree, not more than 50 or 60 feet from the ground. The same animal appears seldom to use these nests more than once or twice, and they are accordingly very abundant in places frequented by the Mias. They feed all through the middle of the day, but seldom return to the same tree two days running. They seem not much alarmed at man, often staring down upon me for several minutes, and then moving away slowly to a short distance. After seeing one, I have often had to go a mile or more to fetch my gun, and in almost every case have found it on my return within a hundred yards of the place. I have never seen two adult animals together; but both males and females are sometimes accompanied by half-grown young ones, or two or three of the latter go in company. They very rarely descend to the ground,—probably only in search of water.

The females have but one young, which clings by the long hair of its mother's flanks, and so little impedes her motions, that in two cases I was not aware of its presence till both fell together. The food of the Mias consists exclusively of fruits, with occasionally, when these are scarce, tender shoots and leaves. They seem to prefer them unripe, and many are intensely bitter, particularly the large red fleshy arillus of one fruit, which seems an especial favourite. In another case, they eat only the small seed of a large fruit, of which they destroy immense quantities. The durian (*Durio zibethinus*) is also a great favourite, and the Mias destroys large quantities of this delicious fruit, in places where it grows surrounded by lofty jungle, but will not pass over clearings to get at them. It seems wonderful how the animal can tear open this fruit, the outer covering of which is so thick and tough, and densely covered with strong conical spines. It probably bites a few of these off first, and then, making a small hole, tears the fruit open with its powerful fingers.

It has been said, that the huge canine teeth of the Orang are for the purpose of defending himself against the tigers, bears, and other carnivorous animals of the Eastern forests. Our observations and inquiries as to the habits of the animal convince us, however, that no such explanation of this part of the animal's structure is at all satisfactory. In the first place, neither the tiger nor any other of the large carnivora are found in Borneo, where the Orang is most abundant; though in Sumatra the tiger and the Mias are found together. In the second place, the tiger cannot climb trees, and is therefore quite unable to attack the Orang, which never need descend to the ground, and very rarely does so. The Malayan Bear (*Helarctos Malayanus*) is the only animal which would have any chance whatever in attacking him; but as it is not carnivorous (or but slightly so), it could have no object in commencing an attack in which it would probably be beaten. The Dyaks are unanimous in their statements that the Mias never either attacks or is attacked by any animal, with one exception, which is highly curious, and would hardly be credible were it not confirmed by the testimony of several independent parties, who have been eye-witnesses of the circumstance. The only animal the Mias measures his strength with is the Crocodile of these regions (*Crocodilus biporcatus*?). The account of the natives is as follows:—"When there is little fruit in the jungle, the Mias goes to the river-side to eat the fruits that grow there, and also the young shoots of some palm-trees which are found at the water's edge. The crocodile then sometimes tries to seize him, but he gets on the reptile's back, beats it with his hands and feet on the head and neck, and pulls open its jaws till he rips up the throat. The Mias always kills the crocodile, for he is very strong. There is no animal in the jungle so strong as he."

Now it is very important to observe, that in this, the only case in which the Mias has to defend himself against a formidable attack, he never uses his teeth at all! He depends solely upon the immense strength of his arms. But even if we suppose that in Sumatra he is sometimes exposed to the attacks of the tiger, does any one imagine for a moment that his teeth would be of the slightest use to him? The tiger always attacks unawares, and almost always from behind. Let us imagine, then, a tiger springing upon the back of an Orang who was walking upon the ground; what could the animal possibly do, with those fearful claws deep in his back and shoulders, and those tremendous teeth firmly fastened in his neck? The vertebræ would probably be broken, and the Mias would fall dead on the spot, as almost every animal does under such an attack; more especially as the tiger, knowing the strength of its prey, would be sure to strike at a mortal part, or obtain such a hold as could not be shaken off. But there is yet another consideration, which shows that the canines of the Orang can hardly have been given it for the purpose of enabling it to defend itself against its enemies. The females have very small canines, and comparatively weak jaws; and as they, when suckling young ones, require defence far more than the males, who are so much more powerful, the same weapons would hardly have been denied them. It may be objected, that they would be guarded by the males; but this cannot be the case, because the females with young are always found alone, and the adult males also by themselves, as is the case with many other animals.

Here then we have an animal which lives solely and exclusively on fruits or other soft vegetable food, and yet has huge canine teeth. It never attacks other animals, and is rarely attacked itself; but when it is, it uses, not these powerful teeth, but its arms and legs to defend itself. And, lastly, the female, which is weaker, which is encumbered by its young, and which would therefore afford a much easier prey, and a more tempting object of attack, is quite unprovided with these supposed means of defence. Do you mean to assert, then, some of my readers will indignantly ask, that this animal, or any animal, is provided with organs which are of no use to it? Yes, we reply, we do mean to assert that many animals are provided with organs and appendages which serve no material or physical purpose. The extraordinary excrescences of many insects, the fantastic and many-coloured plumes which adorn certain birds, the excessively developed horns in some of the antelopes, the colours and infinitely modified forms of many flower-petals, are all cases, for an explanation of which we must look to some general principle far more recondite than a simple relation to the necessities of the individual. We conceive it to be a most erroneous, a most contracted view of the organic world, to believe that every part of an animal or of a plant exists solely for some material and physical use to the individual,—to believe that all the beauty, all the infinite combinations and changes of form and structure should have the sole purpose and end of enabling each animal to support its existence,—to believe, in fact, that we know the one sole end and purpose of every modification that exists in organic beings, and to refuse to recognize the possibility of there being any other. Naturalists are too apt to *imagine*, when they cannot *discover*, a use for everything in nature: they are not even content to let "beauty" be a sufficient use, but hunt after some purpose to which even *that* can be applied by the animal itself, as if one of the noblest and most refining parts of man's nature, the love of beauty for its own sake, would not be perceptible also in the works of a Supreme Creator*.

* The talented author of the 'Plurality of Worlds' has some admirable remarks on this subject. He says, "In the structure of animals, especially that large class best known to us, vertebrate animals, there is a general plan, which, so far as we can see, goes beyond the circuit of the special adaptation of each animal to its mode of living; and is a rule of creative action, in addition to the rule that the parts shall be subservient to an intelligible purpose of animal life. We have noticed several phænomena in the animal kingdom, where parts and features appear rudimentary and inert, discharging no office in their œconomy, and speaking to us not of purpose, but of law." Again: "And do we not, in innumerable cases, see beauties of colour and form, texture and lustre, which suggest to us irresistibly the belief that beauty and regular form are rules of the creative agency, even when they seem to us, looking at the creation for uses only, idle and wanton expenditure of beauty and regularity? To what purpose are the host of splendid circles which decorate the tail of the peacock, more beautiful, each of them, than Saturn and his rings? To what purpose the

The separate species of which the organic world consists being parts of a whole, we must suppose some dependence of each upon all; some general design which has determined the details, quite independently of individual necessities. We look upon the anomalies, the eccentricities, the exaggerated or diminished development of certain parts, as indications of a general system of nature, by a careful study of which we may learn much that is at present hidden from us; and we believe that the constant practice of imputing, right or wrong, some use to the individual, of every part of its structure, and even of inculcating the doctrine that every modification exists solely for some such use, is an error fatal to our complete appreciation of all the variety, the beauty, and the harmony of the organic world.

It is a remarkable circumstance, that an animal so large, so peculiar, and of such a high type of form as the Orang-Utan, should yet be confined to such a limited district,—to two islands, and those almost at the limits of the range of the higher mammalia; for, eastward of Borneo and Celebes, the Quadrumana and most of the higher mammalia almost disappear. One cannot help speculating on a former condition of this part of the world which should give a wider range to these strange creatures, which at once resemble and mock the "human form divine,"—which so closely approach us in structure, and yet differ so widely from us in many points of their external form. And when we consider that almost all other animals have in previous ages been represented by allied, yet distinct forms,—that the bears and tigers, the deer, the horses, and the cattle of the tertiary period were distinct from those which now exist, with what intense interest, with what anxious expectation must we look forward to the time when the progress of civilization in those hitherto wild countries may lay open the monuments of a former world, and enable us to ascertain approximately the period when the present species of Orangs first made their appearance, and perhaps prove the former existence of allied species still more gigantic in their dimensions, and more or less human in their form and structure! Some such discoveries we may

exquisite textures of microscopic objects, more curiously regular than anything which the telescope discloses? To what purpose the gorgeous colours of tropical birds and insects, that live and die where human eye never approaches to admire them? To what purpose the thousands of species of butterflies, with the gay and varied embroidery of their microscopic plumage, of which one in millions, if seen at all, only draws the admiration of the wandering schoolboy? To what purpose the delicate and brilliant markings of shells which live generation after generation in the sightless depths of ocean? Do not all these examples, to which we might add countless others, prove that beauty and regularity are universal features of the work of Creation in all its parts, great and small?"

not unreasonably anticipate, after the wonders that geology has already made known to us. Animals the most isolated in existing nature have been shown to be but the last of a series of allied species which have lived and died upon the earth. Every class and every order has furnished some examples, from which we may conclude, that all isolations in nature are apparent only, and that whether we discover their remains or no, every animal now existing has had its representatives in past geological epochs.

IV.—*Polyzoa collected by* Mr. M'Andrew *on the Coast of Norway and Finmark in* 1856. By George Busk, F.R.S. & L.S.*

[With a Plate.]

MOLLUSCA.

Class POLYZOA.

Order I. P. Infundibulata.

Suborder I. **Cheilostomata.**

1. Fam. Cabereadæ, *Busk* (*B. M. Cat.* p. 37).

1. *Caberea,* Lamx. (B. M. Cat. p. 37).

1. *C. Hookeri,* Fleming (B. M. Cat. p. 39. pl. 38. fig. 2).

2. Fam. Celleporadæ, Busk (*B. M. Cat.* p. 85).

1. *Cellepora,* O. Fabricius (B. M. Cat. p. 85).

1. *C. cervicornis,* auctor. (pars); Couch, Cornish Fauna, p. 111, pl. 19. (Pl. I. fig. 1.)

Much confusion exists with respect to this species, which I have no doubt more properly belongs to *Eschara.* The form here intended, however, which is plainly identical with Mr. Couch's, and therefore most probably with Borlase's, is quite distinct from the *Eschara cervicornis* of the B. M. Cat., and I believe also from that of M.-Edwards (Sur les Eschares, p. 15. pl. 1. fig. 1), though perhaps not from the form represented in his pl. 2. fig. 1. The genus *Eschara* requires careful revision, as does also *Cellepora.*

* The list is arranged according to the artificial classification adopted in my Catalogue of Marine Polyzoa published by the British Museum, in which, so far as that Catalogue at present extends, the synonymy will be found.

3. Fam. Escharadæ, *Busk* (*B. M. Cat.* p. 88).

1. *Eschara*, Ray (B. M. Cat. p. 89).

1. *E. teres*, nob. (n. sp.). Pl. I. fig. 2.

Polyzoary composed of distant, cylindrical, terete branches. Cells ovate, immersed, their outline being indicated by a single row of minute punctures. Mouth arcuate above, with a simple straight lower lip, *within* which is an avicularium with an orbicular mandible.

2. *E. Skenei* (var. *tridens*), nob. (n. sp.). Pl. I. fig. 3.

Polyzoary composed of short, flattened, expanding branches dilated at the ends. Cells distinct, elongated. Mouth suborbicular, horizontal, protected in front by a trifid process consisting of a central (unarmed?) rostrum and an elevated avicularium on either side (Pl. I. fig. 3 *c*).

3. *E. saccata*, nob. (n. sp.). Pl. I. fig. 5.

Polyzoary composed of elongated flattened branches dilated at the ends. Cells (in the growing portions) furnished with a strongly projecting avicularium, in the form of an elongated sac or pouch which covers nearly the whole front of the cell (Pl. I. fig. 5 *b*). Mandible rounded.

4. *E. rosacea*, nob. (n. sp.). Pl. I. fig. 4.

Polyzoary composed of short, somewhat undulating or contorted, expanding lobes. Cells deeply immersed, broadly ovate, surface granulated. Mouth rounded or arcuate above, with a sinus in the middle of the lower lip. An avicularium placed obliquely on one side close to and slightly projecting over the margin of the mouth.

In the younger cells the avicularium is seen distinctly projecting above the surface of the cell, but in the older and thickened parts of the polyzoary its extremity only is seen within the depression leading to the mouth of the cell (Pl. I. fig. 4 *c*). Young specimens (*b*, *b*) are of a delicate rose-colour and simple form.

2. *Retepora*, Imperato (B. M. Cat. p. 93).

1. *R. cellulosa*, Linn. (B. M. Cat. p. 93. pl. 121. figs. 3–8; pl. 123. figs. 5, 6).

A small fragment only occurs.

2. *R. beaniana*, King (B. M. Cat. p. 94. pl. 123. figs. 1–5).

Apparently very abundant.

Suborder II. **Cyclostomata.**

1. Fam. Idmoneadæ, *Busk* (*English Cyclopedia*, Art. "Polyzoa").

1. *Idmonea*, Lamx.

1. *I. atlantica*, Ed. Forbes. Pl. I. fig. 6.

I. atlantica, Johnst. Brit. Zooph. 2nd edit. vol. i. p. 278. pl. 48.
I. radians, Van Beneden, Bull. de l'Acad. de Bruxelles, t. xvi. p. 647. pl. 1. figs. 4–6.

In external habit *I. atlantica* very closely approaches some forms of the Australian *I. radians*, Lamk., figured and described by M.-Edwards (Sur les Crisies, &c., p. 25. pl. 12. figs. 4, 4 *a* & 4 *b*), but the figure has been taken from an imperfectly grown specimen. In all essential characters, however, the two forms are perfectly distinct. In *I. radians* the mouth of the tubes is distinctly bilabiate, in *I. atlantica* simple or merely sinuated; in *I. radians* the surface of the branches is perforated like a sieve with numerous closely contiguous pores, whilst in *I. atlantica* it is quite smooth and merely dotted with minute white spots. The branches also in *I. atlantica* are not nearly so much compressed as they are in *I. radians*, in which, as in the apparently closely allied *I. coronopus*, Defrance, a fossil form found at Grignon (M.-Ed. *l. c.* p. 23. pl. 12. fig. 3), the anterior side of the branches rises in the middle into an acute ridge. Taking also into consideration the wide difference of locality, it would appear quite certain that *I. atlantica* and *I. radians*, notwithstanding their striking outward resemblance under certain conditions of growth, are perfectly distinct species.

2. *Hornera*, Lamx.

1. *H. frondiculata*, Lamx. Pl. I. fig. 7 *a*.

H. frondiculata, Lamx. Exp. Méth. p. 41. pl. 26. fig. 1, & pl. 74. figs. 7, 9; M.-Edwards, Sur les Crisies, p. 17. pl. 10. fig. 1; Blainville, Man. d'Actin. p. 419.
Retepora frondiculata, Lamarck, Hist. d. An. s. V. 2de édit. p. 277.
Millepora tubipora, Ellis & Soland. p. 139. pl. 26. fig. 1.
M. lichenoides, Linn.; Pallas, Elenchus, p. 245; Esper, *Mill.* pl. 3. figs. 1–4.
Madrepore rameux, Marsigli, Hist. de la Mer, p. 49. pl. 33. figs. 162–164.
Var. *α*. *H. affinis*? M.-Edwards, *l. c.* pl. 10. figs. 1, 1 *a*. Pl. I. fig. 7 *b*.

The localities assigned to this species by Lamouroux are Kamtschatka, the Indian and Australian Oceans, and the

Mediterranean. But comparison of the specimens collected by Mr. M'Andrew, and of others in my possession collected by Capt. Beaufort in lat. 61° 35′ N., long. 90° 42′ W., with numerous and excellent specimens collected on the coast of Patagonia by Mr. Darwin, and of Australia by Mr. M'Gillivray, has fully satisfied me that the northern and southern forms are perfectly distinct. I suspect also that it will be found that the Mediterranean locality belongs to a third, distinct species, should the latter retain a place in the genus *Hornera* at all.

2. Fam. Discoporadæ, *Busk* (*Engl. Cyclopedia*, Art. "Polyzoa").

1. *Diastopora* (simplex), M.-Ed. (Sur les Crisies, &c.).

1. *D. obelia*, Johnst. Brit. Zooph. 2nd edit. vol. i. p. 276. pl. 47. figs. 7, 8.

Tubulipora obelia, Couch, Corn. Faun. p. 108; Johnst. Brit. Zooph. p. 269. pl. 30. figs. 7, 8; Thompson, Ann. Nat. Hist. v. 252.

I have preferred the affix of M.-Edwards's name to the genus, although the term *Diastopora* was first employed by Lamouroux. The clear definition of the genus by the former plainly entitles him to the preference. The *Berenicea* of Lamouroux, as observed by M.-Edwards, should certainly be referred to the same genus.

2. *Tubulipora*, Lamarck.

1. *T. hispida*, Fleming.

T. hispida, Johnst. Brit. Zooph. 2nd edit. vol. i. p. 268. pl. 47. figs. 9, 10, 11.

Discopora hispida, Fleming, Brit. Anim. 530; Couch, Corn. Faun. 109. pl. 19. fig. 1? (very bad).

3. *Defrancia*, Bronn (1825). *Defranceia* (1846), Reuss, Fossil. Polypar. d. W. Tertiärb.

Pelagia, Lamx.
Lichenopora, Michelin.
Tubulipora (pars), M.-Ed.
Ceriopora (pars), auctor.

Of this genus numerous fossil forms exist in the cretaceous and tertiary formations, and several living species appear to have been noticed. Of the two here described, one is already known as living, and the other only as fossil in the marl (Mergelgrund) of Essen, and in the tertiary beds of Vienna.

α. Interstices of costæ porous.

1. *D. truncata*, Jameson. Pl. I. fig. 8.

Polyzoary fungiform, simple; centre of upper surface of disk cupped; surface of stem and back of disk covered with small, oblong, rather distant pores (fig. 8 *c*).

Millepora truncata, James. Wern. Mem. i. 560.
Tubulipora truncata, Fleming, Brit. Anim. 529; Johnst. Brit. Zooph. 271. pl. 33. figs. 8–10.

β. Interstices of costæ smooth.

2. *D. stellata*, Goldfuss. Pl. I. fig. 9.

Polyzoary fungiform, proliferous, flattened above; costæ numerous, slender; surface of stem covered with large, hexagonal, closely contiguous pits (fig. 9 *c*).

Ceriopora stellata, Goldfuss, Petrefact. i. p. 39. t. 30. fig. 12; Philippi, Die Tertiärverst. der Nordwestl. Deutschlands, p. 36, 37.
Defranceia stellata, Reuss, Die fossil. Polyparien des Wiener Tertiärbeckens, p. 37. pl. 6. fig. *a*.

EXPLANATION OF PLATE I.

Fig. 1. *Cellepora cervicornis*, auctor.: *a*, nat. size; *b*, portion of surface towards the end of a branch magnified 25 diam.; *c*, cells magnified.
Fig. 2. *Eschara teres* (n. sp.): *a*, natural size; *b*, portion magnified; *c*, transverse section of a small branch magnified.
Fig. 3. *Eschara Skenei* (var. *tridens*): *a*, nat. size; *b*, portion magnified; *c*, front of cell magnified.
Fig. 4. *Eschara rosacea* (n. sp.): *a*, *a*, *a*, nat. size; *b*, portion magnified; *c*, portion magnified (older state of cells); *d*, portion magnified (young state of cells).
Fig. 5. *Eschara saccata* (n. sp.): *a*, nat. size; *b*, portion magnified (young state of cells); *c*, portion of surface in older parts magnified.
Fig. 6. *Idmonea atlantica*, E. Forbes: *a*, nat. size; *b*, front view of branch magnified; *c*, side view of branch magnified; *d*, front of young branch magnified; *e*, back of branch magnified.
Fig. 7. *Hornera frondiculata*, Lamx.: *a*, nat. size; *b*, var. *affinis*? nat. size; *c*, front view of branch magnified; *d*, back view of branch magnified.
Fig. 8. *Defrancia truncata* (n. sp.): *a*, nat. size; *b*, portion of costæ magnified; *c*, surface of stem magnified.
Fig. 9. *Defrancia stellata*?, Goldfuss: *a*, nat. size; *b*, portion of edge of disk magnified; *c*, surface of stem magnified.

V.—*On the Evils of Increasing Synonyms.* By S. P. Woodward, F.G.S.

To the Editors of the Annals of Natural History.

Gentlemen,

In the May Number of the 'Annals' I showed that "the type of Mr. Jeffreys' new genus (*Schismope*) was a typical *Scissurella*."

This was a simple matter of fact, admitting of no reply; but Mr. Jeffreys has thought proper to raise a number of points, wholly irrelevant to the subject, and most unpleasant to enter upon. The inaccuracy of his statements can only be accounted for by great haste and a very bad memory.

He says he had the pleasure of giving me the specimens on which my observations were made—although I had distinctly stated, *in print*, that I received them from Mr. Damon. This makes it necessary to add that when I applied to Mr. Jeffreys for specimens, he informed me he had sent them all to Mr. Damon; and he may perhaps remember that when—after I had shown him the specimens obtained from Mr. Damon—he brought out a boxful of these tiny shells, I asked him "how he could have told me he had none?" He then offered me some more specimens, expressing a wish (as I understood) that, in justice to Mr. Damon, nothing should be said about them.

Further on, Mr. Jeffreys makes me say I had previously seen no other *Scissurellæ*, &c. Forgetting that I showed him the finest species he had ever seen—*S. angulata*, Lovén; that I told him I had found *Scissurella* in sand from New Zealand; and that in the British Museum (to go no further) there is the type of *S. Bertheloti*, D'Orb., in a collection we had both lately been examining. Besides, the question was not about *species*: the specific identity of Mr. Jeffreys' shell with *S. elegans*, D'Orb., was known and admitted by himself, from the first.

A third statement is to the effect that he consulted D'Orbigny's memoir *at the time* I showed him Philippi's and Sowerby's observations. I can only say, that more than a month afterwards (when the paper on "*Schismope*" was gone to the 'Annals,' though not printed) he informed me *he had not seen* the memoir in question.

There are several other assertions which it is unnecessary to follow, as they have neither personal nor scientific interest. Perhaps Mr. Jeffreys thinks he is letting himself down easily, and I should be sorry to dispel the illusion.

I will only add a few words of an accomplished botanist, lately quoted by Dr. Carpenter:—"The naturalist who has the true interest of science at heart, not only feels that the thrusting of an uncalled-for synonym into the nomenclature of science is an exposure of his own ignorance and deserves censure, but that a wider range of knowledge and a greater depth of study are required, to prove those dissimilar forms to be identical, which any superficial observer can separate by words and a name."

I am, Gentlemen, your obedient Servant,

S. P. Woodward.

Barnsbury, June 1856.

VI.—*Observations on the External Characters and Internal Anatomy of a Bitentaculate Slug found at the Island of Aneiteum, New Hebrides.* By John Denis Macdonald, R.N., Assistant-Surgeon of H.M.S.V. "Torch," Tender to H.M.S. "Herald," Capt. Denham, R.N., F.R.S., Commanding the Exploring Expedition in the South Seas.

[With a Plate.]

At the Island of Aneiteum, in the New Hebrides group, we obtained the only naked terrestrial Gasteropod with which we met during our late cruises amongst the South Sea Islands.

At first sight the animal appeared to be simply a moderately large species of *Limax*, but on closely examining two specimens which Mr. Macgillivray very kindly reserved for me, I noticed that they possessed but the two tentacula that supported the eyes. This character made the further study of their anatomy an object of some interest to me, and I have been induced to draw up the following account of it with the view of determining whether the species may be with propriety retained in, or separated from, the genus *Limax*.

The animal having the power of extending its body considerably, or of drawing it up in the longitudinal direction, and spreading it out laterally so as to assume a great variety of shapes, it would be rather difficult to state its proportions with any degree of certainty, but it appears to average about $2\frac{1}{2}$ inches in length, by $\frac{6}{8}$ths of an inch in breadth. It is of a pale yellowish-brown colour, varying in depth in different individuals, and often sparingly mottled with a reddish-brown or black pigment over the dorsal region.

Along the middle line of the back a narrow groove extends from the nape to the obtusely pointed extremity of the tail, and from this primary groove, on either side, a number of smaller channels arise, which take a parallel course obliquely outwards and backwards to the thin margin of the foot, and communicate with each other laterally by the transverse interspaces between the soft mammillary elevations of the skin.

The mantle is of small superficial extent, lying on the right side of the body somewhat in advance of the centre, and circumscribed by a triangular sunken outline, with the angles gently rounded off. The base of the figure thus formed corresponds with the above-mentioned median groove, which is here slightly deflected to the left, while the outer rather obtuse angle is so deeply notched as to appear to be perforated by the respiratory opening. From the upper and anterior angle two depressed lines pass forwards, diverging so as to include the roots of the tentacula, on the outer side of which they are lost.

A remarkably stout scutellum with smoothly rounded extremities, presenting little of the scale-like character of the same organ in other Slugs, is enclosed between the layers of the mantle.

The tentacula arise directly from the head, having no connexion whatever with the mantle. They gradually diminish in size towards the free extremity, which is slightly dilated and of an oval form, containing the visual organs.

The roof of the mouth is furnished with a quadrilateral horny tooth, having a crescentic inferior or cutting edge, and from its intimate connexion with the buccal mass, rather than with the upper lip, it would remind one more of the upper mandible of Cephalopods than of its representative in the veritable members of the genus *Limax*.

The lingual sac and dental plates and tubercles very closely resemble those of *Limax*, *Helix*, and *Bulimus*. Thus, the sac itself is short and moderately wide, with a rounded fundus protruding a little from the buccal mass posteriorly. The lingual plates are subquadrilateral in figure, the outer and posterior borders being somewhat concave, and the anterior and internal slightly convex; and each plate supports a simple conical dental process inclining a little inwards, and having a small angular projection on either side of the base. The plates of the central series are quite rudimentary, each presenting a bifid anterior portion and a small and pointed posterior extremity. The latter characters, if they do not prove to be generic, may at least serve to distinguish the species.

The generative system is remarkable for the compactness of all its parts.

The ovarium (Pl. III. fig. 6 *i*) and testis (*k*) lie in contact with each other at about the middle of the dorsal region. The former, on the left side, gives origin to the small or primary oviduct (*l*), and the latter, on the right, is wrapped up, as it were, with the tortuous commencement of the larger oviduct or uterus (*m*), but both testis and ovarium are separated from the liver by the interposition of the stomach.

The *vas deferens* emerges from the smaller or anterior portion of the testis (*o*), winds in a dextral manner round the uterus, and having reached the union of the organs of both sexes, it crosses over to the left side and retrogrades upon the under surface of the retracted male organ so as to terminate near the insertion of the short retractor muscle (*p*), which arises from a point corresponding to the union of the foot with the dorsal integument on the left side.

The spermatheca (*q*) is of considerable size and filled with a purplish-brown secretion; but its duct, which arises from the uterus, is so short, that the sac itself lies in contact with that tube. Now, in the common Slugs of England, the duct of the spermatheca has no immediate communication with the oviduct, but opens externally by a distinct orifice in the generative pit.

Near the commencement of the uterus there is a much smaller sac-like appendage (*m*), which may be a rudiment of the multifid vesicles; organs which, although peculiar to the genus *Helix*, I have never seen in any of the numerous *Helices* which I have dissected in the Southern hemisphere.

The external respiratory opening leads into a small cavity with stout areolated walls, and a few little fenestrations in a small cribriform space establish a communication between this cavity and the pericardium; a condition which also most distinctly exists in *Nautilus Pompilius*.

The heart (*r*) holds a central position; a small auricle receives the return-blood from the respiratory surface on the right side, and the ventricle gives off its principal arterial trunk inferiorly, a tubular process of the pericardium encircling the vessel at its origin.

A large glandular body (*s*) arches over the viscera from the left to the right side immediately behind the heart, and pours forth its mucous secretion through the respiratory orifice. This gland is furnished with compressor muscles from the circular fasciculi of the integument. It is doubtless the homologue of what might be termed the renal gland of *Paludina* for example, or the renal follicles of *Nautilus*; and indeed the close relationship of the Gasteropoda with the Cephalopoda through the latter genus is well illustrated in many particulars in the little mollusk, the principal details of whose anatomy have just been given*.

The only mollusk with which this may be confounded is the *Janella antipodarum* of Dr. Gray. The *primâ-facie* probability of their identity was first suggested to me by Mr. Macgillivray in the following memorandum, which expresses the state of the question so concisely that I cannot refrain from inserting it, with that gentleman's permission:—

"*Limax bitentaculatus*, Quoy & Gaim. Voy. Astrolabe, t. 13. f. 1, 2, 3. From this description Gray formed a temporary genus under the name of *Janella*, in vol. iv. of 'Mrs. Gray's Mollusca.' He has since, from receiving one in spirits, published the characters of the genus (in Ann. and Mag. of Nat. Hist. for Dec.

* I have since ascertained that a bitentaculate Slug, answering in every respect to that above described, is indigenous to Port Stephens, New South Wales. Both unquestionably belong to the same genus, but not having the opportunity of comparing specimens, I cannot determine if any specific differences exist between them.

1853), describing the only species known to him as '*J. antipodarum.*—N. Zealand.' Now it strikes me that the (only) two-tentacled Slug got during last cruise, and believed by you to be the type of a new genus, will fall into this one—and I make this memorandum for the purpose of inducing you to peruse the December Number of the 'Ann. and Mag. of Nat. Hist.' now on the table at the reading-room of the Library, in case I should forget to mention it to you verbally."

I have only to add to this, that I have studied the characters of the genus *Janella* given by Dr. Gray, in the Number of the 'Ann. and Mag. of Nat. Hist.' referred to, and I find that the three following items are quite sufficient in themselves to show that *Janella antipodarum* can have but little affinity to the mollusk above described.

Janella (Gray).	*Aneiteum Slug.*
1st. Shell none, or at least there is no appearance of any through the skin.	1st. Shell internal, elongated in form, of considerable thickness and smoothly rounded off at the extremities.
2ndly. The tentacles instead of being placed on the head, as in *Philomycus* and all the other Arionidæ and Helicidæ, are placed in the front part of the mantle.	2ndly. Tentacula distinctly arising from the head, as in *Philomycus*, &c.
3rdly. Mantle covering the whole of the back with a slightly raised margin, leaving a rather broad space between the edge and the edge of the foot.	3rdly. Mantle of small superficial extent, lying on the right side of the body somewhat in advance of the centre, but not extending all over the back.

As it is yet possible that a shell may exist in *Janella*, although there is no external appearance of any, too much importance must not be attached to its apparent absence as a distinctive character, but the remaining items need no further comment.

The internal œconomy of the Aneiteum Slug is similar in all essential particulars to that of *Limax*. There are however in the former many peculiarities, which will be noticed, as they present themselves, in the explanation of the figures.

Port Curtis, February 13, 1855.

EXPLANATION OF PLATE III.

Fig. 1. The animal as it appeared in motion.
Fig. 2. Ditto at rest.
Fig. 3. The scutellum.

Fig. 4. The horny cutting tooth: *a*, somewhat enlarged to show its character more distinctly; *b*, natural size.

Fig. 5. *a*. Seven lingual plates taken from the middle portion of a transverse series. The rudimentary and bifid central tooth presents a remarkable contrast to the others. *b*. shows the curvatures of the transverse rows of teeth, the longitudinal series in every case being rectilinear.

Fig. 6. A simple dissection, in which the internal organs are merely unravelled as it were, so as to afford a *tout ensemble* of the digestive and generative systems in particular: *a*, the retracted tentacula; *b*, buccal mass, with the commencement of the œsophagus, and the tortuous ducts of the salivary glands; *c*, a kind of crop or proventriculus, to the exterior of which a loop of intestine is bound down by areolar tissue; *d*, stomach; *e*, a small sacculus, which is probably the rudiment of a pancreas. It is the homologue of the sacculated and internally plaited organ of *Nautilus Pompilius*, represented by a more highly developed glandular apparatus in *Sepia*. *f*, the liver, which is divisible into four distinct lobes, each giving rise to a biliary duct opening separately into the alimentary canal near the glandular sacculus, *e*. The intestinal canal, *g*, is rather lengthy, winding round the liver, passing first forwards and then backwards upon the stomach, forming a loop upon the proventriculus as above noticed, and, finally, terminating in the anus at *h*, near the respiratory orifice.

VII.—*On Vegetable Cell-formation.* By Prof. Arthur Henfrey, F.R.S.

To the Editors of the Annals of Natural History.

Gentlemen,

Your Number for this month (June) contains some remarks by Dr. Carpenter relating to my letter which appeared in the preceding Number (2nd Ser. xvii. p. 417). I am obliged to trouble you with a few lines more on this subject, as Dr. Carpenter appears to have misconceived the purport of my communication. With me it was no question of "general ideas of the process of cell-formation;" although I humbly submit that my 'general ideas' form as good materials for argument as references to *unpublished* investigations. General and long experience in observations of the process did indeed render Mr. Wenham's account quite incredible in my eyes: but if Dr. Carpenter reads my letter carefully, he will see that I founded my criticism on a repetition of the observations, and that the main feature of my letter was a denial of the correctness of the statements and of the accuracy of the drawings.

I am, Gentlemen, yours obediently,

Arthur Henfrey.

VIII.—*On the Method of Palæontology.* By Thomas H. Huxley, F.R.S., Lecturer on General Natural History at the Government School of Mines, and Fullerian Professor of Physiology R.I.

There are two perfectly distinct aspects under which Living Beings may be studied—the Physiological and the Morphological. On the one hand, every living being exerts certain forces and performs certain acts or functions. It is the object of the physiologist to ascertain the precise mode in which these acts are performed, to refer them as far as possible to the ordinary laws of physics and chemistry, and when, as in many cases, the functions are highly complex, to analyse them into their elementary acts, and to determine by what part of the frame, by what special organs, these are performed. With the form of these parts, with their connexion other than that which is involved in their coadjustment towards a common effect, the pure physiologist has no concern.

On the other hand, every living being has a definite form, and in all the higher living beings this form is complex; it is made up of a greater or smaller number of lesser parts, each of which has its own definite and appropriate figure. Now it is with these forms, with their mutual relations, with the laws which govern their association, that morphology is alone concerned. Although in practice the two branches of biological science are commonly more or less united, yet it would be quite possible to write a complete system of pure physiology without reference to morphology, and of morphology without reference to physiology. They are as distinct as in the mineral world are crystallography and chemistry. To put the case in another way. The different parts of every living being are all mutually related, they are subject to definite laws of correlation, but these laws of correlation are of two kinds essentially independent of one another: there are physiological correlations and there are morphological correlations. Thus the teeth and the stomach are physiologically correlated, contributing as they do to the common end of alimentation; and inasmuch as this coadaptation towards a common end is the very essence of physiological correlation, the latter has sometimes received the name of *rational* correlation; for when the result to which a combination tends is obvious, we commonly imagine we can see the reason for that combination.

Since the validity of nine-tenths of the science of animal physiology involves the admission, that multitudes of the parts of animals are organs working towards a common end, I do not suppose that it ever has entered, or ever will enter, into the mind of any person conversant with the rudiments of that science to question the existence of physiological correlation between the different parts of animals. But how far that correlation is in any case to be called *necessary*; that is, how far in order to the due performance of a given function in any case it is impossible that the organs performing that function should be different from what we find them to be, is quite another question. Thus the teeth of a lion and the stomach of the animal are in such relation that the one is fitted to digest the food which the others can tear; they are physiologically correlated, but we have no reason for affirming this to be a necessary physiological correlation, in the sense that no other could equally fit its possessor for living on recent flesh. The number and form of the teeth might have been quite different from that which we know it to be, and the construction of the stomach might have been greatly altered, and yet the function of these organs might have been equally well performed. Nothing can be more uniform than the physiological ends which have to be attained by living beings; nothing more various than the modes in which they are attained; and it would, I think, in the face of these well-known facts, be the height of presumption to affirm that the function which we see in any case performed in a particular way could not possibly have been performed in any other mode.

If physiological correlations are however not *necessary*; if, so far as physiology is concerned, we have no right to say with Cuvier, that "Every organized being constitutes a whole, a single, and complete system, whose parts mutually correspond and concur by their reciprocal reaction to the same definite end. None of these parts can be changed without affecting the others, and consequently each taken separately indicates and gives all the rest;"—then a very important consequence follows, viz. that it is quite impossible to reason conclusively on physiological grounds alone from any part of a living being to the whole.

I by no means assert that Cuvier, in enunciating the proposition quoted above, meant to exclude all but physiological considerations so completely as the words appear to indicate. On the contrary, his practice, no less than other passages of the remarkable essay from which that citation is taken, shows clearly that no man more fully understood the value of morphology. Nevertheless the words of the proposition are distinct enough to justify those who, guided more by authority than by right reason, have denominated it Cuvier's law of correlation, and, ambiguously supported by Cuvier's phraseology elsewhere, have imagined the principle which it involves to have been his guide in palæontological research.

A simple illustration or two, however, will show that the laws of physiological correlation alone are wholly incompetent to furnish such guidance. Suppose I find the jaw of a vertebrate animal with sharp cutting teeth imbedded in it, how far will physiology help me to determine the precise nature of the animal to which it belonged? The sharpness of the teeth may lead me to guess that they were used for cutting some soft substance. The shape of the articular condyle and that of the processes for muscular attachment may equally render probable the direction and force of its ordinary movements; but as to the rest of the organism, whether the teeth were for cutting up fish, flesh, fowl, or carrion, whether the creature itself was piscine or reptilian or mammalian,—on all these points no amount of mere physiological reasoning will help me. Nay, how do I know it is a vertebrate jaw at all? that it is vertebrate bone and tooth substance? For anything physiology teaches me to the contrary, Invertebrate animals might develope osseous and dentinal tissue, and might possess appendages having the form of vertebrate jaws.

Every naturalist knows that Invertebrate animals do not thus mimic the Vertebrata, and he believes that they never have and never will do so; but his confidence is based, not on any physiological reasoning as to the impossibility of such a proceeding, but on his simple experience that it never does occur. He rests not on a deduction from the laws of physiological correlation, but on the morphological law that no Invertebrate animal ever possesses an organ having the form and structure displayed by the jaw in question. And this law is an empirical one; no further reason for it can be given than for the law of gravitation. The whole object of morphology is to ascertain *what* structural peculiarities invariably coexist with one another: *why* these structural peculiarities coexist is a question with which it does not necessarily concern itself, and so far as the mere restorations of the palæontologist are concerned, it is a wholly irrelevant question. The empirical laws of morphology supply all that the palæontologist requires for this object.

Let us imagine that all existing animals had perished, but that their dead forms were gathered together and submitted to the investigation of some intelligent being from whom the knowledge that they had ever lived was concealed. He would of course remain entirely ignorant of physiology and all its laws. Life, if he were acquainted before only with physical and chemical phænomena, would be an inconceivability, and the conception of adaptation to purpose, of physiological correlation, would fail to suggest itself where nothing was known of actions or functions.

Nevertheless, by the careful comparison of one form with another, he would see that in one set of specimens certain structural peculiarities were invariably associated, in another set others, and he would thus arrive at precisely the same laws of morphological correlation*, and at the same classification of these dead forms as that which we have reached from our study of the living ones. He would not term Lions and Tigers and Wolves "Carnivora," for he would not even know that they eat anything, but he would assuredly form a group with pretty nearly the same limits as the Carnivora, simply because all these animals resemble one another, and differ from the rest in certain peculiarities of dentition, &c. So again, he would group Oxen and Sheep and Deer together, because they present corresponding coexistences of structure, though, knowing nothing of their digestive processes, he would not call them "Ruminantia."

And now, after our imaginary being had made himself acquainted with the whole series of forms before him, and had established his great laws of morphological correlation and his classification, suppose that a mass of fragments of other creatures, more or less similar to those which he had first familiarized himself with, were placed before him, and he were desired to put these fragments together, and to reconstruct these dismembered forms, how would he proceed? Suppose the first bone which came to hand very closely resembled the jaw of a Deer, would he not naturally conclude—could he logically escape the conclusion—that in all probability the skull and limbs which belonged to this jaw were like those of a Deer also? And finally, supposing that, guided by this strong probability, he had selected a complete deer skeleton from the mass, all of whose parts were in such proportion to one another and to the jaw first discovered, as to accord perfectly with his already ascertained laws of correlation of form in the Deer species, could the validity of his restoration be questioned, because he knew nothing about the purposes of all these parts or their physiological correlation?

What additional certainty would he gain by now learning that the Deer had once lived—that it was herbivorous—that its teeth and internal organs were all exquisitely adjusted to its mode of life? He would say, That is all very beautiful, and I am very glad to know it; but such considerations did not in the least help me to pick out the bones which belonged to the jaw, nor do they add a grain of certainty to that which I already feel as to the justice of my restoration. Indeed, my method tells me a great deal that yours is quite silent about. I knew empirically that the kind of tooth and jaw placed before me was

* Except so far as he would be deprived of the advantage of the study of development. This, however, obviously by no means interferes with the validity of the general argument.

always associated with horns, with slender limbs, and with cleft hooves; but I could never have divined these things from knowing that the jaw and tooth were specially adapted to a herbivorous diet.

Surely all this is so obvious as to need no great amount of demonstration, and no less clear is its application to the question, What is the method of palæontology? How is it that we are able to restore an extinct animal from some fragments of its skeleton? It is by deduction from those empirical laws of morphology which express the invariable coexistences of structure, so far as observation has yet made them known to us, and it is by this method only. When once the general nature of an extinct animal has been ascertained, the laws of physiology may help us to very useful hints and guesses; but the fundamental steps towards the determination of the nature of any unknown fragment, whether recent or fossil, are purely morphological, and, so far as they are concerned, physiology might be non-existent.

The truth of what has just been asserted must long have been familiar to every thinking botanical palæontologist; and I have never met with any indication, either in their works or in conversation, that the botanists imagined they were guided in their determinations of extinct plants by any reference to physiological correlation, or by any other method than deduction from purely empirical morphological laws. Nor does the palæontologist, who concerns himself with invertebrate forms, often seek for help from physiology. In fact, the total absence of any acquaintance with physiology which many excellent palæontologists manifest, is a curious illustration of the justice of my line of argument, as it nowise interferes with the soundness of their work,—so long as they confine themselves to such purely morphological questions as are involved in the restoration of extinct forms.

Nor can I find that *in practice* those palæontologists who have studied the Vertebrata trouble themselves much about physiological correlations or adaptations to purpose. The reader of Cuvier's "Ossemens fossiles" might begin at the tenth volume and read on to the second, and while he would be astounded at the enormous knowledge of the laws of morphology—of the observed coexistence of parts which it displays—he would find himself very rarely troubled with any remarks upon physiological correlations or adaptations; and any which might offer themselves would be entirely subordinate to the great object of the work, which is, to apply the purely empirical laws of morphological correlation, which have been ascertained to obtain among living beings, to the elucidation of fossil remains.

It is with no little surprise, therefore, that in the first volume he finds, or seems to find, the principle of physiological correlation brought prominently forward, in the celebrated 'Discours sur les Révolutions,' as *the* guide in palæontology, as the especial means by which the determination of mammalian fossils, at any rate, is effected. I say, *seems* to find; for, after all, if the master's words be studied carefully, it will be discovered that his followers are more Cuvierian than Cuvier.

In fact, as I have already particularly pointed out, in a lecture which I recently delivered before the members of the Royal Institution, Cuvier gives up the principle of physiological correlation, both explicitly in words and implicitly in practice, as an exclusive guide in palæontological research; and he expressly admits the necessity of a reference to the laws of morphological correlation.

But while admitting the importance of both methods, the physiological and the morphological, he gives to the former by his words a prominence which it by no means has in his practice; or perhaps I may more justly say, that his phraseology is ambiguous, from his having confounded the two methods together, under the one term of "principe de la corrélation des formes dans les êtres organisés." Those who will read carefully from p. 178 to p. 189 (ed. 4, 1834) of the 'Discours,' will find that this confusion exists throughout. Thus, if we take one of the opening passages already cited (p. 178):—

"Every organized being constitutes a whole, a single, and complete system, whose parts mutually correspond and concur by their reciprocal reaction to the same definitive end. None of these parts can be changed without affecting the others; and, consequently, each taken separately indicates and gives all the rest."

The first paragraph here embodies the principles of both physiological and morphological correlation. The second paragraph, however, regards physiological correlation only, and the statement which it contains is not true. We have no evidence to justify us in asserting that no one part can be changed without affecting all the others. On the contrary, we have abundant evidence to show that allied species, for instance, differ in only a single character; which would be an impossibility if a change in one part sensibly affected all the rest.

Cuvier then goes on to show, in a very beautiful manner, the physiological correlation which exists between the parts of a Carnivore, concluding with the well-known phrase, "in the same way the claw, the scapula, the condyle, the femur, and all the other bones taken separately, will give the tooth, or one another; and by commencing with any one, he who had a rational conception of the laws of the organic œconomy could reconstruct the whole animal."

If Cuvier means by "the laws of the organic œconomy," (and the context would indicate that he does,) its physiological laws merely, then I must venture to say, that I believe this assertion to be incorrect. I do not believe that the problem—given a tooth or a bone, the mode of life of an animal, and the laws of physiology, to find the structure of other parts of the body of that animal,—is a soluble one.

In fact, Cuvier himself, in the very next paragraph (p. 182), almost gives up his own principle. I give his own words:—

"Ce principe est assez évident en lui-même dans cette acceptation générale pour n'avoir pas besoin d'une plus ample démonstration; *mais quand il s'agit de l'appliquer, il est un grand nombre de cas où notre connaissance théorique des rapports des formes ne suffirait point si elle n'était appuyée sur l'observation.*"

And again, in concluding, at p. 187 Cuvier says:—

"Et, en adoptant ainsi *la méthode de l'observation comme un moyen supplémentaire quand la théorie nous abandonne,* on arrive à des détails faits pour étonner. La moindre facette d'os, la moindre apophyse, ont un caractère déterminé relatif à la classe, à l'ordre, au genre et à l'espèce auxquels elles appartiennent, au point que toutes les fois que l'on a seulement une extrémité d'os bien conservée on peut avec de l'application, et en s'aidant avec un peu d'adresse de l'analogie et de la comparaison effective, determiner toutes ces choses aussi sûrement que si l'on possédait l'animal entier."

Finally, at p. 184, after speaking of those invariably coexistent peculiarities of organization among the Ruminants, which have no apparent physiological connexion, Cuvier says:—

"Cependant puisque ces rapports sont constans il faut bien qu'ils aient une cause suffisante; mais comme nous ne la connaissons pas, nous devons supplier au défaut de la théorie par le moyen de l'observation; elle nous sert a établir des lois empiriques qui deviennent presque aussi certaines que les lois rationelles, quand elles reposent sur des observations assez répetées: en sorte qu'aujourdhui quelqu'un qui voit seulement la piste d'un pied fourchu, peut en conclure que l'animal qui a laissé cette empreinte ruminait, et cette conclusion est tout aussi certaine qu'aucune autre en physique ou en morale."

I confess that, considering the Pig has a cloven foot, and does not ruminate, the last assertion appears to me to be a little strong. But my object is not to criticise Cuvier, but simply to show that nothing could be more marked than his appreciation of the value of the merely empirical laws of morphology, as applied to palæontology, nothing more erroneous than the popular notion, too much favoured by his own language, that his method essentially consisted in reasoning from supposed physiological necessities. In the lecture above referred to, I not only maintained this view, but I further asserted, and endeavoured to prove, that not only are popular and other writers thus mistaken in interpreting Cuvier, but that Cuvier himself was in error in ascribing to the laws of physiological correlation that primary importance in palæontology which he undoubtedly does give them. I brought forward, in fact, the doctrine which I have argued at greater length in the preceding pages, viz. that palæontology, so far as it consists in the restoration of extinct forms, is entirely based upon deductions from the empirical laws of morphology; that its conclusions, so far, would be as valid if the whole science of physiology were non-extant, and if we knew nothing of final causes or adaptations to purposes.

The publication of the abstract of the lecture has elicited a brusque attack from Dr. Falconer, which, coming as it did from the pen of a palæontologist of high repute, caused me at first, I must confess, no slight alarm; the more so as Dr. Falconer, in his laudable desire at once to extinguish heresy, had, I found, taken the somewhat unusual course of widely circulating his little pamphlet.

The perusal of Dr. Falconer's essay, however, soon relieved me from my only real source of uneasiness, by demonstrating very clearly that Dr. Falconer had been far too much in a hurry either to master the real question in dispute, to read what I had written with attention, or to quote me with common accuracy and fairness. In fact, I have not the good fortune to be among the "*tantis* viris" de quibus "modeste tamen et circumspecto judicio pronuntiandum est," and it is clearly in Dr. Falconer's opinion not worth while to use much circumspection in dealing with the opinions of mere ordinary "viri."

The first evidence of Dr. Falconer's entire misconception of the point at issue meets one in the title-page—"On Prof. Huxley's attempted refutation of Cuvier's Laws of Correlation in the reconstruction of extinct Vertebrate Forms." It is repeated at page 477. "Nearly three-fourths of Mr. Huxley's abstract are devoted to the first head, viz. Natural History, regarded as knowledge, the leading feature of which is an attempt to refute the principle propounded by Cuvier, that the laws of correlation which preside over the organization of animals, guided him in his reconstruction of extinct Forms." Nothing can be more entirely incorrect than the assertion contained in the latter part of this paragraph. I did *not* attempt to refute any one of Cuvier's laws of correlation. There is not a passage in my lecture which can be justly so interpreted. I merely endeavoured to prove, and I can find nothing in Dr. Falconer's essay to show that I did not prove, first, that the *physiological* laws of correlation which Cuvier laid down are not as universally and necessarily applicable as he seems to have imagined; secondly, that his physiological laws of correlation are of wholly subordinate importance in palæontology, if not absolutely unimportant, the really important laws by which he worked being those morphological laws, those empirical laws of coexistence which, as I have said, no man lays down more clearly, but to which he nevertheless ascribes in words, though not in practice, a subordinate place. This entire misunderstanding of the real point under discussion vitiates the whole of Dr. Falconer's paper. It is again repeated at p. 481, just after Dr. Falconer has gravely warned us how necessary are "precision of thought and expression in disquisitions of this kind."

So again, at p. 487, Dr. Falconer says:—

"The argument drawn by Mr. Huxley from instances of empirical relation in the vegetable kingdom *against* there being necessary or reciprocal relation in the high classes of the animal kingdom is exactly of this character."

I assert that no one who carefully reads my abstract will find the slightest ground for the assertion that I have ever made use of any such argument as that imputed to me by Dr. Falconer. What I say in regard to plants is:—

"And if we turn to the botanist and inquire how he restores fossil plants from their fragments, he will say at once that he knows nothing of physiological necessities and correlations."

To any unprejudiced reader of ordinary intelligence it will be quite obvious that the question of the existence of physiological correlation between the parts of plants is here utterly untouched. The question is whether the physiological or the morphological laws of correlation guide the botanical palæontologist. I affirm the latter, and I am supported by every botanist with whom I have spoken on the subject.

Dr. Falconer writes at p. 487:—

"Nature has formed living beings upon certain types which constitute the basis of methodical nomenclature, and the correlation of part to part and organ to organ is adjusted in subordination to these types."

Now what is this but an admission of all that I have contended for, namely, that the physiological correlation of organs is wholly subordinate to their morphological or, in other words, typical correlation? What is it that Dr. Falconer attacks, after all? And this question becomes all the more bewildering, when we find at p. 480:—

"Our first remark is, where and by whom has the principle of the 'utilitarian adaptation to purpose' been used as an instrument of research? Mr. Huxley avers that its value as such has been enormously overrated. If so, by whom has it been ever used? From the prevalence of adaptations and mechanisms in nature suited to the production of certain ends we reason up to the agency of an all-wise, powerful and benevolent Designer. But the inference is a product not an *instrument* of the research, and to call it the latter is simply a misuse of terms."

Surely Dr. Falconer can understand that adaptation to purpose is adaptation to use, and that therefore adaptation to purpose may well be said to be 'utilitarian.'

In answer to the next part of his inquiry, I must refer him to Dr. Whewell*; and with regard to the last part, the misuse of words is Dr. Falconer's. I am not speaking of any inference from the principle, but of the principle itself.

But the most curious proof that Dr. Falconer has not taken the trouble to read with attention or think over carefully the statements contained in my abstract is yielded by the passage at p. 480, beginning, "Mr. Huxley contrasts the two as opposite dogmas." Dr. Falconer here takes two parts of the same argument, thrusts them into opposition, and is then excessively puzzled to discover that he can find no "opposition or incompatibility" between them. However glad I may be to have Dr. Falconer's testimony to the connexion of the two parts of my argument, even *malgré lui*, I think he would have done well to have read the passage twice before entangling himself in it.

Dr. Falconer writes at p. 490:—

"This invariable coincidence may be, as has been shown above, either *empirical* or *necessary*. Cuvier, like a true interpreter of nature, employed both indifferently in his restorations, accordingly as they were presented to him, and professed it. This important fact is *nowhere* recognized by Mr. Huxley, who argues the case throughout as if Cuvier had excluded the empirical and admitted only of necessary correlations."

This is in the teeth of the passage of my abstract, which Dr. Falconer himself quotes at p. 487: "And if it were necessary to appeal to any authority save facts and reason, our first witness would be Cuvier himself, who in a very remarkable passage, two or three pages further on (Discours, pp. 184, 185), implicitly surrenders his own principle." Surely this amount of careless incorrectness is hardly venial. Surely I may quote to Dr. Falconer his own courteous words, "rarely in the history of science has confident assertion been put forward in so grave a case upon a more erroneous and unsubstantial foundation."

* Philosophy of the Inductive Sciences, vol. ii. pp. 87, 88; and again, p. 78:—"This idea of a final cause is an essential condition in order to the pursuing our researches respecting organized bodies."

Just after reproaching me at p. 482, as I conceive unjustifiably, with affirming a case to be one of Cuvier's selection, which is not so, Dr. Falconer falls into the precise error which he wrongfully attributes to me.

"Let us now take the case as put by Mr. Huxley, and suppose that the Brown and White Bears were only met with in the fossil state; but with the proviso of the other living species being known to us as at present."

What I say is, "If Bears were only known to us in the fossil state." Dr. Falconer's proviso, in fact, is the precise nullification of my argument, and yet he still ventures to quote it as mine. So again at p. 483, after discussing the Bear question, Dr. Falconer states, "Mr. Huxley next takes in hand the opposite case of the *Ungulate Herbivora*, as put by Cuvier." Dr. Falconer's assertion is inaccurate; I do *not* next take in hand the *Ungulate Herbivora*; any one who will read my abstract may see that the discussion as to the Bears, comes at the end of the argument about the Ungulata, forming not a separate question or opposite case, but part of the same.

But here as elsewhere, Dr. Falconer seems to forget the important distinction between a question of detail and one of principle. If physiological arguments are good at all in the way Cuvier put them, they must be universal in their application, in which case any exception is fatal; on the other hand if they be of limited application, before we can apply them in palæontology, we must first have ascertained to what group the subject of our studies belongs by other means, and these can only be the application of morphological laws.

I trust I have now brought forward sufficient evidence to justify my accusation of misrepresentation and misconception on Dr. Falconer's part, and I would most willingly leave the subject, were it not necessary in defence of myself and others to advert to one or two other points in Dr. Falconer's attack. In two of these, accuracy as to matters of fact is involved. The first relates to the Stonesfield Mammal, a title which has been applied as much to the Phascolotherium as to the Amphitherium. Dr. Falconer asserts, that I have been unhappy in my citation of this case, because the Amphitherium is an Insectivore, and because the Phascolotherium has fewer teeth than the Amphitherium. Candour might have led Dr. Falconer to quote a little more of Prof. Owen's opinion as to the latter animal than he does*. If he had combined careful thought with candour, he would have

* See British Fossil Mammals, pp. 55 and 56. Professor Owen especially warns us against concluding "too absolutely" that the Amphitherium "may not have combined the more essential points of the Marsupial organization" with the slighter inflection of the angle of the jaw.

perceived that inasmuch as the Phascolotherium possesses forty-eight teeth (four more than the typical number in mammals), and *has* the strongly inflexed angular process, it precisely fulfils the conditions of my argument. In point of fact, however, the number of teeth is an irrelevant consideration. The other question of fact relates to the structure of the Sloth's tooth: when Cuvier speaks of the alternation of substance in the teeth of an Ungulate animal, he obviously refers to that peculiar alternation of vertical plates of enamel, dentine and cement, which the teeth of the typical Ungulates present. A difference of structure in layers parallel to the crown of the tooth, is of course possessed by every Carnivore, and it is this kind of arrangement which the Sloth also presents. I venture to think, therefore, that this objection to my argument is like most of Dr. Falconer's, and to use his own words, "more specious than valid."

I have left untouched many points in Dr. Falconer's essay, not because they cannot be answered, but because I conceive they will answer themselves. Under this category I leave such passages as those at p. 488, the singular bad taste of which will cause Dr. Falconer, in his cooler moments, far more annoyance than they have occasioned to any one else, except his friends. But I cannot pass without more grave comment, the allusion, at p. 477, to the audience which I had the honour to address. Dr. Falconer's apparent ignorance of the nature of the Friday evening audience at the Royal Institution—one which the best men in this country approach gravely and earnestly, knowing as they do that, whatever be the "mixture" of their hearers, there is pretty sure to be among them a fair jury of their peers,—can be his sole excuse for the tone of his remarks.

BIBLIOGRAPHICAL NOTICES.

The Ferns of Great Britain, illustrated by J. E. Sowerby. *The Descriptions by* C. Johnson. London, Sowerby, 1855. 8vo.

The Ferns of Great Britain and their Allies. By Anne Pratt. London, Society for Promoting Christian Knowledge. 8vo.

The Fern-Allies, illustrated by J. E. Sowerby. *The Descriptions by* C. Johnson. London, Sowerby, 1856. 8vo.

British Poisonous Plants. By C. Johnson. London, Sowerby, 1856. 12mo.

It has seemed more convenient to notice the above books conjointly, for the first three of them treat upon the same subject. Our pages (xv. 354) have already contained a recommendation of Sowerby's 'Ferns' to the favourable consideration of botanists, and we should not have thought it necessary to record the fact, that its proprietor has issued an edition with uncoloured plates at a very cheap rate, had it not come to our knowledge that this determination was caused by the publication by the 'Society for Promoting Christian Knowledge' of the book that stands second on the above list. It really does seem to us that a 'religious' Society goes much out of its way when it employs the funds of its subscribers in the issue of books of a secular character, and thus becomes a 'publishing house,' in competition with men who have to gain their bread by their business. But the matter becomes far worse when the book published is such as that before us. Here we have a work illustrated by numerous plates, nearly all the magnified portions of which, with the entire figures of some of the plants, are badly, but certainly copied from the plates contained in Sowerby's work. We have taken some trouble in the examination of this piratical act, and find that of those figures which Sowerby cannot claim, a considerable number are derived from Newman's 'Ferns.' There is not the slightest acknowledgement on the part of the Society, nor of the artist, that such is the origin of these plates; and we are informed that it was only after legal proceedings had been threatened that the Society, with some difficulty, consented to insert the following notice in future copies of their book, and Sowerby obtained payment for the use of his plates:—

"Copy of Notice.—The artist also wishes it to be understood, that he has purchased permission of Mr. J. E. Sowerby, to copy from the work lately published by him, entitled 'The Ferns of Great Britain, Illustrated,' certain details of the plates, including the figure of the rare plant *Gymnogramma leptophylla*."

This notice gives a very faint idea of the extent to which he is indebted to Sowerby, and takes no notice of his appropriations from Newman. We have entered rather fully into this matter, because we believe that neither the authoress nor the leading members of the Society have any idea of the mode in which their "Committee of General Literature" is acting towards authors and publishers. That they should require the threat of legal proceedings to perform an act of common honesty, is more than we can easily believe.

But enough of this. The public benefit by the issue of the cheap edition of Sowerby's 'Ferns.'

The Society's book makes no pretensions to a scientific character, and will probably fulfil the objects of its writer; but it is certainly not a work that we can recommend to persons desiring to acquire any except the most superficial knowledge of the plants.

Messrs. Sowerby and Johnson's 'Fern-Allies' contains 31 plates, and is intended to be a companion to their 'Ferns.' It treats of the *Equisetaceæ, Lycopodiaceæ, Marsileaceæ* and *Characeæ*. The plates are mostly good; but exception must be made of several of those representing the *Characeæ*, and a few others. That of *Equisetum limosum* is not like either of the forms, or, as Fries thinks them, species, included under that name; it appears to be a combination of the two, such as we have never seen in nature. No figure is given of the typical form of *E. variegatum*. There is a good plate of *E. Moorei*, a plant of which the specific distinctness is doubtful.

We have very slight acquaintance with it, but fancy that it will prove to be a form of the *E. trachyodon* (A. Br.), which is the *E. Mackaii* (Newm.).

The genus *Chara* seems to have been added to this book unadvisedly; for neither the artist nor the describer appears to know much about the plants included in it. Most of the plates are copied from those in 'English Botany,' or its 'Supplement;' but these are not all therefore good, for that of *C. vulgaris*, taken from an early volume of 'Eng. Bot.,' is very poor.

The new plates profess to represent *C. syncarpa* and *C. prolifera*, the other five species described in Mr. Babington's Monograph (A. N. H. ser. 2. vol. v. p. 81) remaining unfigured in any English work. The plate of *C. syncarpa* is tolerable, and might have passed without notice had not a piece of some totally different plant, perhaps *C. polysperma*, been added at the foot. Certainly *C. syncarpa* never has the many-jointed stems there represented. As we do not know from which plant the magnified nucules were taken, their value is greatly reduced. In all probability the two entire nucules were derived from the wrong plant, and the highly magnified piece of stem is similarly erroneous. We must be allowed to doubt the correctness of Mr. Johnson's remark, that *C. syncarpa* is sometimes monœcious.

The other new plate is a fair representation of *C. prolifera*, although the jointed structure of the primary branches is not shown. We may remark, that Mr. Wilson's *C. gracilis* from Llyn Idwell is stated in the above-mentioned Monograph to be *C. syncarpa*, and that authentic specimens now before us confirm that statement. Mr. Johnson therefore must not think that he has disproved the permanency of the monœcious structure in *C. gracilis*.

The 'British Poisonous Plants' deserves our approbation, being good as far as it goes. The 28 plates are transferred from 'English Botany,' and are therefore all, or nearly all, that could be desired. The recent cases of accidental poisoning with the root of Monkshood is the especial cause of its publication. It would have been well if a figure of the root of this plant, and that of the Horse-radish, for which it was mistaken, had been given; for at the season when such mistakes are liable to occur, neither leaves nor flowers exist, and they can only be guarded against by making generally known the differences between the roots.

We hope that this little book will obtain an extensive circulation.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

June 12, 1855.—W. Yarrell, Esq., in the Chair.

On a New Species of the Genus Prion. By John Gould, F.R.S.

Through the kindness of Mr. Yarrell, I have the pleasure of bringing to the Meeting a bird which I conceive to be a new species of *Prion,* captured on the island of Madeira, or on the neighbouring rocky islets called the Desertas. I also exhibit five other species (forming part of my own collection), which I consider to belong to the same beautiful group, and which were captured by myself during my voyages to or from Australia.

The entire series present a great similarity in the colour of their plumage, but a great diversity in the breadth or lateral development of their mandibles, as well as in the fringe-like pectinations of the base of the upper mandible; this latter character being much more prominent in the larger than in the smaller species of the group, in which, indeed, it is almost obsolete, if not entirely absent. I consider the members of this genus to constitute a very distinct group among the Petrels, quite equal in point of interest and value to that of the *Thalassidromæ.* I have had many opportunities of observing the whole of them in their oceanic haunts, and did not fail to observe that every five or six degrees of latitude was frequented by a different and distinct species: they all inhabit the wide ocean, and rarely visit the land except for the purpose of incubation: they are often seen in immense flocks, and sometimes in multitudes: they never mount high in the air, but are altogether the most light, buoyant and fairy-like members of the great group to which they belong: their great stronghold is the temperate latitudes of the southern ocean, and until the occurrence of the present new species, I have never heard of one being found north of the equator. The species to which the Madeiran bird is most nearly allied, is that to which I have given the name of *P. Ariel,* and which I met with and shot in great numbers in Bass's Straits. It differs, however, in being smaller in all its admeasurements, in having a shorter, more swollen or robust bill, particularly with reference to the nostrils and the terminal hook of the upper mandible. For this new species I propose the name of

Prion brevirostris.

Upper surface delicate blue; edge of the shoulder, the scapularies, outer margins of the external primaries and the tips of the middle tail-feathers black; lores, sides of the head and all the under surface white, stained with blue on the flanks and under tail-coverts; bill light blue, deepening into black on the sides of the nostrils and at the tip, and with a black line along the side of the under mandible; feet light blue, the interdigital membrane flesh-colour.

Total length, $10\frac{1}{2}$ inches; bill, $\frac{15}{16}$; wing, $6\frac{5}{8}$; tail, $3\frac{1}{2}$; tarsi, $1\frac{1}{4}$.

Descriptions of some new Species of Ant-Thrushes (Formicariinæ) from Santa Fé di Bogota. By Philip Lutley Sclater, M.A., F.Z.S.

1. Grallaria hypoleuca.

G. supra ferruginea, loris albidis: subtus alba, lateribus magis cinerascentibus: tibiis et hypochondriis brunnescentibus.

Long. tota 6·5, alæ 3·5, caudæ 1·8.

The collection of the Jardin des Plantes at Paris contains the only example I have yet seen of this bird, which appears to have escaped the notice of the French ornithologists. It is marked as having been received from Bogota in 1843 by M. Rieffer. Its form is typical, but in colouring it differs from all hitherto known members of the genus, though perhaps showing some resemblance to *Grallaria brevicauda* (Bodd.) (Pl. Enl. 706. fig. 1), which is, however, much smaller. It is of a uniform ferruginous brown above and white below, passing into a cinereous tinge on the sides. Some brown colour is mixed with the feathers on the sides of the breast. The bill is black, the tarsi plumbeous; the thighs and the under wing-coverts brown.

2. Grallaria modesta.

G. supra intense brunnescenti-olivacea, alis caudaque nigricanti-brunneis olivaceo tinctis: subtus olivacea, flavescenti-albido flammulata; ventre medio flavescenti-albido: tectricibus sub-alaribus pallide castaneis: mandibula superiore plumbea, hujus apice et tomiis et mandibula inferiore, nisi basi, albicantibus: pedibus pallide brunneis.

Long. tota 6·2, alæ 3·2, caudæ 1·8, tarsi 1·75.

This is a rather uniformly-coloured species, of which the British Museum contains a single specimen. There are indications of darker marginations to the feathers of the nape and back. The breast feathers are medially yellowish-white, broadly margined with olivaceous.

3. Chamæza mollissima.

C. supra brunneo-castanea, remigibus rectricibusque intus nigricantibus: capitis lateribus et corpore toto subtus nigris, albo dense transvittatis: uropygii plumis laxis, elongatis, densissimis: rostro Chamæzæ marginatæ *simili sed minore.*

Long. tota 5·75, alæ 3·2, caudæ 2·5.

This peculiar Ant-thrush, of which there is one specimen in the British Museum, has the lower back very densely feathered, the coverts reaching to within an inch of the end of the rectrices. The wings are shorter than is usual in *Chamæza*—the 4th, 5th, 6th and 7th primaries being nearly equal in length, but the 5th rather the longest; the tail rather more lengthened; the formation of the feet is much the same.

Above the colouring is of a brown chestnut, rather darker towards the tail; the sides of the head and whole under-plumage are blackish barred with white, every feather having three or more transverse white bars. A slight tinge of castaneous is intermixed, particularly on the breast.

4. Formicivora callinota.

F. olivacea; pileo summo et nucha nigris: loris, capitis lateribus, et corpore subtus ad imum pectus cinereis: abdomine pallide flavicanti-viridi: tergo læte castaneo, pennis quibusdam nigris supra marginato: alis nigris, carpo et tectricum marginibus flavis: secundariis et rectricibus olivaceo marginatis: rostro *subulato, mandibula superiore nigricante, inferiore pallide plumbea : pedibus plumbeis.*

Long. tota 4·0, alæ 2·0, caudæ 1·7.

This is an exceedingly pretty species of *Formicivora*, distinguished by the bright chestnut colouring of its lower back, above which, in the middle of the back, are a few black-tipped feathers, forming a small black patch. It must be placed next to the Brazilian *Formicivora maculata*, (Max.) (*Leptorhynchus striolatus*, Menetries, Mém. de l'Ac. St. P. 1835, pl. 10. fig. 2*), with which it agrees in form and style of plumage. A single example of it is in the British Museum.

5. Dysithamnus semicinereus.

♂ *cinereus, pileo intensiore ; subtus medialiter albicantior : dorso postico et remigum marginibus cum ventre imo olivascentibus : tectricibus alarum tenuissime albo limbatis : rostro pedibusque nigris.*

♀ *olivacea, pileo rufescente : gutture medio albo, lateraliter cinerascente : ventre flavicanti-olivaceo ; mandibula inferiore basi albicante.*

Long. tota 4·5, alæ 2·4, caudæ 1·6.

In this apparently new *Dysithamnus*, of which the British Museum contains several specimens, the cinereous colour in the male occupies the whole upper plumage down to the middle of the back, where it gradually passes into olive, and the whole lower plumage down to the middle of the belly, where a like colour supervenes. The middle of the body beneath is much paler. The bill is rather longer than in *D. mentalis*, but the form is otherwise the same. The genus to which this bird belongs is certainly very closely connected with *Thamnophilus*, but I doubt whether that form can be divided even as a subfamily from the South American Ant-thrushes.

6. Pyriglena tyrannina.

♂ *nigricanti-cinereus, carpo summo et alarum tectricum marginibus albis : plaga dorsi medii interna nivea : subtus paulo pallidior, rostro et pedibus nigris.*

♀ *pallide brunnea, rufescente tincta ; abdomine toto clare rufo : mandibula inferiore, nisi apice alba.*

Long. tota 5·2, alæ 2·5, caudæ 2·25.

A series of specimens in the British Museum clearly connect the somewhat dissimilar male and female of this species, which it is difficult to place satisfactorily in any of the present established genera of this family as far as I am acquainted with them, though without doubt a member of the group, with somewhat of a Tyrannine aspect. The characteristic white patch underneath the feathers of the back is well marked in both sexes.

* M. Menetries has made this bird a second species of his genus *Leptorhynchus*, but I do not think it can be satisfactorily arranged along with the peculiar form which he has made the type of his genus ; and the name *Leptorhynchus* being preoccupied, I propose to change it into *Psilorhamphus*. Type *P. guttatus*, mihi. (*Leptorhynchus guttatus*, Men. pl. 10. fig. 1.)

June 26, 1855.—Dr. Gray, F.R.S., in the Chair.

Descriptions of some New Species of Birds from Santa Fé di Bogota. By Philip Lutley Sclater, M.A.

1. Nemosia albigularis.

N. nigra: dorso postico crissoque cum macula collari utrinque et plumis narium quibusdam aurantio-flavis: speculo alari albo: subtus alba pectoris et laterum plumis partim intus nigro vittatis: rostro supra nigricante, subtus carneo: pedibus nigris.

Long. tota 4·2, alæ 2·5, caudæ 1·8.

This is a close ally of *Nemosia flavicollis* (Vieill.), from which, however, it may be at once distinguished by its white throat, the yellow colour being confined to a patch on the side of the neck. The spot above the nostrils and orange tint of the yellow are other differences which serve to confirm the validity of this species. There are examples of it in the British Museum and in Mr. Gould's collection and my own.

2. Pyriglena Ellisiana.

P. fusco-castanea unicolor: facie, mento et regione auriculari cum cauda nigricantibus: rostro nigro, mandibula inferiore, nisi ipsa tomia basique, alba.

Long. tota 7·0, alæ 3·3, caudæ 3·1.

The only specimen I have seen of this species was received by Lady Ellis in a collection of birds from Bogota, and presented by her to the British Museum. At the request of Mr. G. R. Gray, I have named it after the donor. The form is nearly that of *P. domicella*, but there is no sign of a white, subinterscapular spot, as is general in the species of this genus. The tail-coverts are very thick. The plumage is of a nearly uniform cinnamon-brown, brighter above, and with a greenish gloss on the breast. The front, sides of the head, throat and tail are black.

3. Anthus bogotensis.

A. pennis corporis superi medialiter nigris pallido cervino-brunneo late marginatis: alis intus nigris; primariis stricte, secundariis autem et tectricibus pallido cervino-brunneo late marginatis: rectricibus nigris; una utrinque extima, nisi pogonii interioris parte basali, tota pallide alba, brunnescente tincta; cæteris extus et duabus mediis utrinque cervino-brunneo anguste limbatis: capitis lateribus et corpore toto subtus pallide cervino-brunneis, ventre crissoque albescentioribus; pectoris lateribus et collo antico punctis paucis triangularibus nigris, quasi torquem formantibus, notatis: rostro nigro, mandibula inferiore basi flavido: pedibus validis, flavis: ungue postico valde elongato.

Long. tota 5·0, alæ 3·2, caudæ 2·3.

This is the only bird of the nearly universally distributed family of Pipits I have seen from Bogota, and appears distinct from any species previously noticed. The bill is rather larger, and the feet stronger and thicker than in the ordinary members of the genus. Above, the plumage is of the usual pale brownish fawn-colour, thickly clouded with black, caused by the feathers being broadly margined on each side with the fawn-colour. The sides of the head and under-plumage are uniform, except on the sides of the breast and across the neck, where there are small black triangular spots in the centre of some of the feathers. The under wing-coverts are pure pale buff; the middle of the belly and crissum lighter and nearly whitish.

4. Otocorys peregrina.

Otocoris chrysolaimos, Bp. Att. Sc. It. 1845, p. 405 (nec Wagl.).

O. supra grisescenti-brunnea, rufo tincta; pennis nigro variegatis: fronte, facie gulaque flavis, loris et regione auriculari et vitta transversa verticis cum plaga magna superpectorali nigris: abdomine crissoque et tectricibus alarum inferioribus albis, pectore et lateribus rufescenti-griseo mixtis: alis nigricantibus; primariis albido, secundariis rufescenti-griseo, tectricibus majoribus rufo limbatis; tectricibus summis pure rufo-brunneis, pæne castaneis: cauda nigricante; rectrice una utrinque extima late, secunda autem versus apicem solum et angustius albo limbata; duabus mediis rufescenti-griseo utrinque late marginatis: tectricibus caudæ superioribus basi rufis: rostro nigro, mandibula inferiore basi alba: pedibus intense brunneis.

Long. tota 5·5, alæ 3·8, caudæ 2·4.

I have had an example of this bird in my possession several years, but have always considered it the same as Wagler's *O. chrysolæma*, with which it has been identified by Prince Charles Bonaparte. Having however lately obtained specimens of the Mexican species, I find the Bogota bird presents such differences as to render its specific isolation necessary. It is rather smaller than the former, the tai i s shorter, the bill longer and more curved, and the back has more black upon it. But the chief peculiarity to be remarked in my specimen (which is not quite adult) is the pure red-brown colour of the upper wing-coverts, which in the Mexican bird are lighter, paler, and more pinky. There are many examples of this species in the Paris Museum, in the collection recently transmitted from Bogota by M. Lewy, the French consul there. I have no doubt fully mature individuals will exhibit still further differences.

ROYAL INSTITUTION OF GREAT BRITAIN.

May 2, 1856.—The Duke of Northumberland, K.G., F.R.S., President, in the Chair.

"On the Ruminant Quadrupeds and the Aboriginal Cattle of Britain." By Prof. Owen, F.R.S.

The speaker introduced the subject of the Ruminant order of quadrupeds, and the source of our domesticated species, by some general remarks upon the classification of the class *Mammalia*, and on the characters of the great natural group defined by Ray and Linnæus as the *Ungulata*, or hoofed mammalia.

These are divisible into two natural and parallel orders, having respectively the *Anoplotherium* and *Palæotherium* as their types; which genera, as far as geological researches have yet extended, were the first, or amongst the earliest, representatives of the *Ungulata* on this planet.

The brilliant researches of Baron Cuvier, the founder of palæontological science and the reconstructor of those primæval hoofed animals, from fragmentary fossil remains in the gypsum quarries at Montmartre, were alluded to.

Diagrams of the entire skeletons of the Anoplotherium and Palæotherium were referred to, in illustration of their dental and osteological peculiarities.

The *Anoplotherium*, with the typical dentition of

$$\textit{incisors}\ \frac{3-3}{3-3},\ \textit{canines}\ \frac{1-1}{1-1},\ \textit{premolars}\ \frac{4-4}{4-4},\ \textit{molars}\ \frac{3-3}{3-3} = 44,$$

had all its teeth of the same length, and in a continuous unbroken series: this character is peculiar to Man in the existing creation. The *Palæotherium*, with the same dental formula as the *Anoplotherium*, had the canines longer than the other teeth, and developed into sharp-pointed weapons; necessitating a break in the dental series to receive their summits in closing the mouth.

The Anoplotherium had 19 vertebræ between the neck and sacrum, viz. 13 dorsal and 6 lumbar. The Palæotherium had 16 dorsal and 7 lumbar vertebræ.

The Anoplotherium had a femur with two trochanters, and the fore-part of the ankle-bone, called "astragalus," divided into two equal facets. Its hoofs formed a symmetrical pair on each foot. Cuvier has very justly inferred that its stomach must have been complex, and probably, in some respects, like that of the Camel or Peccari. The Palæotherium had a femur with three trochanters, an astragalus with its fore-part unequally divided, and hoofs, three in number, on each foot. It most probably had a simple stomach, like the Tapir and Rhinoceros, which, amongst existing animals, most nearly resemble that extinct primitive hoofed quadruped, with toes in uneven number.

Every species of ungulate mammal with an uneven number of hoofs or toes, that has been introduced into this planet since the eocene tertiary period, whether it have 1 hoof on each foot, as in the Horse, 3 as in the Rhinoceros, or 5 as in the Elephant, resembles the Palæotherium in having more than 19 dorso-lumbar vertebræ, which vertebræ also differ in number in different genera; *e.g.* 22 in the Rhinoceros, 23 in the Mastodon, 27 in the Hyrax. The typical Pachyderms, with an odd number of hoofs, have also three trochanters on the femur, the fore-part of the astragalus unequally divided, and the pattern of the grinding surface of the molar teeth unsymmetrical, and usually crossed by oblique enamel-ridges. All the existing odd-toed or perissodactyle mammals have a simple stomach and a vast and complex cæcum; the horned species have either a single horn, or two odd horns, one behind the other on the middle line of the head, as *e.g.* in the one-horned and two-horned Rhinoceroses.

Every species of ungulate animal with hoofs in even number, whether 2 on each foot, as in the Giraffe and Camel, or 4 on each foot, as in the Hippopotamus, resembles the Anoplotherium in having 19 dorso-lumbar vertebræ, neither more nor less; in having two trochanters on the femur, in having the fore-part of the astragalus equally divided, and in having the pattern of the grinding surface of the molar teeth more or less symmetrical. The horned species have the horns in one pair, or two pairs. All have the stomach more or less complex, and the cæcum small and simple. In the Hog the gastric complexity is least displayed; but in the Peccari the stomach has three compartments; and in the Hippopotamus it is still more complex. But the most complex and peculiar form of stomach is that which enables the animal to "chew the cud," or submit the aliment to a second mastication, characteristic of the large group of even-hoofed *Ungulata*, called "*Ruminantia*."

These timid quadrupeds have many natural enemies; and if they had been compelled to submit each mouthful of grass to the full extent of mastication which its digestion requires, before it was swallowed, the grazing ruminant would have been exposed a long time in the open prairie or savannah, before it had filled its stomach. Its chances of escaping a carnivorous enemy would have been in a like degree diminished. But by the peculiar structure of the ruminating stomach, the grass can be swallowed as quickly as it is cropped, and be stowed away in a large accessory receptacle, called the "rumen," or first cavity of the stomach; and this bag being filled, the ruminant can retreat to the covert, and lie down in a safe hiding-place to remasticate its food at leisure.

The modifications of the dentition, œsophagus, and stomach, by which the digestion in the Ruminantia is carried out, were described and illustrated by diagrams.

The speaker next treated of the various kinds of horns and antlers; the manner of growth, shedding, renewal, and annual modifications of the deciduous horns, the peculiarities of the persistent horns, the mechanism of the cloven foot, and the provision for maintaining the hoofs in a healthy condition, were pointed out.

The following were the chief varieties of the ruminating stomach. In the small Musk-deer (*Tragulus*) there are three cavities, with a small intercommunication-canal between the second and last cavity; the "psalterium," or third cavity, in the normal ruminating stomach, being absent. This cavity is likewise absent in the Camel-tribe, which have the cells of the second cavity greatly enlarged, and have also accessory groups of similar cells developed from the rumen, or first cavity. These cells can contain several gallons of water. The relation of this modification, and of the hump or humps on the back, to the peculiar geographical position of the Camel-tribe, was pointed out.

The modifications of the ruminating stomach; the discovery of rudimental teeth in the embryo *Ruminantia*, which teeth (upper incisors and canines) have been supposed to characterize the Pachyderms; the occurrence of another alleged pachydermal character, viz. the divided metacarpus and metatarsus, in the fœtus or young of all ruminants, and its persistence in the existing *Moschus aquaticus*, and in a fossil species of Antelope; the absence of cotyledons in the chorion of the Camel-tribe, with the retention of some incisors as well as canines in the upper jaw of that tribe; the ascertained amount of visceral and osteological conformity of the supposed circumscribed order

Ruminantia, with the other artiodactyle (even-toed) Ungulata; above all, the number of lost links in that interesting chain which have now been restored from the ruins of former habitable surfaces of the earth—all these and other similar facts have concurred in establishing different views of the nature and value of the Ruminant order from those entertained by Cuvier, and the majority of systematic naturalists up to 1840. Thus instead of viewing the *Anoplotherium* as a pachyderm, the speaker, having regard to the small size of its upper incisors and canines, to the retention of the individuality of its two chief metacarpal and metatarsal bones, and to the non-development of horns at any period of life, would regard it rather as resembling an overgrown embryo-ruminant—of a ruminant in which growth had proceeded with arrest of development. The ordinal characters of the Anoplotherium are those of the *Artiodactyla*. On the other hand, instead of viewing the Horse as being next of kin to the Camel, or as making the transition from the Pachyderms to the Ruminants, the speaker had been led, by considerations of its third trochanter, its astragalus, its simple stomach and enormous sacculated cæcum, the palæotherian type of the grinding surface of the molars, and the excessive number of the dorso-lumbar vertebræ, to the conviction of the essential affinities of the *Equidæ* with other perissodactyles (odd-toed hoofed beasts).

The primitive types of both odd-toed and even-toed Ungulates occur in the eocene tertiary deposits: the earliest forms of the ruminant modification of the *Artiodactyla* appear in the miocene strata. The fossil remains of the aboriginal cattle of Britain have been found in the newer pliocene strata, in drift-gravels, in brick-earth deposits, and in bone-caves. Two of these ancient cattle (*Bovidæ*) were of gigantic size, with immense horns; one was a true Bison (*Bison priscus*), the other a true Ox (*Bos primigenius*); contemporary with these were a smaller species of short-horned Ox (*Bos longifrons*), and a Buffalo, apparently identical in species with the Arctic Musk-buffalo (*Bubalus*, or *Ovibos, moschatus*).

The small Ox (*Bos longifrons*) is that which the aboriginal natives of Britain would be most likely to succeed in taming. They possessed domesticated cattle (*pecora*) when Cæsar invaded Britain. The cattle of the mountain fastnesses to which the Celtic population retreated before the Romans, viz. the Welsh "runt" and Highland "kyloe," most resemble in size and cranial characters the pleistocene *Bos longifrons*. Prof. Owen therefore regards the *Bos longifrons*, and not the gigantic *Bos primigenius*, as the source of part of our domestic cattle.

From the analogy of colonists of the present day he proceeded to argue that the Romans would import their own tamed cattle to their colonial settlements in Britain. The domesticated cattle of the Romans, Greeks, and Egyptians bore the nearest affinity to the Brahminy variety of cattle in India. As the domestic cattle imported by the Spaniards into South America have, in many localities, reverted to a wild state, so the speaker believed that the half-wild races of white cattle in Chillingham Park, and a few other preserves in Britain, were descended from introduced domesticated cattle. The size of the dewlap, and an occasional rudiment of the hump in these white cattle, as well as the approximation to the light-grey colour characteristic of the Brahminy race, seemed to point to their primitive oriental source. But the speaker could not regard the pure white colour as natural to a primitive wild stock of oxen. It is now maintained by the careful destruction of all piebald calves that are produced by the so-preserved half-wild breeds.

If the blood of any of the aboriginal cattle, contemporary with the Mammoth and hairy Rhinoceros, still flowed in the veins of any of our domesticated races, he thought it would be that of the *Bos longifrons* transmitted through the short-horned or hornless varieties of the oxen of the mountains of Wales and Scotland.

In conclusion the speaker referred to the subjoined table of the classification of recent and extinct hoofed quadrupeds, as indicative of the progressive extinction of those forms of *Ungulata* least likely to be of use to man, and of the substitution of the ruminant forms, which, from the perfect digestion of their food, elaborate from it the most sapid and nutritious kinds of flesh.

UNGULATA.

Typica.		*Aberrantia.*	
ARTIODACTYLA*.	PERISSODACTYLA†.	TOXODONTIA.	SIRENIA.
Anoplotherium.	Palæotherium.	Toxodon.	*Manatus.*
Chalicotherium.	Paloplotherium.	Nesodon.	*Halicore.*
Dichobune.	Lophiodon.		Rytina.
Cainotherium.	Coryphodon.	PROBOSCIDIA.	Halitherium.
Poebrotherium.	*Tapirus*‡.	*Elephas.*	Prorastomus.
Xiphodon.	Macrauchenia.	Mastodon.	
Moschus‡.	Hippotherium.	Dinotherium.	
Antelope.	*Equus.*		
Ovis.	Elasmotherium.		
Bos.	*Hyrax.*		
Cervus.	*Rhinoceros.*		
Camelopardalis.	Acerotherium.		
Camelus.			
Auchenia.			
Merycotherium.			
Merycopotamus.			
Hippopotamus.			
Dichodon.			
Hyracotherium.			
Hyopotamus.			
Anthracotherium.			
Hippohyus.			
Chœropotamus.			
Dicotyles.			
Phacochœrus.			
Sus.			

* Ἄρτιος, *par*; δάκτυλος, *digitus*.

† Περισσοδάκτυλος, *qui digitos habet impares numero.*

‡ Only those genera printed in *italics* now exist.

BOTANICAL SOCIETY OF EDINBURGH.

April 10th, 1856.—Professor Balfour, V.P., in the Chair.

The following papers were read:—

1. "Remarks on the State of the Forests in Pegu, and other parts of India," by Dr. M'Clelland.

The statements in this communication were taken from Dr. M'Clelland's Report, as given in a Madras paper. That report, taken in connexion with Dr. Falconer's report on the forests of the Tenasserim provinces, and Dr. Cleghorn's on the forests of Madura and Malabar, prove—

1. That the forests of Southern India and Pegu are approaching rapidly to exhaustion. 2. That the first step necessary to check this process is a more effective organization of the forest department of the government of India. Instances are recorded in the Tenasserim provinces of the indiscriminate felling of teak trees of all ages. Trees with a straight bole of 100 feet, and trees with the wood not yet hard, were all hewn down alike. In some forests the axe never ceased for twenty years. In others, every teak tree was removed. In Malabar the destruction had not been so extensive, and steps had been taken to prevent the further deterioration of the forests.

In Pegu, it appears that the Burmese Government and the squatters have overworked the forests in a most reckless manner. Trees of all sizes and ages were allowed to be cut, and it was stated that upwards of 70 per cent. of the trees cut were under-sized. In some places the forests have been worked unceasingly for thirty years. Exclusive of trees felled or killed, there remain in the northern forest about 520,000 teak trees, which at the utmost will allow thinning to the extent of 25,000 trees a-year. This number will soon be exceeded, and the forests will thus speedily disappear, unless measures are taken for the renewal of the trees, which it is not the interest of the lessees to provide for.

The conservancy of the valuable forests in India is a matter of great importance, and calls for the immediate attention of the Indian Government. Steps have already been taken in some of the Presidencies, but much still remains to be done in order to secure that the timber of these extensive forests shall be preserved and turned to good account.

2. "Remarks on some Edible Sea-weeds," by Dr. Davy.

This paper detailed some experiments on *Chondrus crispus*, or Carrageen; *Rhodymenia palmata*, or Dulse; *Porphyra laciniata*, or Laver; *Laminaria digitata*, or Tangle; and *Fucus vesiculosus*, or Doughlaghman. The author showed from the chemical composition of these sea-weeds that they were valuable articles of food, containing more nitrogen than is present in the ordinary articles of vegetable food.

3. "On Fibrous Substances used in India, as communicated in the Report of the Jurors of the Madras Exhibition."

The Jurors report that it has been shown that Southern India is abundantly supplied with fibrous materials of every description for textile manufactures.

Among the Endogenous plants of India yielding fibre, are noticed species of Palms, *Agave, Yucca, Sanseviera, Fourcroya, Ananassa, Musa, Pandanus,* Rushes, Grasses, and Sedges; among Exogenous plants are species of *Calotropis, Tylophora, Cryptostegia, Damia, Cannabis, Corchorus, Crotalaria, Hibiscus, Abelmoschus,* and *Abutilon*; besides the barks of species of *Ficus, Bauhinia, Grewia, Dalbergia, Isora, Butea,* and *Vernonia.* Among the Palms are *Cocos nucifera,* the Cocoa-nut Palm; *Borassus flabelliformis,* the Palmyra Palm of Europeans; *Elate* or *Phœnix sylvestris,* the wild Date; *Caryota urens,* or the Indian Sago Palm; *Calamus Rotang,* or ground Rattan. Among Liliaceous plants may be recorded: *Agave americana,* American Aloe, and varieties; *Fourcroya gigantea,* Seemay Kathalay; *Sanseviera zeylanica,* Marool; *Yucca gloriosa,* Adam's Needle; *Y. aloëfolia*; *Ananassa sativa,* Pine Apple. Of Pandanaceæ and Musaceæ: *Pandanus odoratissimus,* or Screw Pine; *Musa paradisiaca,* or Plantain, and *Musa sapientum,* or Banana.

Substitutes for flax and hemp are found in the following Dicotyledons:—*Calotropis gigantea,* or Yercum; *Cryptostegia grandiflora,* or Palay; *Damia extensa,* or Ootrum; *Crotalaria juncea,* or Sunnee Hemp; *Corchorus olitorius,* or Jute; *Hibiscus cannabinus,* and other species; *Abelmoschus esculentus* and *ficulneus*; *Abutilon tomentosum* and *polyandrum.*

4. "Notice of the Flora of the Cumbrae Islands," by Professor Balfour.

The Cumbrae Islands are situated on the Frith of Clyde, between the coast of Ayrshire and the Island of Bute. In their geological structure, as well as in their flora, they present many points of affinity with the latter island. Red sandstone, with limestone and trap, constitute the chief rocks of the Cumbraes. The rarer plants are found on the rocky grounds near the shores. The species are in general those which characterize the western parts of Scotland. The climate is mild, and some species are met with which are usually considered characteristic of more southern situations. The Great Cumbrae is about three miles long and one and a half broad; its surface embraces about 2500 acres, one-half of which is arable. The land rises in the centre of the island to about 400 feet. It consists of a mass of red sandstone traversed by trap veins, some of which form very conspicuous dykes. In some parts of the island, limestone occurs.

The Little Cumbrae lies about half a mile south of the Great Cumbrae. It is about a mile in length and half a mile in breadth. It is composed chiefly of trap, with here and there portions of sandstone.

The Phanerogamous plants seen by Dr. Balfour and his party amounted to about 420; viz.—

Dicotyledones	314
Monocotyledones	106
Total	420

Among the more interesting of these may be enumerated the following:—

Brassica monensis (on the sandy shores).
Sagina subulata.
Malva moschata.
Hypericum Androsæmum.
Geranium sanguineum.
Radiola Millegrana.
Rubus discolor.
Lythrum Salicaria.
Cotyledon Umbilicus.
Sedum Telephium.
Carum verticillatum.
Conium maculatum.
Eryngium maritimum (northern shores of the Great Cumbrae).
Haloscias scoticum.
Helosciadium inundatum.
—— nodiflorum.
Œnanthe Lachenalii.
Dipsacus sylvestris (naturalized).
Hieracium gothicum.
—— vulgatum.
Jasione montana.
Calluna vulgaris (var. tomentosa).
Pyrola media.
Erythræa littoralis.
Convolvulus Soldanella (sandy northern shores of the Gt. Cumbrae).
Mertensia maritima (western shore of the Great Cumbrae).
Solanum Dulcamara.
Hyoscyamus niger.
Linaria vulgaris.
Lamium intermedium.
Lycopus europæus.
Scutellaria galericulata.
Stachys ambigua.
Pinguicula lusitanica.
Utricularia minor.
—— vulgaris.
Anagallis tenella.
Samolus Valerandi.
Littorella lacustris.
Atriplex Babingtonii.
—— erecta.
Salicornia herbacea.
Suæda maritima.
Polygonum Raii.
Rumex viridis.
Habenaria viridis.
Listera cordata.
—— ovata.
Juncus maritimus.
Alisma ranunculoides.
Zostera marina, var. angustifolia.
Carex extensa.
—— paniculata.
—— vulpina.
Eleocharis uniglumis.
Schœnus nigricans.
Scirpus maritimus.
Catabrosa aquatica, var. minor.
Festuca arundinacea.
—— Pseudo-Myurus.
Melica uniflora.
Phalaris arundinacea, var. picta.
Sclerochloa maritima.
Triticum laxum.

The number of Ferns and their allies is—

Equisetaceæ	4
Filices	20
Lycopodiaceæ	3
Total	27

The proportion of Ferns, as compared with Phanerogamous plants, is large. Among the more interesting of these may be noticed—

Asplenium marinum.
Botrychium Lunaria.
Hymenophyllum Wilsoni.
Lastræa Fœnisecii.
Ophioglossum vulgatum.
Osmunda regalis.
Polypodium Phegopteris.
Polystichum angulare.
Scolopendrium vulgare.

The following is a list of the Cumbrae Mosses, partly determined by Mr. Nichol, and partly from a list given by Mr. Levack:—

Sphagnum cymbifolium.
—— acutifolium.
—— cuspidatum.
—— squarrosum.
Pleuridium subulatum.
Gymnostomum tenue.
Weissia controversa.
Dicranum heteromallum.
Dicranum varium.
—— cerviculatum.
—— Scoparium.
—— palustre.
Campylopus flexuosus.
Fissidens bryoides.
—— adiantoides.
—— taxifolius.
Pottia Heimii.
—— truncata.
Tortula muralis.
—— subulata.
—— unguiculata.
Didymodon rubellus.
Ceratodon purpureus.
Trichostomum homomallum.
Orthotrichum affine.
Grimmia pulvinata.
—— maritima.

Racomitrium lanuginosum.
—— canescens.
—— aciculare.
Ptychomitrium polyphyllum.
Physcomitrium ericetorum.
Entosthodon Templetoni.
Splachnum ampullaceum.
Bartramia fontana.
—— pomiformis.
Bryum capillare.
—— carneum.
Mnium punctatum.
—— undulatum.
—— hornum.
—— rostratum.
Atrichum undulatum.
Pogonatum nanum.
—— alpinum.
Polytrichum commune.
Fontinalis antipyretica.
Neckera complanata.
Pterygophyllum lucens.
Pylaisea polyantha.
Homalothecium sericeum.
Thamnium alopecurum.
Thuidium tamariscinum.
Hylocomnium splendens.
—— triquetrum.
—— loreum.
—— squarrosum.
Plagiothecium undulatum.
Eurhynchium longirostre.
—— Stokesii.
Brachythecium rutabulum.
—— velutinum.
—— populeum.
—— plumosum.
Hypnum commutatum.
—— revolvens.
—— cuspidatum.
—— scorpioides.
—— Schreberi.
—— fluitans.
—— purum.
—— cupressiforme.
Jungermannia asplenioides.
—— tamarisci.
—— furcata.

The following list of Lichens, collected on the Cumbraes, has been prepared by Mr. Macmillan :—

Nephroma resupinata (in fruit).
Parmelia caperata (barren).
—— pulverulenta.
—— parietina.
—— stellaris.
Sticta scrobiculata (barren).
Borrera tenella.
Placodium plumbeum.
Sphærophoron coralloides (in fruit).
—— compressum.
Parmelia glomulifera (barren).
—— omphalodes (in fruit).
Parmelia perlata (barren).
Cladonia rangiferina.
—— uncialis.
Roccella tinctoria.
Parmelia conspersa (in fruit).
Peltidea canina.
—— horizontalis.
Scyphophorus alcicornis.
Ramalina fraxinea.
—— fastigiata.
Parmelia saxatilis.
Lecanora tartarea.
Parmelia aquila (in fruit).
Evernia prunastri.
Usnea florida.
Squamaria murorum.
Ramalina scopulorum.
Lecidea geographica.
—— sulphurea.
Lecanora atra.
Sticta pulmonaria (barren).
Parmelia olivacea.
Variolaria velata.
Lecanora parella.
Collema lacerum.
Sticta fuliginosa (barren).
Squamaria affinis.
Parmelia perforata (barren).
Stereocaulon paschale (in fruit).

Mr. Macmillan remarked, "In the above list of the most conspicuous Lichens of these islands, it will be observed that several species occur which are usually found only in the depths of shady woods, in situations far inland. The *Parmelia glomulifera*, *Sticta scrobiculata*, *Placodium plumbeum*, *Nephroma resupinata*, and *Sticta fuliginosa*, are almost peculiar to the extensive forests of mountainous regions where there is a great deal of moisture and shade; and hence their occurrence, not merely as stray or isolated individuals, for the Lichens are sometimes very erratic in their choice of habitats, but in considerable quantities on islands almost entirely destitute of wood and very much exposed, is a somewhat singular circumstance. It is also curious to notice in the list no less than eight species, which we should scarcely expect beforehand to find, insomuch as they belong to a somewhat Alpine zone, which usually commences at a greater elevation than that of the highest ground on the islands. The region in which the *Cladonia rangiferina, Lecanora tartarea, Lecidea geographica, Sphærophoron coralloides, Parmelia omphalodes,* &c., prevail in the greatest quantity, and attain to their greatest luxuriance and beauty, commences at about 500 feet, and terminates at a height of 1000 feet or a little more. Of course, extensive patches of these Lichens may sometimes be found at much lower elevations; indeed, I have repeatedly gathered considerable quantities of each of them, but very diminutive and ill-developed, all along the west coast of Scotland in immediate proximity to the sea; but it is only within the above limits that uniformly large and perfect specimens, furnished with fructification, can be obtained. There are two Lichens occurring on these islands which are found on almost all our sea-coasts, and are never found far inland, the *Parmelia aquila* and *Ramalina scopulorum.* The former has never been found, I believe, at a greater distance from the sea than some twenty or thirty miles, and always grows on rocks fully exposed to the sea-breeze; it is found in considerable abundance on rocks so situated on Arthur's Seat. The latter lichen is peculiarly plentiful upon rocks along the west coast of Scotland, and attains a greater length and thickness in proportion as we advance northward, the Orcadian rocks being sometimes covered with individuals from six to eight inches long, and nearly one broad. The specimens obtained in the Cumbraes are among the longest and shrubbiest I have ever seen, and present a remarkable contrast to those gathered on the east coast, and especially along the Frith of Forth, where it is rare to find an individual above an inch high, and with lateral branches. The fructification is rather uncommon, and occurs, I believe, more frequently on small and well-grown individuals, than on those which attain the greatest length; the thallus, in the case of the latter, commonly developing new elongated branches at the points of the margin where apothecia ought to have been produced. The specimens found in the Western Islands differ considerably from those collected on the Irish coasts, in being much narrower, of a paler colour, and destitute of the oblong pale pitted buds, which give a rough appearance to the aged Irish plant, and also in the disk of the apothecia being of a much lighter colour, and nearly similar to the thallus. It is a very variable species, however, if species it can be truly called, presenting slight differences as regards size, colour, shape, and mode of branching, on almost every coast. I have observed in Menzies' Herbarium at the Botanic Garden, a specimen marked '*R. scopulorum*?' collected on the coast of California, which appears to me to differ very little from certain states of our native plant, except perhaps in the thallus being a little thinner, softer, and somewhat lacunose; and I possess specimens collected in New Zealand and the Antarctic regions, which, making the usual allowances for the widely different circumstances in which they were developed, may safely be referred to one or other of the numerous states of our own *R. scopulorum.*

"By far the most interesting rarity found in these islands, however, is the *Roccella tinctoria*, now for the first time ascertained to be a native of Scotland; the most northern localities previously known for it being the maritime rocks along the south coast of England, and the Guernsey, Portland, and Scilly islands. The specimens found on the Cumbraes, where I believe it occurs in pretty considerable abundance, are somewhat slender and diminutive, but remarkably characteristic. The west coast of Scotland, and especially the smaller islands, have been very little visited and explored by the botanist; and hence it is that we have remained so long ignorant of the existence of this very interesting addition to the Flora Scotica. I have no hesitation in saying, that, were a sufficiently careful and diligent search once instituted along the other smaller and less-known islands on the same coast, we should be able to record more than one locality in Scotland for the *Roccella tinctoria*. I may add, in conclusion, that the nomenclature of these Lichens is that of Hooker's English Flora. I have adopted it in preference to that of other authors, whose works are now slowly finding their way among us—not because it is the best, but because it can be more easily consulted."

The following list of Marine Algæ found on the coast of the Cumbraes was prepared by Mr. R. Hennedy:—

Halidrys siliquosa.
Fucus vesiculosus and var. balticus.
—— ceranoides.
—— serratus.
—— nodosus.
—— canaliculatus.
Himanthalia lorea.
Desmarestia aculeata.
—— viridis.
Alaria esculenta.
Laminaria digitata.
—— bulbosa.
—— saccharina.
—— phyllitis.
—— fascia.
Chorda Filum.
—— lomentaria.
Zonaria parvula.
Dictyota dichotoma and var. intricata.
Stilophora rhizodes.
—— Lyngbyii.
Dictyosiphon fœniculaceus.
Striaria attenuata.
—— fragilis.
Punctaria latifolia.
—— plantaginea.
—— tenuissima.
Asperococcus Turneri.
—— echinatus.
Litosiphon pusillus.
—— Laminariæ.
Chordaria flagelliformis.
Mesogloia vermicularis.
—— virescens.
Leathesia tuberiformis.
Ralfsia verrucosa.
Elachistea fucicola.
—— stellulata.
Myrionema strangularis.
—— Leclancherii.
—— punctiformis.
Cladostephus verticillatus.
—— spongiosus.
Sphacelaria scoparia.
—— plumosa.
—— cirrhosa.
—— radians.
—— racemosa.
Ectocarpus siliculosus.
—— Hincksiæ.
—— fasciculatus (var. tessellatus).
—— tomentosus.
—— crinitus.
—— distortus.
—— Landsburgii.
—— littoralis.
—— granulosus.
—— sphærophorus.
—— branchiatus.
—— Mertensii.
Myriotrichia clavæformis.
—— filiformis.
Odonthalia dentata.
Rhodomela lycopodioides.
—— subfusca.
Polysiphonia urceolata.
—— formosa.
—— fibrata.
—— elongella.
—— elongata.
—— fibrillosa.
—— Brodiæi.
—— nigrescens.
—— atrorubescens.
—— fastigiata.
—— parasitica.
—— byssoides.
Dasya coccinea.
Bonnemaisonia asparagoides.
Laurencia pinnatifida.
—— cæspitosa.
—— dasyphylla.
Chrysymenia clavellosa.
Chylocladia kaliformis.
—— parvula.
—— articulata.
Corallina officinalis.
Jania rubens.
Melobesia polymorpha.
—— fasciculata.
—— membranacea.
—— verrucata.
—— pustulata.
Hildenbrandtia rubra.

Lithocystis Allmani.
Delesseria sanguinea.
—— sinuosa.
—— alata.
—— Hypoglossum.
—— ruscifolia.
Nitophyllum punctatum.
—— laceratum.
Plocamium coccineum.
Rhodymenia bifida.
—— laciniata.
—— jubata.
—— palmata.
Sphærococcus coronopifolius.
Hypnea purpurascens.
Gelidium corneum.
Gigartina mammillosa.
Chondrus crispus.
Phyllophora rubens.
—— membranifolius.
—— Brodiæi.
Peyssonelia Dubyi.
Gymnogongrus plicata.
Polyides rotundus.
Furcellaria fastigiata.
Dumontia filiformis.
Iridæa edulis.
Catenella Opuntia.
Dudresnaia Hudsoni.
Ptilota plumosa.
—— sericea.
Ceramium rubrum.
—— botryocarpum.
—— strictum.
Ceramium flabelligerum.
—— nodosum.
—— echionotum.
—— acanthonotum.
—— ciliatum.
Griffithsia equisetifolia.
—— setacea.
Wrangelia multifida.
Callithamnion plumula.
—— Turneri.
—— tetragonum.
—— Hookeri.
—— polyspermum.
—— corymbosum.
—— pedicellatum.
—— Rothii.
—— floridulum.
—— Daviesii.
Bryopsis plumosa.
Vaucheria velutina.
Cladophora rupestris.
—— lætevirens.
—— albida.
—— lanosa.
—— arcta.
—— flavescens.
—— fracta.
Rhizoclonium riparia.
Conferva littorea.
—— tortuosa.
—— implexa.
—— ærea.
—— Youngiana.
Enteromorpha intestinalis.
—— compressa.
Enteromorpha ramulosa.
—— percursa.
Ulva latissima.
—— Lactuca.
—— Linza.
Porphyra laciniata.
—— vulgaris (var. linearis).
Bangia fusco-purpurea.
—— ceramicola.
—— carnea.
Rivularia plicata.
—— atra.
Schizosiphon Warreniæ.
Calothrix confervicola.
—— luteola.
—— scopulorum.
—— fasciculata.
—— frannosa.
—— hydnoides.
Lyngbya majuscula.
—— Carmichaelii.
—— speciosa.
Microcoleus angustiformis.
Oscillatoria littoralis.
—— subuliformis.
—— insignis.
Spirulina tenuissima.
—— Hutchinsiæ.
Monormia intricata.
Sphærosyga Thwaitesii.
—— Broomei.
Spermoseira littorea.

Professor Gregory examined the Diatoms, and prepared the following list of them:—

Epithemia gibba.
—— rupestris.
—— turgida.
—— Argus.
—— zebra.
—— sorex.
Cymbella maculata.
—— cuspidata.
—— Ehrenbergii.
—— turgida, *W. G.*?
—— obtusa, *W. G.*
Cocconeis placentula.
—— pediculus.
—— Thwaitesii.
—— transversalis, *W. G.*
Amphora ovalis.
Amphora minutissima.
Cyclotella Kützingiana.
Campylodiscus spiralis.
Surirella minuta.
—— pinnata.
—— biseriata.
Tryblionella apiculata, *W. G.*
Cymatopleura Solea.
Nitzschia sigmoidea.
—— amphioxys.
—— vivax.
—— minutissima.
—— linearis.
Navicula ovalis, *Sm.* (elliptica, *Kütz.*)
—— varians, *W. G.*
Navicula bacillans.
—— gibberula.
—— rhomboides, var.
—— elegans.
—— amphisbæna.
—— rhynchocephala.
—— lanceolata.
Pinnularia major.
—— Dactylus, *Ehr.*
—— viridis.
—— Tabellaria.
—— gibba.
—— peregrina.
—— viridula.
—— mesolepta.
—— divergens.
—— nodosa, *Ehr.*

Pinnularia biceps, *W. G.*
—— linearis, *W. G.*
—— acuta.
Stauroneis Phœnicenteron.
—— punctata.
—— anceps.
—— acuta.
—— linearis.
—— rectangularis, *W. G.*
—— undulata, *W. G.*
—— dubia, *W. G.?*
Pleurosigma attenuatum.
Synedra radians.
—— lunaris.
Synedra minutissima.
—— acicularis.
Cocconema lanceolatum.
—— cymbiforme.
—— cistula.
Gomphonema tenellum.
—— olivaceum.
—— constrictum.
—— coronatum.
—— Fusticulus, *Sm.?*
—— geminatum.
—— insigne, *W. G.*
Meridion circulare.
Achnanthes exilis.
Achnanthidium lanceolatum.
Himantidium Arcus.
—— undulatum.
—— gracile.
Fragilaria capucina.
Odontidium mutabile.
—— mesodon.
—— Harrisoni, *Sm.*
—— Tabellaria.
Denticula tenuis.
—— sinuata.
Tabellaria fenestrata.
—— flocculosa.
Diatoma elongatum.
Melosira varians.
—— distans.
Mastogloia elliptica.
Colletonema neglectum.

To the names of such species as have been recently added to the British flora, the name of the observer is added.

It will be seen that the number and variety of species is considerable, yet, as we have found it in all other localities in the summer or autumn of 1855, smaller than usual. The species are, with very few exceptions, such as belong to fresh water; for the only forms that belong to brackish or sea water are *Navicula elegans*, *Pinnularia peregrina*, and perhaps *Synedra acicularis*.

There are one or two forms, which, although I have described them as occurring in the Glenshira sand, are yet more frequent in some of these gatherings than I have seen them elsewhere. Such are *Cocconeis transversalis*, which I have also found in other freshwater gatherings; and *Tryblionella apiculata*, figured in the paper I lately read to the Royal Society of Edinburgh. The rest of the forms, with the exception of those marked with my name, and one or two others of Ehrenberg's, are such as have long been known, and are very frequent.

MISCELLANEOUS.

EDWARDSIA VESTITA (FORBES).

One of the most interesting additions to our native zoophytology that has been made for some time is a species described by the late Professor Edward Forbes under the above title from specimens found by him on the island of Paros in the Ægean Sea*. It is a vermiform *Actinia* some six inches in length, with a beautiful expanded disk of spotted tentacles; the most conspicuous phænomenon in its œconomy being that it inhabits a tough thick tube formed of condensed mucus, which is secreted in great abundance and thrown off from the surface of its body.

This curious and beautiful zoophyte has been procured in some numbers by Mr. W. A. Lloyd from the coast of North Wales; and

* See Annals and Mag. of Nat. Hist. for December 1841, and for July 1843.

specimens may now be seen in the tanks of the Zoological Society in the Regent's Park.

It is a very interesting coincidence, that the remarkable Annelide found by Mr. Forbes in the same circumstances and described in the same communication is also at present in the same noble collection; for, though I have had no opportunity of closely examining the specimen, I have no doubt that the curious *Serpula* which spontaneously appeared some months ago in one of the central tanks, and which has been looked upon with some interest by zoologists, is identical with Forbes's Grecian Annelide in question. Its most salient point is the long but graduated pectination of the branchial filaments on their interior face, the pectinations projecting into the infundibulum and meeting in the centre. It will probably require to be characterized afresh, and to form a new genus.—P. H. Gosse.

CYCLAS LACUSTRIS, DRAPARNAUD.

In Forbes and Hanley's admirable 'History of the British Mollusca' (vol. ii. pp. 118 & 119) is a particular and accurate description of specimens in my collection which I obtained from Mr. Clark, marked "Exmouth 1831 and Dr. Turton's cabinet." They were referred by those authors to the above-named species. Dr. Gray could not have been aware of this when he described the same species in the last Number of the 'Annals,' and assigned to it the name of "*Sphærium pallidum*." Specimens which I took last month in company with Mr. Rouse exactly agree with those in my collection mentioned above, as well as with the description and figure in Draparnaud's work. *Cyclas caliculata* (to some of the varieties of which this approaches in form), *C. rivicola*, and a variety of *C. cornea* occurred in the same spot; so that the species in question cannot be a local variety of any of the others. Its distinctive characters are the rhomboid form and nearly straight hinge-line; yellowish-white being the predominant colour, with a greyish tinge and darker irregular zones in adult specimens. It is probably the *Tellina lacustris* of Müller; but Pfeiffer, Charpentier, Dupuy and some other continental writers, appear to have mistaken for it varieties of *Cyclas cornea* and *C. caliculata*. Mr. Rouse having afterwards told me that Dr. Gray intended to publish the discovery, I communicated to the latter my ideas on the subject, but I presume not in time for him to make any use of them.—J. Gwyn Jeffreys.

1 Montagu Square, 16th June 1856.

Occurrence of Clausilia Mortilleti, *Dumont, in Kent.*

A shell, for which I am indebted to Mr. S. P. Woodward, and which is regarded by him as a small variety of *Clausilia Rolphii*, Leach, proves to be a pale, clear variety of *C. Mortilleti.* Mr. Woodward found it on the chalk hills at Charing in Kent, living on the ground in the woods, at the roots of ivy. Compared with a specimen of

C. Rolphii, collected by him at Charlton near Woolwich, it presents the following differences.

In *C. Rolphii* the shell is more elongate and the spire more gradually decreasing in breadth towards the apex, not ventricose, and suddenly narrowing to the attenuated upper portion of the spire, as in *C. Mortilleti*. It is lighter in colour, with a fulvous tint, rather than the purplish hue which pervades the specimens of the latter; the basal crest is not prominent or sharply defined, and the rima is narrow, and elongated nearly to the base; whereas in *C. Mortilleti* the crest forms a strong funiculate keel, and the periomphalus is open and semicircular. In *C. Rolphii* the lower lamella is cruciate; both species are deficient in the palatal callus so conspicuous in the true *C. plicatula*, Dr.

Length of *C. Rolphii*, 14 mill.
——— of *C. Mortilleti* from Charlton-Kings near Cheltenham, 14 mill.
——— of ditto from Charing, 11 mill.

C. Rolphii has $10\frac{1}{2}$ whorls; *C. Mortilleti* only $9\frac{1}{2}$ in English examples, but a specimen of a more slender variety, which I got at Chaud-fontaine in Belgium, exhibits the same number as *C. Rolphii*.

Thus the two distant counties of Kent and Gloucestershire produce a shell which has so long been unaccountably overlooked on the continent, as well as in England. There are some who still persist in confounding *C. Rolphii* with *plicatula* of Draparnaud, notwithstanding the differences observable, and the assurance of De Férussac, as reported by Gray. Independently of other characters the more remote costation of *plicatula*, its palatal callus, and different mode of rimation sufficiently distinguish it. In colour its ranges with *C. Mortilleti*, the differences of which were pointed out by Adolf Schmidt in the 'Annals' for January last.

C. plicatula, omitted in Mr. Jeffreys's notes on the Swiss Mollusca (Annals for January 1855), but noticed in his collection catalogue, occurs at Monthey and St. Maurice in the Valais, as well as at Glarus. In both catalogues he has omitted *C. pumila*, Ziegler, var. β, Pfr., and *C. lineolata*, Held. The latter shell I got in the tract explored by him, between Chillon and Villeneuve, as well as in the north of Switzerland.

W. H. Benson.

12th June 1856.

On the Siliceous Sporangial Sheath of the Diatomaceæ.

In the 16th volume (1855, p. 92) of the 'Annals of Natural History,' I pointed out the occurrence of a siliceous sheath enveloping the sporangial frustule of a *Navicula* (*Amphirhynchus*?), and stated that "it was composed of silex, *i. e.* was indestructible by heat and nitric acid;" also, that it was "colourless, elongate, rounded at the ends, and furnished with coarse transverse striæ, or depressions, through which the line of fracture runs when the object is crushed."

In the 2nd volume of the 'Synopsis of the British Diatomaceæ,' the Rev. W. Smith states, that he has never observed this siliceous sheath, and that "probably it may have been an *appearance* resulting from the condensation and corrugation of the mucus developed around the reproductive body."

I need scarcely say that Mr. Smith's conclusion is untenable, for no kind of mucus will resist the action of a red heat and nitric acid. Moreover, the specimen was not an isolated one, but hundreds of them were present. It is, however, perhaps excusable that Mr. Smith should consider me as having been misled by an appearance, having himself mistaken the cellular appearance upon the valves of the Diatomaceæ for the expression of a cellular structure.

In regard to the "blunder" committed by Dr. Hassall in the formation of the name *Gyrosigma* (which is not alliterative however), I may remark, that this name was retained in the 'Micrographic Dictionary' and elsewhere, because it had claims from priority, and from its adoption by Kützing and Rabenhorst; also because, although objectionable in structure, it was less so than the name *Pleurosigma*, considering that no two authors agree as to which is the side of a Diatomacean frustule.

Again, the objection to the name *Gyrosigma* applies also to some other established generic names, as *Spirogyra*, &c., the alteration of which would cause great and unnecessary confusion.

J. W. Griffith, M.D.

9 St. John's Square, May 9, 1856.

Travels in Central America. By MM. Scherzer and Wagner. (Communicated by Count Marschall.)

Dr. Scherzer lately communicated to the Imperial Academy of Sciences at Vienna (March 6, 1856) a report of his travels through the northern portion of Central America, undertaken, in company with Dr. M. Wagner, in 1852–55. A meteorological journal was carefully kept during the whole journey; and the altitudes of mountains, plateaux, and volcanic peaks, together with the limits of the diffusion of the most important among the animals and the cultivable vegetables, were approximately determined by the aneroid barometer. Intercourse with the savage Indian tribes, and residence at villages of the settled and agricultural aborigines of Honduras, San Salvador, and Guatemala, provided the travellers with valuable materials for their ethnographical studies. The governments through whose territories MM. Scherzer and Wagner passed most readily communicated a large amount of statistical and administrative information.

An extensive entomological collection was made in Costa Rica and Guatemala; and MM. Scherzer and Wagner brought home about 40,000 specimens of Invertebrata; among which are nearly 300 undescribed species (according to MM. Klug and Hopffer, of Berlin) of Coleoptera, Lepidoptera, and Hymenoptera. There are also many new and interesting forms among the land and freshwater Mollusca.

The specimens of Vertebrata, chiefly Reptiles, are far less numerous than those of the Invertebrata; and have been presented, together with the specimens of North American rocks and fossils, by Dr. Scherzer to the scientific establishments of the Austrian Empire, or to persons making them objects of special study.

The collections made by these indefatigable travellers are at least sufficient to represent the essential characters of the Central American fauna and flora which have been hitherto scarcely known. These researches, having been pursued on the opposite sides of the Cordilleras and along the coasts of both oceans, are highly valuable with reference to the geographical distribution of organized beings; and the result proves that the ridge of the Andes is an effectual barrier to the diffusion of animals endowed with a small amount of locomotive power, especially the terrestrial molluscs, the insects, and the Arachnides.

The range of the travellers, who sometimes pursued different courses for the sake of completing the object of their journey, extends from 50° to 9° N. lat.: from the uniform and gloomy scenery about the mouth of the St. Lawrence, in Canada, to the virgin forests of the Andes, south of Costa Rica, luxuriant in the richest variety of animal and vegetable life. At Belize they embarked for the West Indies, and visited Jamaica, Hayti, St. Thomas, and Cuba. The vegetation of these isles, although strikingly luxuriant and graceful in some localities (as the Blue Mountains, in Jamaica, and the central mountain-valleys of St. Domingo), is far from rivalling in grandeur the Centro-American flora, as it wants the lofty and magnificent trees and the variety of parasitical and climbing plants characteristic of the forests of Central America. On the other hand, the tropical features of the scenery of the Antilles is in beautiful contrast with the gloomy uniformity of the North American vegetation; and a traveller, landing at Cuba, after having left Quebec eight days before, may well be struck by the change of scene.

As a general rule, it appears that the level of the highest development of vegetable life gradually rises from the ground-level from the poles to the equator. In tropical America the most magnificent flowers are those on the tops of high trees, and on the plants climbing on them. In the temperate zone the shrubs are richer in blossoms than the other vegetable forms; and from 46° lat. northwards the great variety of flowers is concentrated in the meadows.

MM. Scherzer and Wagner, besides the observation of physical facts and the collection of specimens, paid particular attention to the *status* of the West Indian Colonies, their œconomical relations, and their population.

Dr. Scherzer has already published his remarks on North America (in three vols.), and on Central America (in one vol.); he is far, however, from regarding the object of his researches as exhausted, as he and his companion went through the whole of their enterprise at their own expense, and consequently with limited resources (excepting the excursion to the ruins of Guirigua, in Guatemala, which was undertaken at the cost of the British Government).

On the Non-existence of Polarizing Silica in the Organic Kingdoms. By Prof. J. W. Bailey.

It is now more than twenty years since Sir David Brewster announced the existence of polarizing or doubly refractive silica in the cuticle of *Equisetum*, and in that of some of the grasses. In Lindley's 'Natural System of Botany,' the following account of Brewster's experiments is given:—"On subjecting a portion of the cuticle of *Equisetum hyemale* to the analysis of polarized light under a high magnifying power, Brewster detected a beautiful arrangement of the siliceous particles, which are distributed in two lines parallel to the axis of the stem and extending over the whole surface. * * * * Brewster also observed the remarkable fact that each particle has a regular axis of double refraction. In the straw and chaff of wheat, barley, oats and rye, he noticed analogous phænomena."

In Quekett's 'Treatise on the Microscope,' 3rd edit. p. 358, directions are given for preparing the siliceous cuticle of *Equisetum hyemale* for microscopic examination, by boiling in strong nitric acid, and it is added that "in balsam it forms a beautiful object for polarized light." Similar directions are given for preparing the silica in the chaff of wheat, oats, &c.

As these statements are contained in the last editions of each of the above-mentioned works, it is evident that no contradiction of the error involved in them has been pointed out; yet, notwithstanding the high authority on which they rest, the statements, so far as the polarizing action of the silica is concerned, are wholly erroneous. If the cuticle of the above-mentioned plants is completely deprived of its carbonaceous tissues, it will be found wholly devoid of action on polarized light, and any preparation of the cuticle which is found to affect polarized light, will also be found to blacken when heated in concentrated sulphuric acid, and if then decarbonized by throwing into the hot acid solution a little chlorate of potassa, the residual silica shows no signs of action under the polariscope, either alone or with the selenite plate, although it still retains the forms of the cells, stomata, &c.

It is clear then that the error in the above statements has been caused by the imperfect removal of the dense carbonaceous tissues which are deposited beneath the silica. I have examined several species of *Equisetum* and a large number of plants of the Grass tribe which are most remarkable for their siliceous cuticles, but have found no trace of any action upon polarized light, when the carbonaceous matter was removed. But it is unnecessary to resort to artificial preparations to prove the correctness of my statements. Nature has made her own preparations, and deposited them by myriads beneath every peat-bog, where may be found not only the siliceous shells of the Diatoms and the spicules of the freshwater sponges, but also a large number of the siliceous parts of the grasses, sedges, &c. Ehrenberg has shown*, and I can confirm his statements, that the

* Berlin Monthly Reports, May 1848.

silica in these Phytolitharia, as well as in the Diatomaceæ, Polycystineæ and Spongiolites, is not doubly refractive. He makes an exception in the case of the shell of *Arachnoidiscus*, but my own experiments prove that when properly cleaned this shell forms no exception. As I have shown above that the silica in the cuticle of the *Equisetum* and Grasses agrees with that in the lower tribes in characters, I think the conclusion is warranted, that doubly refractive silica has no existence in the organic world.—*Silliman's American Journal for May* 1856, p. 357.

METEOROLOGICAL OBSERVATIONS FOR MAY 1856.

Chiswick.—May 1. Overcast: cold showers, partly hail: clear and cold. 2. Quite clear: cloudy: frosty at night. 3. Cloudy and cold: showery. 4. Overcast: cloudy: clear, with sharp frost at night. 5. Frosty early A.M.: cloudy and cold. 6. Fine: cloudy and cold: rain. 7. Cold rain. 8. Densely clouded: cold north wind. 9. Heavy clouds. 10. Uniformly overcast: fine. 11. Light haze: fine: cloudy. 12. Uniform haze: rain. 13. Rain: cloudy. 14. Heavy showers. 15. Fine: showers, with some hail. 16. Fine. 17. Cloudy. 18. Boisterous, with rain and hail. 19. Very fine. 20. Very fine: slight frost. 21. Fine: rain. 22. Rain. 23. Cloudy: fine. 24. Fine. 25. Cloudy: rain. 26. Fine. 27. Very fine: heavy rain at night. 28. Cloudy: very fine. 29. Hazy: cloudy: fine. 30. Cloudy and cold. 31. Rain.

Mean temperature of the month	50°·09
Mean temperature of May 1855	48 ·78
Mean temperature of May for the last thirty years	53 ·55
Average amount of rain in May	1·852 inches.

Boston.—May 1. Cloudy: rain and sleet P.M. 2, 3. Cloudy: rain and hail P.M. 4, 5. Cloudy. 6. Cloudy: hail and snow A.M. 7. Cloudy. 8. Cloudy: rain A.M. 9, 10. Cloudy. 11. Fine. 12, 13. Cloudy. 14. Cloudy: rain with thunder P.M. 15, 16. Cloudy. 17. Cloudy: rain P.M. 18. Cloudy: rain A.M. and P.M. 19. Cloudy. 20, 21. Fine. 22. Rain A.M. and P.M. 23. Fine: rain and thunder P.M. 24. Cloudy: rain A.M. and P.M. 25, 26. Cloudy: rain P.M. 27. Fine: rain P.M. 28. Cloudy: rain A.M. and P.M. 29. Cloudy: 30. Fine. 31. Cloudy: rain P.M.

Sandwick Manse, Orkney.—May 1. Bright A.M.: cloudy P.M. 2. Sleet-showers A.M.: cloudy P.M. 3—5. Cloudy A.M. and P.M. 6. Cloudy A.M.: clear P.M. 7. Clear A.M. and P.M. 8. Cloudy A.M.: clear P.M. 9. Clear A.M.: rain P.M. 10. Cloudy A.M.: drops P.M. 11. Drizzle A.M.: fog P.M. 12. Hazy A.M.: clear, fine P.M. 13. Cloudy A.M. and P.M. 14. Cloudy A.M.: rain P.M. 15. Cloudy A.M. drops P.M. 16. Bright A.M.: cloudy P.M. 17. Clear, fine A.M.: cloudy, fine P.M. 18. Showers, bright A.M.: showers P.M. 19. Cloudy A.M.: showers P.M. 20. Bright A.M.: clear P.M. 21, 22. Bright A.M.: cloudy P.M. 23, 24. Cloudy A.M. and P.M. 25. Clear A.M. and P.M. 26, 27. Cloudy A.M. and P.M. 28. Bright A.M: cloudy P.M. 29—31. Clear A.M. and P.M.

Mean temperature of May for previous twenty-nine years ...	47°·85
Mean temperature of this month	46 ·83
Mean temperature of May 1855	43 ·81
Average quantity of rain in May for fifteen previous years ...	1·66 inches.

The great drought continues; the rain during the last three months being less than the average for May alone, which is our driest month, and not half the quantity that fell in March alone last year.

Meteorological Observations made by Mr. Thompson *at the Garden of the Horticultural Society at* Chiswick, *near London; by* Mr. Veall, *at* Boston; *and by the* Rev. C. Clouston, *at Sandwick Manse,* Orkney.

Days of Month.	Barometer.					Thermometer.					Wind.			Rain.		
	Chiswick.		Boston. 8¾ a.m.	Orkney, Sandwick.		Chiswick.		Boston. 8¾ a.m.	Orkney, Sandwick.		Chiswick. 1 p.m.	Boston.	Orkney, Sandwick.	Chiswick.	Boston.	Orkney, Sandwick.
1856. May.	Max.	Min.		9¼ a.m.	8½ p.m.	Max.	Min.		9¼ a.m.	8½ p.m.						
1.	29·840	29·463	29·28	29·88	30·00	47	30	43·5	47	42	ne.	e.	ne.	·26	·10	....
2.	29·977	29·970	29·63	30·06	30·14	54	27	43	45	40	nw.	n.	nnw.	....	·02	·02
3.	30·098	30·015	29·68	30·22	30·30	52	37	40	45	41	nw.	n.	nne.	·16	·05	·02
● 4.	30·111	30·048	29·76	30·26	30·22	52	21	43·5	44	41½	ne.	n.	ne.	....	·03	....
5.	30·172	30·044	29·75	30·16	30·11	53	35	45	45	40	ne.	nw.	ne.	....	....	....
6.	29·917	29·568	29·60	29·99	29·94	52	41	47	45½	36½	se.	e.	e.	·24	·06	....
7.	29·609	29·409	29·20	29·92	30·07	44	39	50	48	41½	n.	ne.	n.	·16	....	....
8.	30·115	29·792	29·52	30·22	30·30	49	41	45	44½	42½	n.	n.	e.	....	·03	·02
9.	30·151	30·099	29·82	30·23	30·08	54	43	46	49½	47	ne.	ne.	se.	....	....	....
10.	30·015	29·898	29·71	30·01	29·97	68	44	50	53	48½	ne.	ne.	ese.	....	....	·31
☽ 11.	29·870	29·777	29·48	29·93	29·93	71	43	52·5	49	50	n.	ne.	nw.	....	....	·07
12.	29·719	29·637	29·36	29·91	29·87	64	52	52·5	50	46	ne.	ne.	e.	·70	....	·07
13.	29·628	29·606	29·22	29·70	29·62	65	40	55	52½	49½	sw.	ne.	e.	·14	....	....
14.	29·543	29·521	29·10	29·62	29·61	58	40	58	51	46	sw.	s.	nne.	·19	....	·04
15.	29·492	29·394	29·08	29·53	29·48	62	40	55	47½	45	sw.	s.	n.	·20	·21	·10
16.	29·610	29·447	29·06	29·40	29·44	64	41	52·5	48½	46	sw.	n.	w.	....	....	....
17.	29·651	29·472	29·18	29·44	29·36	62	40	61	50	47	sw.	sw.	e.	·34	....	....
18.	29·518	29·440	28·96	29·33	29·42	60	40	50	52	45	sw.	s.	ene.	·13	·06	·12
○ 19.	29·996	29·702	29·21	29·62	29·81	70	30	51·5	47½	44	sw.	w.	nnw.	....	·23	....
20.	30·058	30·019	29·60	29·91	30·00	71	30	53	46½	45½	sw.	wnw.	nw.	....	....	·05
21.	29·937	29·746	29·50	29·97	29·94	73	50	53	49½	47	s.	s.	e.	·24	....	·02
22.	29·634	29·586	29·20	29·83	29·76	64	36	59	49	45½	sw.	s.	e.	·16	·15	....
23.	29·576	29·482	29·10	29·65	29·64	66	42	55	48	45½	s.	sw.	ne.	·04	·18	....
24.	29·549	29·475	29·04	29·67	29·73	63	42	62	49½	45½	sw.	sw.	e.	....	·20	....
25.	29·807	29·491	29·15	29·74	29·80	64	44	65	51½	48	sw.	sse.	ese.	·14	·21	....
26.	29·887	29·777	29·37	29·78	29·73	70	48	61·5	50	45	sw.	sse.	ese.	·02	·07	....
☾ 27.	29·801	29·626	29·30	29·69	29·69	70	47	60	47½	47	sw.	w.	ese.	·63	·09	·02
28.	29·708	29·583	29·11	29·72	29·84	69	40	58·5	53½	46	sw.	s.	n.	·41	·31	....
29.	30·005	29·853	29·48	30·00	30·16	60	36	50	48½	44	nw.	ne.	n.	....	·20	·03
30.	30·130	30·084	29·75	30·17	30·15	57	41	53·5	52	48	ne.	ne.	ese.	....	....	....
31.	29·880	29·700	29·53	30·08	30·02	51	47	48·5	50½	47½	n.	ne.	ese.	·22	....	....
Mean.	29·828	29·700	29·38	29·859	29·880	60·61	39·58	52·2	48·72	44·95				4·38	2·20	0·89

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SECOND SERIES.]

No. 104. AUGUST 1856.

IX. — *On the Development and Propagation of* Sphæroplea annulina. By Dr. Ferdinand Cohn*.

Up to last year there were few botanists who believed in the sexuality of the Algæ. Thuret's observations on the antheridia of the Fucaceæ did indeed open a new prospect, in demonstrating the impregnation of the reproductive spores by minute spontaneously-moving spermatozoids (*antherozoids*, Thuret); yet this discovery, so long as it remained isolated, appeared rather to remove the Fucaceæ from the class of Algæ, just as the previously discovered sexuality of the Characeæ has altered the position of those plants in many systems. The observations of Pringsheim†, laid before the Academy in March last, have proved that one of our freshwater unicellular Algæ also possesses separate sexual organs. Having discovered spermatozoa in the "*horns*" (previously suspected to be antheridia) of *Vaucheria*, and traced their entrance into the orifice of the sporangial cell, Pringsheim has established the fertilizing process in the most remarkable manner, and grounded upon this the conjecture that difference of sexes exists in *all the rest of the Algæ*, and that the resting-spores, the true reproductive organs of these plants, are in all cases impregnated by spermatozoa and are not capable of germination without this. The history of development which I am about to sketch in the following pages affords new evidence in favour of this proposition: as it rests upon a totally independent series of observations, almost simultaneously performed, and reveals most remarkable modifications of this process, it may still lay claim perhaps to an especial interest.

* Translated from the 'Monatsbericht' of the Berlin Academy, May 1855, by Arthur Henfrey, F.R.S. &c.

† Annals of Nat. Hist. 2nd Ser. xv. p. 346.

Sphæroplea annulina, Ag., is one of the rarer freshwater Algæ, which is not observed, like most of these plants, everywhere and at all seasons, but only at long intervals and under peculiar circumstances; it consists, like all the Confervæ, of cells of variable length, connected in a single row into long filaments, and is characterized by a peculiar arrangement of the chlorophyll. Ehrenberg has already remarked that it covers extensive surfaces about Berlin with a red coating, and hence may have given rise to traditions of "blood-rain." Near Bremen, where it was discovered by Treviranus, it occurs upon flooded tracts. At Breslau I found it the first time at the end of October, last year, in a potato-field which had been laid under water by the great overflow of the Oder in the last week of August. The *Sphæroplea* covered the field, which had dried again after the retreat of the water, as an almost uninterrupted felt, of a beautiful red-lead or vermilion colour on the smooth upper surface, and green on the under side, where it was disentangled into the separated filaments. The red colour depended upon the spores with which the filaments of the *Sphæroplea* were completely filled up; only those filaments which were exposed to light and air on the surface of the felt fructified; the under side, resting on the ground, contained only vegetative filaments of the normal green colour.

The structure of the *Sphæroplea*-spores is very simple; they are red globules, usually from 1–125 to 1–100‴ in diameter, surrounded by two hyaline membranes, of which the inner lies close upon the contents, while the outer is somewhat separated and is elegantly creased. The spores of *Sphæroplea* are usually described as stellate; Kützing however states that they are encircled by spiral bands. Both these assertions are justified to a certain extent: it depends upon the position of the spores whether they look like many-rayed stars, or as longitudinally streaked, smooth-bordered globes. The outer coat of the spore is so folded that the folds meet at the two poles of the globe like so many meridians. Hence if we look at the pole of a spore, the folds are seen surrounding the globe like a frill, in a sharp-angled zigzag; while if we look upon the equator of the spore with the axis parallel to the object-glass, the folds may be traced in their whole course as longitudinal lines. In many spores, especially the large ones, the plaiting of the outer coat is very irregular, and forms merely wart-like elevations without any definite arrangement. Sulphuric acid causes an expansion of this coat, but does not destroy it; iodine and sulphuric acid colour it bright yellow.

The contents of the spores consist of rather large starch-granules, and protoplasm which is coloured bright vermilion-red by a peculiar colouring matter; they contain a red oil which stands in the closest relation to chlorophyll, and is equally produced from this and transformed into it. In normal conditions this oil is diffused so minutely in the colourless plasma, forming a kind of emulsion, that it appears in infinitely small, red globules which might be confounded with the so-called protoplasm-granules; their oily nature may be ascertained, however, when the spores die or are destroyed by chemical reagents, as the red globules then become confluent into large red-lead-coloured drops, strongly refracting light, soluble in æther, are coloured bluish-green by iodine, and by a somewhat longer action of sulphuric acid acquire a blue colour; this last reaction exactly resembles that of sulphuric acid on chlorophyll; hence it is not improbable that the acid converts the oil into the related substance chlorophyll. If the sulphuric acid remains long in contact with the spores, the latter become bleached; the action of light produces the same effect upon the spores when dead. The red colouring matter of the spores of *Sphæroplea* is different from the erythrophyll of leaves and flowers, but it occurs in the spores of *Bulbochæte*, as shown by Pringsheim, in *Protococcus nivalis* and *pluvialis*, *Chroolepus Iolithus*, and many other Algæ, also in *Euglena sanguinea*; in every case it is changed, in the course of development, into green chlorophyll, and *vice versâ*. The spores of *Sphæroplea* present a remarkable resemblance to the red, stellate reproductive bodies which Ehrenberg pointed out in the genus *Volvox* (*V. stellatus*), and which, according to my investigations, contain both red oil and starch-granules.

The course of development of *Sphæroplea* being hitherto altogether unknown, and in fact the germination of the resting-spores of the Algæ generally never having been observed, except in the Conjugatæ and *Vaucheria*, I resolved to turn to account an immense mass of *Sphæroplea*-spores at my disposal, in an investigation, and accordingly, at the beginning of October 1854, I placed a portion of the red felted mass in a vessel of water. A putrefaction immediately took place, through which the cells of the filaments were dissolved; while the spores thus set free,—which, as a microscopic examination showed, protected by their two membranes, underwent no alteration whatever,—subsided to the bottom of the vessel in countless numbers as a reddish mud. Notwithstanding that the glass now stood all through the winter in the window of a warm room, I could not detect any change in the spores before March; the germination showed itself first after a few mild spring days, and it occurred *simultaneously* in two separate vessels. In order to ascertain whether a six-months' rest was actually necessary to the *Sphæroplea*-spores, I placed a fresh portion of the filamentous mass in water, at the end of March; in this case I observed germinating plants *five days* *after*. The germination took place still more quickly in subsequent third and fourth experiments, wherein it occurred in forty-eight hours, with spores which up to that time had been kept in the herbarium. I am quite unable to explain the enigmatical hastening of the germination in the spring months; it could scarcely have depended on the greater heat, for the room was heated to a higher temperature during the winter. At the same time the germination of the *Sphæroplea*-spores occurred relatively rarely in cultivation, so that it went on through many weeks, and the majority of the spores still remained unchanged; while in the natural locality, the potato-field above mentioned, by the middle of April, about which time the field was again flooded, the spores had all germinated, and no trace of the red felted mass remained, while the standing water was full of the green filaments of *Sphæroplea*.

The germination of the spores of *Sphæroplea* differs from everything formerly known of the development of the Algæ and of plants generally; on the other hand, it agrees surprisingly with simultaneous observations on the germination of *Bulbochæte** already published by Pringsheim in these Reports. The youngest germs of *Sphæroplea* that I perceived were spindle-shaped corpuscles from $\frac{1}{190}$ to $\frac{1}{130}$ of a line in diameter, and about $\frac{1}{40}$ of a line long, running out at both ends into long filiform points which were irregularly curved and twisted, and increased the total length to $\frac{1}{14}$ of a line and more. These germinating plants resembled in shape, even indistinguishably, that interesting species of *Closterium* which Ehrenberg has described and figured as *C. rostratum*. The contents of the germ displayed every intermediate stage from the red of the spore to the green of the developed plant; the red and green were mingled in a most elegant manner, either with the red oil-globules accumulated at one end and the green chlorophyll at the other, with a colourless band separating them in the middle; or bands of red and green alternated; or the whole contents were green sprinkled with red globules. At first sight of these germs, I perceived that their dimensions were much smaller than those of the spores from which they must have been produced; hence they evidently must have originated from a part, not the whole, of the spore. Added to this, I never found a germinating plant sticking in the membranes of the spore, but always scattered free in all parts of the water; so that I was necessarily driven to the conjecture that these portions must have been discharged from the spores as "swarming-cells." I was soon enabled to confirm my conjectures by direct observation.

* Ann. Nat. Hist. Ser. 2. xv. p. 349.

When the spores of *Sphæroplea* are about to germinate, in the first place their contents are metamorphosed, acquiring a peculiar granular organization and assuming a colour more brown-red, a lighter circle becoming visible in the middle. The red of the spore is frequently changed into green before germination, the conversion advancing gradually from the borders to the centre. The *contents of the spore next divide*, first into two, then into four or eight portions; these portions break through their double membrane and emerge into the water as free 'swarming-cells.' In the small number of spores which germinated daily out of the enormous quantity present, I never succeeded in catching the moment of the exit, and therefore I do not know how the two coats of the spore are torn; but the empty membranes are often met with, a mere remnant, at most, of unconsumed contents remaining in them; I also found spores with undischarged 'swarm-cells' dancing about actively in their interior. The whole process differs from what Pringsheim observed only in so far, that in *Bulbochæte* a long cylindrical germinal filament escapes from the spore, and the contents of that are formed into free 'swarming-cells,' while in *Sphæroplea* this operation is completed within the spore itself; but I often met with spores from which the outer stellate membrane had been stripped, and the contents had begun to divide within the inner smooth coat.

The 'swarming-cells' (*zoospores*) which are formed in the interior of the spores of *Sphæroplea* have an exceedingly elegant shape, which however, like their size and colour, is subject to considerable variation. Ordinarily they are globular or short cylindrical corpuscles $\frac{1}{190}$ to $\frac{1}{150}$ of a line long, of a splendid carmine or vermilion colour, furnished at one end with a short colourless head from which extend two long cilia. Other swarming-cells are larger and pear- or spindle-shaped; these evidently derive their origin either from a larger fractional part or from larger spores: I met with globular swarming-spores even as much as $\frac{1}{140}$ of a line in diameter, not inferior in size to the ordinary spores; and perhaps these might have consisted of the total contents of such a spore swarmed out in one mass. Many swarming-cells are of two colours; the part next the beak red, the rest green; or a green border surrounds a red centre; but the colourless head or beak, with the cilia, is always evident. Their movements last for many hours, and exhibit that vigorous, and yet at the same time lazy character which distinguishes for example the swarming-spores of *Œdogonium*, and still more those of *Chlamidomonas pluvialis*, which are similar also in their colour and the number of their cilia. The long pauses which occur from time to time in the movements of these swarming-cells are remarkable; one might imagine sometimes that they had settled quite to rest, but after an interval of an hour or more they suddenly recommence their old revolutions.

At the time when the swarming-cell breaks through the membrane of the spore of *Sphæroplea,* it possesses no cellular membrane; but it produces this while still in motion, so that it becomes distinctly surrounded by a delicate, young, and very elastic cellulose coat. When the swarming-cell germinates, this membrane becomes rigid and prolonged at both ends so as to produce the spindle-shape; these ends grow out rapidly into capillary points, which constantly increase in length; the middle of the germinating cell then likewise extends itself, the ends being pushed still further apart, and the entire cell is thus rendered at once longer and thicker. The originally homogeneous, finely-granular contents of the swarming-cell is changed in germination, the remainder of the red oil becoming rapidly converted into chlorophyll, the germinating plant thus acquiring a uniform green colour; but even in the earliest condition colourless bubbles (*vacuoles*) are found in the green plasma, these vacuoles containing a fluid of less density, while the chlorophyll between them is compressed, and thus assumes the form of green rings standing at certain distances apart. In these streaks large starch-globules are soon secreted, and by the time the germinating plant is $\frac{1}{15}$ of a line long, it has already assumed the full character of the cells of *Sphæroplea.* It continues to increase in length and breadth, retaining however its Closterium-like shape. I met with colossal spindle-shaped cells half a line and more long, prolonged into capillary points at both ends. *Sphæroplea* is the only Conferva known to me that *never possesses a root*; in all other genera one end of the germinating filament, avoiding the light, grows downward into an organ of attachment, while the other differently formed end grows by apical development into the proper filament. In *Sphæroplea,* not only are both extremities of exactly the same shape from the first origin, but no apicular growth occurs, at least not after the capillary ends are completed; the cells here grow in the middle. Since the green rings in the cells of *Sphæroplea* fix the relative positions of their points, the places where the growth takes place may be readily observed, the number of rings being constantly multiplied, by the division of the old, previously formed ones. But a minute investigation of this subject would carry us too far from the object of this notice. After some time the germ-cell divides in the middle, and with the enlargement of the plant the number of cells is increased: the length of the cells is strikingly unequal, for while in some cells they cannot be perceived, other cells are only $\frac{1}{4}$ or $\frac{1}{8}$ of a line. But in the longest, many-celled filaments, the fine capillary parts of the elongating ends may always be observed,—a fact hitherto overlooked.

The contents of the full-grown cells of *Sphæroplea* exhibit most elegant structures, the comprehension of which is essentially furthered by the interesting investigations of Al. Braun. The constituents, colourless protoplasm, green chlorophyll, aqueous fluid and starch-granules, are distributed in a peculiar manner, the aqueous fluid forming large bubbles or vacuoles which attain a diameter almost equal to that of the cell, and hence stand in rows, like pearls, often in contact at their poles, and flattened there so as to form seeming septa. In the interval between the vacuoles is compressed the green plasma with the starch-granules; and here further the space becomes disputed by numerous smaller vacuoles which are excreted from the plasma: under a low magnifying power the whole appears as if there was a regular alternation of narrow green and broad colourless rings. If the vacuoles are smaller and the chlorophyll is more abundant, the cell appears uniformly green,—more intense merely in the interval between the vacuoles. The vacuoles have an envelope of condensed plasma, so that when the whole is softened in water the vacuoles do not dissolve, but sustain themselves for a long time, like cells; but they are not permanent structures; their number and size are subject to constant alteration.

In the second half of April I first observed the *germinated filaments of* Sphæroplea *beginning to reproduce spores*. The regular arrangement of the green rings disappeared in particular cells; the vacuoles increased in number, so that the whole contents assumed the appearance of a green froth; the starch-globules were irregularly diffused through this. These were soon seen to become grouped together in twos or threes, and largish masses of the green plasma became accumulated around them; after a certain time the middle line of the cell was occupied by a great number of green lumps, at regular distances, the frothy matter being distributed between them. As the majority of the vacuoles gradually disappeared these lumps assumed the form of green stars, such as occur in pairs in the cells of *Zygnema*, remaining connected together by the green radiating filaments of plasma. Between each pair of these stellate masses a large vacuole was formed, which became flattened to level septa, so that the whole cell appeared as if divided into chambers by a number of parallel plates of plasma. In each of these chambers there began an uninterrupted metamorphosis of the green mass; the mucilaginous filaments were gradually retracted; the green substance contracted itself sometimes towards the right, sometimes to the left; in a short time the colourless plasma had become so distributed around the chlorophyll that the septa of the chambers separated, and the whole contents were broken up into a large number of *free globular masses,* which were sharply defined, composed chiefly of colourless mucilage, and enclosed in their centre an irregularly diffused, mostly laterally situated heap of chlorophyll. These masses, the *young spores,* then pass uninterruptedly through the most wonderful changes; at first they are in contact, and thus form by their adjacent boundaries the plasmic septa, which are consequently double; their substance becoming somewhat contracted, the two layers of these septa separate, the spores thereby becoming isolated; the chlorophyll in their interior is constantly changing its mode of distribution; the colourless mucilaginous envelope at one time contracts strongly, so that free, regular globules are produced; at another it expands again, so that they are flattened against their neighbours; or sometimes one becomes elongated laterally, and if a drawing is begun to be made, its shape has entirely altered before the sketch is completed. Finally, the nascent spores become rounded-off into smooth spheres, which however are still far larger than in the mature condition, and are not completely filled with chlorophyll. But the latter becomes diffused gradually more regularly in the spore-globe, while the colourless plasma is progressively more elaborated and excreted; consequently the spore is constantly becoming more condensed and diminished in size, and finally becomes a regular sphere composed entirely of a granular green substance, enclosing a few starch-granules, bounded externally by a smooth, clearly-defined layer of plasma; there is no cellulose membrane, the green structure is very soft, elastic, and under pressure passes away into mucus; it is to be regarded as a 'primordial cell.'

Long before the *contents* of the cells of *Sphæroplea* have become converted into young spores, peculiar changes have commenced in the *membrane* of their cells; it begins to change into *amyloid,* and therefore is now coloured purple-red or violet by iodine alone, without sulphuric acid. Evidently this is the commencement of the chemical metamorphosis of this membrane, which terminates in its total solution and sets free the ripe spores. *At particular points of the membrane small holes are formed* $\frac{1}{300}$ to $\frac{1}{300}$ of a line in diameter; I have counted from two to six of these orifices in each cell; the holes are more easily observed, as colourless spots, when the cell is coloured blue by sulphuric acid and iodine.

This course of development, by which they are transformed into *sporangia* with numerous *spores,* does not occur in all the cells of a filament of *Sphæroplea*; during the same epoch totally different processes are completed in a large portion of the cells. Here the green rings between the colourless vacuoles have gradually assumed a peculiar colour: they have become *reddish-yellow*, and the starch-granules have vanished. The orange-coloured substance is soon seen to acquire a peculiar organization; in it may be detected, at first obscurely, but progressively more distinctly, a separation into granules, then into little streaks, and *finally it becomes converted into myriads of short, confusedly crowded, little stick-shaped bodies.* The colourless vacuoles between the yellow rings take no part in this transformation. After this the rings begin to dissolve; suddenly one of the little stick-shaped bodies imbedded in the substance acquires its liberty and begins to move about in the cavity of the cell; more follow the example; the movement of these bodies becomes more and more rapid; in a few minutes the entire ring becomes decomposed into a countless number of actively moving corpuscles; then the stick-shaped bodies of a second and third ring enter into movement; finally the entire cell becomes filled with these corpuscles, which shoot about and circulate in all directions among each other. It is a wonderful sight to see their incredibly lively motions inside the parent-cell. The vacuoles partly persist during these processes, and they are seen swimming in the cavity of the cell as globular bubbles enclosed by a mucilaginous coat, often put into rapid rotation by the movements of the stick-shaped bodies.

One or more orifices are formed very early in these cells also, similar in shape and size to those which we have described in the sporangial cells. The first of the stick-shaped corpuscles is now seen to emerge through a hole into the water; it is soon followed by another, and at length by a whole herd at once. Their movements in the water are at first very weak; they adhere firmly together and oscillate about in masses; but in a short time they acquire greater energy and become scattered like dust, with infinite rapidity, through all parts of the drop of water. The corpuscles remaining in the mother-cell acquire a more rapid motion the freer the space left them; but their number gradually diminishes, and within a few hours all the moving corpuscles have left their parent-cell. This is then quite empty, and the orifices of exit can be perceived very distinctly; empty cells of this kind have been observed before, but their peculiarities could not be explained. The orifices often become stopped up by a vacuole, which with its mucilaginous membrane lies against the hole; this prevents the corpuscles from escaping, and I have seen them dancing about in their mother-cell after a lapse of twelve hours, then coming to repose and changed into yellowish vesicles. It is not rare to find in the cells of *Sphæroplea*, after the exit of the stick-shaped corpuscles, other larger, brownish globules, which often display a sluggish movement;

these structures, to which Al. Braun had already directed attention, under the name of *pseudo-gonidia*, are remnants of the cell-contents, unconverted into stick-shaped corpuscles, but which have nevertheless acquired a power of independent motion: perhaps they owe their origin to the fusion of a number of the corpuscles. I likewise sometimes found similar moving globes in the sporangial cells, mingled with the spores, and they appeared to have been formed simultaneously with the latter, out of the cell-contents. These are distinct from other abnormal, cell-like structures in the *Sphæroplea*-cells, some of which have a power of motion, as also from the parasitic Infusoria (e. g. *Trachelius trichophorus*) which make their way into the interior of the cells through the orifices; the former are very remarkable and varied; but I reserve a special examination of them for another occasion.

The corpuscles which 'swarm' out from the last-described cells of the *Sphæroplea*-filaments are elongated, bacilliform, and mostly $\frac{1}{250}$ of a line or more in length; their form reminds one of certain slender Curculionidæ. The posterior extremity is somewhat expanded, often spread out flat and of a yellow colour; one or more granules may often be distinguished in its interior; the anterior extremity runs out into a long narrow colourless beak, bearing at its end two long cilia, which are rendered clearly visible when the corpuscles are killed with iodine. These corpuscles differ strikingly therefore from the spermatozoids of *Vaucheria* discovered by Pringsheim, and which I have quite recently likewise had the good fortune to observe; as also from the spermatozoids of the Fucoideæ described by Thuret—whatever resemblance may exist in other respects—by the position of the two cilia; and they resemble herein many 'swarming-spores' of Algæ, especially those denominated microgonidia, with which they are intimately connected in morphological respects.

The movement of the bacilliform corpuscles in *Sphæroplea* is characteristic: when the energy is weak they oscillate, as if feeling about with the beaks; when the motion is more active they rotate on their *transverse* axis, like a stick fastened in the centre and rotated around this; their movement is distingushed by this from that of true 'swarming-spores,' which rotate on their longitudinal axis. Sometimes the corpuscles rotate upon themselves without moving from one spot, like a cat round its tail; but they mostly dart off in cycloids, frequently advancing with jerks and springs; more rarely they screw themselves straight onwards. A tendency to seek the light is indicated by their readily collecting at the side of the drop of water next to the window.

Not only did the external resemblance of these corpuscles to the spermatozoids of the Fucaceæ and *Vaucheriæ* give ground for concluding an analogous function,—I further succeeded in demonstrating *their fecundating power, by direct observation*, with an evidence such as can only be possessed by a fact of natural science: there can be no doubt that the active bacilliform corpuscles are the spermatozoids of *Sphæroplea*, and therefore the cells in which they are formed must be denominated the antheridial cells.

When the discharged spermatozoids have become diffused through the water, they are soon seen to assemble around those cells of a *Sphæroplea*-filament, the contents of which have become metamorphosed into spores. They dance about in the vicinity of these cells, attach themselves to the membrane, sometimes tearing away again, soon to return. After a while a spermatozoid approaches one of those little orifices, which we have already noticed as perforating the wall of the sporangial cells; here it fixes itself and pushes the slender beak into the hole. The posterior extremity is often too broad to pass in uninjured; then it screws itself forward with evident effort, the beak constantly working its way, compressing the elastic body; finally it succeeds in forcing its way through and entering into the cavity of the sporangial cell. In the mean time other spermatozoids have slipped in through various orifices; frequently three or four crowd at once into one orifice; the more slender corpuscles make their way, at the first attempt, in a remarkable manner swimming in wide curves, from the water, through the hole, without obstruction, into the cavity of the cell; after a time as many as twenty spermatozoids circulating about in its interior and 'swarming' round the young spores. These, as above described, are smooth spheres, more or less completely filled with chlorophyll, surrounded by colourless plasma, without cellulose membrane. The spermatozoids rush from one spore to another, as if electrically attracted and repulsed, so rapidly, that the eye can scarcely follow them; they often swarm from one end of the sporangial cell to the other; now and then the spores are thrown into slow rotation by the vibratile cilia of the spermatozoids, but this is only accidental and inessential, possibly only when the spores are in a very free position. I have seen the spermatozoids moving about in the sporangial cell for more than two hours; gradually their motion becomes more sluggish, they become adherent to the young spores, in such a manner that one or two spermatozoids become fixed to each spore, cleaving firmly to it with the beak and cilia, so that their body stands perpendicularly upon the spore. In this position they oscillate backwards and forwards for some time longer; finally they come quite to rest and apply themselves with their whole length against the surface of the spores; their body is converted into a drop of mucilage and loses its form; it appears as if a portion of the substance was absorbed endosmotically by the spore: a formal penetration of the spermatozoid into the spore certainly did not take place, for a remnant of it, perhaps the reddish drops, can long be seen attached upon the outside of the spore. However, *Sphæroplea* is not very well adapted for the investigation of the real act of impregnation, on account of the want of transparency in the green spores, notwithstanding that it offered an exceedingly favourable object for the earlier processes.

After a short time the impregnated spore becomes enveloped by a true cell-membrane, which at first can only be detected by the contraction of the contents by reagents, but subsequently can be readily seen by direct inspection, as it gradually separates further from the cell-contents. A second membrane is soon produced *beneath* the first, the second being originally in close contact with the contents of the spore, but subsequently folded in the stellate manner above described; the uppermost, earlier-formed coat is next thrown off, and such coats are found in the sporangial cells as empty vesicles among the spores—a 'moulting' or *ecdysis* already observed by Al. Braun. Finally there is produced under the stellate coat a smooth membrane, so that the impregnated spore of *Sphæroplea* bears an analogy with those of *Spirogyra* and *Zygnema*, and possesses likewise the three coats, the outermost of which however is thrown off, not in germination, but even before the spore is ripe. The contents of the spore are originally of a uniform green colour, in which several starch-granules make their appearance; subsequently they become opake, and pass through olive-green and reddish-brown, finally into a pure red. The number of the spores depends upon the quantity of chlorophyll which was present in the sporangial cell; their size is also very variable according as more or less of the green plasma is applied to the formation of one spore; although they are usually from $\frac{1}{123}$ to $\frac{1}{100}$ of a line in diameter, spores also occur which have double and even 100 times that magnitude; I observed elliptical spores which attained $\frac{1}{40}$, $\frac{1}{30}$, even $\frac{1}{23}$ of a line in the long diameter; I once met with a monster spore $\frac{1}{12}$ of a line in the long diameter, the red contents being enclosed in the papillose spore-coat just as usual. The approximate or distant arrangement of the spores, in one or several rows, is also liable to variation.

Sphæroplea annulina, although it always occurs as a multicellular filament, must be regarded as essentially a *unicellular* plant, in Nägeli's sense, since all the cells, without exception, even the terminal capillary-pointed cells included, take part in the propagation, and therefore the whole filament can only be viewed as a family of cells (cell-stock). The history of development here narrated reveals to us the fact, that, contrary to what has been hitherto imagined in unicellular plants, the individual is not immediately represented by each cell, but that these apparently equivalent cells become sexually differenced in exactly the same way as is the case in any of the most complicated animal or vegetable organisms; that consequently each individual cell is by itself barren, and can only be rendered capable of propagation by the cooperation of a cell of the other sex. We must therefore distinguish in the cells of the *Sphæroplea*-filament, *male and female cells*, or, for comparison with analogous organs in another kingdom of nature, sperm-vesicles and ovaries, which however must be more correctly conceived as independent, sexualized, elementary organisms. The process of impregnation in the Algæ has been found precisely similar in the three cases as yet known; in the *Fucaceæ, Vaucheriæ,* and *Sphæroplea,* the spermatozoids come into immediate contact with primordial cells destitute of (cellulose) membranes. The case of *Sphæroplea* is especially interesting, because there can be no question here of an accidental contact of the seminal elements; for if in *Fucus* the spores to be fertilized emerge upon the surface of the thallus—in *Vaucheria* the surfaces of the antheridia and sporangia come almost into immediate contact—in *Sphæroplea* the spermatozoids must often make their way through the water to an often far-distant mature female cell, and force an entrance through a narrow orifice. Easy as it is to observe the fact of the entrance of the spermatozoid, the force which guides these corpuscles through the wide surface of water and the crowd of countless animalcules and plants, to the female cells, and often makes them find their way through the narrow holes at the first attempt, remains still an enigma. I may also recall the fact that *Sphæroplea* is as far removed from alliance with *Vaucheria* as the latter from *Fucus,* and that since sexuality has been discovered in such diverse forms of the Algæ, there can scarcely be a doubt that it must only remain to be discovered in the rest of the Algæ, and indeed in all plants; I therefore cannot hesitate to give my adhesion to this conclusion of Pringsheim.

Whether the remarkable fact, that the spores of *Sphæroplea* do not always give origin, like all other spores and seeds, to one individual, but mostly to several swarming-cells, and therefore to several germ-plants;—whether this is connected with the action of one or more spermatozoids upon the nascent spore, I must leave unaswered; the only analogy to this fact is afforded by the origin of several embryos in the ova of the Planariæ. It is remarkable, that, according to Pringsheim's discovery, the fertilized spores of *Vaucheria* grow out into a germinal tube by direct elongation of the internal coat, like the spores of the Zygnemaceæ formed through conjugation, while the spores of *Bulbochæte*, and perhaps the spores of the Desmidieæ, likewise originating through conjugation, behave in the same way as those of *Sphæroplea*. This induces us to regard the latter fact as a peculiar form of the 'alternation of generations,' if we denominate the 'swarming-cells' produced from the spores of *Bulbochæte* and *Sphæroplea* an asexual generation, which by metamorphosis is converted at once into the *Closterium*-like germ, then by asexual division produces the sexual cells, till the cycle is concluded by the formation of the impregnated spores.

X.—*New Terrestrial Shells from Ceylon, with a General List of the Species inhabiting that Island.* By W. H. Benson, Esq.

Cyclophorus Parma, nobis, n. s.

Testa latissime umbilicata, planato-depressa, discoidea, tenuiuscula, confertim et arcuatim sericato-striata, saturate castanea, flammulis nonnullis pallidis spiram versus ornata, subtus interdum pallidiori; spira planata, apice nullo modo prominente, sutura profunda; anfractibus 5 convexis, ultimo antice descendente; apertura valde obliqua, ampla, ovato-rotundata, superne angulata, intus livide cærulea; peristomate duplici, interiori continuo, albido, ad dextram expansiusculo, exteriori breviter interrupto, expansiusculo, fusco-corneo; margine columellari subtus recedente, dextro prorsum arcuato; umbilico latissimo, minime profundo. Operculo tenui, corneo, $5\frac{1}{2}$-spirato, suturis intus extusque pulchre carinatis.

Diam. major 26, minor 23, alt. 6 mill.

Hab. in regione montana Insulæ Ceylon. Mus. E. L. Layard.

There are two specimens in the cabinet of Mr. Edgar Layard. The shell is easily distinguished from the other planorbular *Cyclophori* of Ceylon by its dark colour and depressed form, which recall those of *Pterocyclos hispidus*, Pearson, by its very wide and shallow umbilicus, and by the size and peculiar position of the aperture. The whorls of the operculum, which is of a clear horn-colour, are less closely wound than in *C. Cratera*.

Cyclophorus Cratera, nobis, n. s.

Testa late umbilicata, planulato-depressa, subdiscoidea, tenuiuscula, radiatim et confertim ruguloso-striata, vix nitidula, fulvo-cornea, raro castaneo-strigata; spira planulata, apice vix prominente, sutura profundiuscula; anfractibus 5 convexiusculis, ultimo longe lenteque descendente; apertura obliqua mediocri, subrotundata, superne angulata, intus albida; peristomate duplici, interiori continuo, acuto, breviter porrecto, exteriori expansiusculo, breviter adnato, albido; umbilico aperto, profundiusculo. Operculo tenui, corneo, 7-spirato; anfractibus valde angustis, suturis intus et extus pulchre carinatis.

Diam. major	24 .. minor	20 .. alt.	8
„ „	22 „	18 „	6
„ „	13 „	11 „	4

Hab. in Insula Ceylon.

There are five good specimens in the cabinet of Mr. Edgar Layard, of which the largest only has irregular streaks on the upper side. I find a single dead and bleached specimen among some Cingalese shells received from Mr. Frederick Layard. The operculum is more closely wound than in *C. Parma*, from which it differs in colour, the form and position of the aperture, sculpture, and deeper umbilicus; this part is shallower than in its near ally, *C. annulatus*, Trosch., which exhibits, moreover, a prominent dark apex to the spire, whereas in *C. Cratera* the apex is flattened and white. The variation in size is considerable, as may be seen by reference to the measurements. The smallest variety exhibits the adult character: the narrow volutions of the operculum, and a darker corneous hue than in *C. Parma*, are constant. Its double peristome and the flatness of the apex at once distinguish it from *C. Thwaitesi*, Pfr. Of three specimens of *C. Bairdii*, Pfr., contained in Mr. E. Layard's cabinet, two specimens, well variegated with chestnut, show no indication of a keel, while a pallid variety exhibits it distinctly.

Leptopoma apicatum, nobis, n. s.

Testa subobtecte perforata, globoso-conica, tenui, oblique striatula, sublente spiraliter confertim striata, albida, interdum flammulis et fascia unica infra periphæriam angulatam ornata, sutura profunda; spira conica, apice saturate castaneo-nigrescente, acutiusculo; anfractibus $4\frac{1}{2}$ convexiusculis, ultimo ad periphæriam obtuse angulato; apertura obliqua, rotundata; peristomate duplici, interiori expansiusculo marginibus callo junctis, exteriori breviter expanso; margine columellari reflexo perforationem fere occultante.

Diam. major $10\frac{1}{2}$, min. 9, axis 9 mill.

Hab. in Insula Ceylon (ad portas Curuwitty dictas provinciæ Suffragam ?).

This *Leptopoma* may be distinguished from any of the varieties of *L. vitreum* by its angular periphery, dark apex, more convex whorls, deeper suture, double peristome and parietal callus, as well as by the reflexion of the columellar lip over the perforation, and of the narrow lip above it. It is deficient also in the angular projection observable on the lower part of the same lip in that species. The label which accompanies the three specimens in Mr. E. Layard's collection gives only the general habitat as Ceylon; but Mr. Layard's remarks on a small *Cyclostoma*, $4\frac{1}{2}$ lines in height and diameter, and presenting a closed umbilicus and black apex, contained in his 'Rambles in the Island,' leave little room for doubting that this is the species found by Mr. C. P. Layard in the Curuwitty Pass, with another scarcer species which I have not yet seen.

Bulimus fuscoventris, nobis, n. s.

Testa anguste rimato-perforata, ovato-conica, tenui, irregulariter puncticulata? striatula, albida, nitidula, fasciis tribus rufo-castaneis evanescentibus, basali latissima, picta; spira conica, apice obtuso, sutura impressa; anfractibus 5 convexiusculis, ultimo $\frac{4}{9}$ testæ æquante, ventricosiusculo; apertura obliqua, ovata; peristomate tenui, undique breviter expanso, marginibus remotis callo tenui rufo-castaneo junctis, columellari rimam obtegente, intus calloso ascendente.

Long. 25, diam. 13, apert. 12 longa, $9\frac{1}{2}$ mill. lata.
Hab. in Insula Ceylon. Teste F. Layard.

This shell is not in good condition, and the surface and colour may be somewhat different in perfect specimens. It has some affinity to *Bulimus Bontiæ*, but the last whorl is less ventricose, and the spire and aperture narrower.

Bulimus rufopictus, nobis, n. s.

Testa anguste perforata, ovato-pyramidata, oblique striatula, albida, strigis rufis interruptis fulguratis, fasciisque tribus saturatioribus, mediana basalique angustis, submediana latiori, picta; spira elongato-conica, apice obtuso, sutura impressa; anfractibus 5 convexiusculis, ultimo $\frac{3}{7}$ testæ vix æquante, basi convexa; apertura obliqua, rotundato-ovali; peristomate tenui, acuto, expansiusculo, marginibus remotiusculis callo tenui junctis, columellari superne latiori, perforationem obtegente, dextro valde arcuato.

Long. 20, diam. $11\frac{1}{2}$, apert. 9 longa, $7\frac{1}{2}$ mill. lata.
Hab. in Insula Ceylon. Teste F. Layard.

Achatina parabilis, nobis, n. s.

Testa oblongo-ovata, solidiuscula, nitida, rugose striata, striis minutissimis obsoletis spiralibus decussata, sub epidermide luteo-cornea albida; spira elongato-conica, apice obtuso, sutura leviter impressa, subcrenulata; anfractibus 6, subplanulatis, ultimo convexiusculo, $\frac{3}{7}$ testæ vix æquante; apertura triangulari semiovata, intus albida; peristomate leviter inflexo, marginibus callo tenui junctis, dextro sinuato, obtusiusculo, columellari perarcuato, oblique valde truncato.

Long. 20, diam. 10, long. apert. 9, lat. 5 mill.
Hab. in Insula Ceylon. Teste F. Layard.

Helix Galerus, nobis, n. s.

Testa umbilicata, subconoideo-depressa, lenticulari, pallide cornea, confertissime oblique striata, striis spiralibus exiguis decussata; spira depresse conoidea, sutura impressa, apice obtusiusculo; anfractibus 5 lente accrescentibus, convexiusculis, ultimo antice majori, non descendente, periphæria acute carinata, marginata, subtus convexiusculo, margine periomphali obtuse angulato; umbilico profundo, subanguste perspectivo; apertura subsecuriformi; peristomate acuto, marginibus distantibus, columellari brevi, superne reflexiusculo.

Diam. major 9, minor 8, axis 4 mill.

Hab. ad Ragama, Ceylon. Coll. E. L. Layard.

5th June 1856.

Cingalese Land Shells.

Vitrina irradians, *Pfr.*
—— Edgariana, *Bens.*
—— membranacea, *Bens.*
Succinea Ceylanica, *Pfr.*
Helix Waltoni, *Reeve.*
—— Skinneri, *Reeve.*
—— Juliana, *Gray.*
—— Ganoma, *Pfr.*
—— Chenui, *Pfr.*
—— semidecussata, *Pfr.*
—— hæmastoma; also in Nicobars.
—— Phœnix, *Pfr.* Melanotragus contains vars. of this and the last, and is set aside by Pfeiffer.
—— superba, *Pfr.*
—— Tranquebarica, also in South India.
—— bistrialis, *Beck*; also in South India.
—— Ceylanica, *Pfr.*
—— Gardneri, *Pfr.*
—— coriaria, *Pfr.*
—— vittata, *Müll.*
—— Layardi, *Pfr.*
—— ceraria, *Bens.*
—— concavospira, *Pfr.*
—— novella, *Pfr.*
—— verrucula, *Pfr.*
—— hyphasma, *Pfr.*
—— Emiliana, *Pfr.*
—— Woodiana, *Pfr.*
—— puteolus, *Bens.*=clathratula, *Pfr.*?
—— mononema, *Bens.*
—— marcida, *Bens.*
—— partita, *Pfr.*
—— vilipensa, *Bens.*; apparently also in Nilgherries.
—— perfucata, *Bens.*
—— biciliata, *Pfr.*
—— Isabellina, *Pfr.*
—— trifilosa, *Pfr.*
—— politissima, *Pfr.*
Helix Thwaitesi, *Pfr.*
—— subopaca, *Pfr.*
—— nepos, *Pfr.*
—— subconoidea, *Pfr.*
—— convexiuscula, *Pfr.*
—— carneola, *Pfr.*
—— Corylus, *Reeve.*
—— umbrina, *Reeve.*
—— Rivolii, *Fér.*
—— erronea, *Pfr.*
—— Charpentieri, *Pfr.*
—— fallaciosa, *F.*; also in S. India.
—— Galerus, *Bens.*
Streptaxis Layardiana, *Bens.*
—— Cingalensis, *Bens.*
Pupa muscerda, *Bens.*
—— mimula, *Bens.*
—— Ceylanica, *Pfr.* (Ennea).
Bulimus 3-fasciatus, *Brug.*
—— Ceylanicus, *Pfr.*
—— albizonatus, *Reeve.*
—— adumbratus, *Pfr.*
—— intermedius, *Pfr.*
—— punctatus, *Anton*; Bundelkhund and South India.
—— Mavortius, *Reeve.*
—— pullus, *Gr.*=insularis; North India.
—— Panos, *Bens.*
—— proletarius, *Pfr.*
—— gracilis, *Hutton*; and North India.
—— fuscoventris, *Bens.*
—— rufopictus, *Bens.*
Achatina nitens, *Gray.*
—— Ceylanica, *Pfr.*; and Nilgherries.
—— punctogallana, *Pfr.*
—— inornata, *Pfr.*
—— pachycheila, *Bens.*
—— capillacea, *Pfr.*
—— veruina, *Bens.*
—— parabilis, *Bens.*

Cyclostomacea.

Cyclophorus Ceylanicus, *Sow.*
—— Menkeanus, *Ph.*
—— Involvulus, *Müll.*, var.
—— alabastrinus, *Pfr.*
—— punctatus, *Grat.*
—— Bairdi, *Pfr.*
—— Thwaitesi, *Pfr.*
—— annulatus, *Trosch.*
—— loxostoma, *Pfr.*
—— parapsis, *Bens.*
—— Parma, *Bens.*
—— Cratera, *Bens.*
Leptopoma halophilum, *Bens.*
—— orophilum, *Bens.*
—— flammeum, *Pfr.*
—— conulus, *Pfr.*
—— semiclausum, *Pfr.*
—— pœcilum, *Pfr.*
—— elatum, *Pfr.*
—— apicatum, *Bens.*
Aulopoma Itieri, *Grat.*
Aulopoma helicinum.
—— Hoffmeisteri, *Trosch.*, distinct.
—— grande, *Pfr.*
Cataulus Templemani, *Pfr.*
—— Layardi, *Gray.*
—— Eurytrema, *Pfr.*
—— pyramidatus, *Pfr.*
—— Thwaitesi, *Pfr.*
—— Austenianus, *Bens.*
—— decorus, *Bens.*
—— marginatus, *Pfr.*
—— duplicatus, *Pfr.*
—— aureus, *Pfr.*
Cyclostomus? gradatus, *Pfr.*
Pterocyclos rupestris, *Bens.*, var. picta, *Trosch.*
—— Cumingi, *Pfr.*
—— Cingalensis, *Bens.*
—— Troscheli, *Bens.*
—— bifrons, *Pfr.*

[117 Land Shells.]

Note.—Cyclophorus stenostoma, Sow. and *Pterocyclos bilabiatus*, Sow., have lately been sent to me as from Ceylon, without any definite locality. They are both Nilgherry shells, and I consider their Cingalese habitat so doubtful, that I have not introduced them in my list.

The *Vitrinæ* of Ceylon have an Indian aspect. A membranaceous species also occurs in South India.

The most characteristic form of *Helix* is that of *H. Waltoni* and *Skinneri.*

A considerable number of Cingalese *Helices* are of the vitriniform type, well represented in the Nilgherries by small species, and by larger forms even to a considerable height in the Himalaya, and throughout Hindostan.

Several species are common to Hindostan (especially the Peninsula) and Ceylon.

The group, *H. Rivolii, erronea*, and *Charpentieri*, is represented, on the east side of the Bay of Bengal, by *H. refuga*, Gould, and *Achatina*, Gray.

The *Streptaxes* are nearly allied to the Nilgherry species.

Pupa Ceylanica is closely allied to the North Indian *P. bicolor*, Hutton, both belonging to the type *Ennea*, Ad.

Some of the *Bulimi* are Indian in type, others approach the Philippine forms.

The *Achatinæ* are of a type well represented in the Nilgherries, and to which belong species from the Mahabaleshwur hills, Bombay, Central India, Lower Bengal, Sikkim, and the Khasya range.

The *Cyclophori* are of Indian types. *Leptopoma* represents forms of the Indian Archipelago.

Aulopoma is probably altogether, and *Cataulus* is nearly confined to Ceylon, a species occurring in the Nicobar Isles.

Pterocyclos is an Indian type.

November 24th, 1855.

XI.—*Notice of a curious Metamorphosis in a Polype-like Animal.* By C. W. Peach, Member of the Royal Physical Society of Edinburgh *.

[With a Plate.]

In March of the present year, I obtained from a fisherman's line an old and deeply corroded valve of *Psammobia ferroensis*, hooked up from deep water. On it I observed some minute jelly-like spots, and on placing it in a shallow glass of sea-water and examining it next day with my pocket-lens, I fancied I could make them out to be Polype-like animals. I accordingly transferred the shell, in a watch-glass filled with sea-water, to my microscope, and was delighted to find my suspicions correct, for, after a little management so as to catch the light, I could see the forms as figured at A (Pl. VIII.), attached to the shell by short footstalks; they were a little inflated near the upper part, and tipped with a slightly raised and rounded centre, from which extended four long and four short leaf-like arms, each granulated down the centre. One or two had springing from these, delicate tentacle-like arms, as seen at A, *a*—probably in a farther state of development. They were easily disturbed, but soon again displayed themselves, and their transparency, added to this shyness, rendered it difficult to catch their forms. At first I thought they were the early stage of an *Hydractinia*, and probably *H. brevicornis* of Müller, mentioned in Johnston's second edition of the 'British Zoophytes,' p. 35.

My next examination was on the 2nd of April, after giving them a supply of sea-water; they were still fixed; I could however perceive a difference—the centre of the head was more raised and conical, and the arms shorter. I examined them daily, and on the 6th, instead of *moored creatures*, I had a fleet of probably more than 100 minute *free naked-eyed medusoid* beauties jerking about in all directions. Except in size they were all alike, and perfectly transparent; the umbrella was well rounded and pilose; the subumbrella large; each had four large ocellus-like bulbs, composed of minute dark granules on the edge of the mantle,

* Communicated by the Author, having been read at the Annual Meeting of the Royal Institution of Cornwall, Nov. 1855.

at the bases of the stiffly turned-up tentacles, which were tipped with a disk having a dark centre surrounded by a light ring, and outside a darker edge, as seen at fig. 5. Dark but short bars were arranged in a quincunx manner on the tentacula, as in fig. 9.

Besides these long tentacula, there were four smaller and shorter, also turned up, but not furnished with ocelli (as at fig. 4, where the edge of the mantle is shown); on the lower part of the mantle runs a canal communicating with the bulbs of the larger tentacula. In this canal I observed spherical granules passing along, and as if revolving in the bulbs and a short way down each large tentacle; into these bulbs smaller granules descended from the subumbrella by the gastro-vascular canals. The latter extended to the upper part of the stomach, as seen at fig. 8, the stomach being attached to them, rounded on the upper part and divided into four lobes, as at fig. 6; it then narrows and runs out in a campanulate form to the quadrate mouth, which has four long lips fimbriated at the tips, as shown at fig. 6, and by the view from the under side at fig. 7.

The animals were very active up to the 10th, when some little change took place; I supplied small quantities of water and used every precaution, being anxious to see all I could of them. On the 11th they became sickly, and as figured in Pl. VIII. fig. 2; the mouth, as at fig. 2 *a*; the upper part of the umbrella, as at fig. 2 *b*, in eight festoons, the tentacula drooping. On the 13th they were nearly inactive, and *turned inside out*, with the tentacula folded in the upper part, as at figs. 10 & 11. I began to hope, that, as the mouth had become elongated into a peduncle-like form, they were about to become fixed again; they however dwindled away, and although I kept the water for months, I could trace nothing more. I have not yet seen Steenstrup's work on the "Alternation of Generations," and therefore am unable to say whether it may be one of the interesting facts observed by him. They differed in the *fixed state* from any of the zoophytes noticed by Johnston, and when *free*, from all the naked-eyed Medusæ figured in Forbes's Monograph. It may be one of the latter in its earlier stage, and probably is, *from its being pilose*, as is the case with many of the young of the Medusæ which have fallen under my notice: I have seen many, but this is the most interesting of all. The most like the free state is *Lizzia octopunctata* of Forbes, pl. 12. fig. 3; it agrees in the form of the umbrella, in having eight tentacular bulbs and four gastro-vascular canals, in the shape of the stomach, quadrate mouth and long fimbriated lips. It differs in being pilose, and in having only eight tentacula instead of twenty, viz. three at each large bulb and two at each of the smaller ones. Even this difference in the number of tentacula, &c. is of little consequence, for I have seen, and have a long list of notes and numerous drawings of the strange changes, from the young to the adult state, of these lovely gems; at present I cannot spare the time to make the drawings and extend the notes.

Custom House, Wick, N. B., 9th Nov. 1855.

EXPLANATION OF PLATE VIII.

All very highly magnified.

A. A group of the animals on a piece of shell.
A, *a*. One with slender additional tips to the tentacles.
B. One of the animals more highly magnified.
Fig. 1. One of the Medusoids.
Fig. 2. Ditto when changing.
Fig. 2 *a*. Stomach and lips. 2 *b*. Upper part of umbrella.
Fig. 3. Under side, showing the arrangement of the tentacula, &c.
Fig. 4. Edge of mantle to show the canal, &c.
Fig. 5. One of the disks at the end of a tentacle.
Fig. 6. The stomach, mouth and lips.
Fig. 8. Upper part of the umbrella, showing the arrangement of the gastro-vascular canals.
Fig. 9. A tentacle to show the markings.
Figs. 10 & 11. The Medusoid changed and turned inside out.

XII.—*Brief Outline of the Anatomy of the genus* Atlas (*Lesueur*). By John Denis Macdonald, Assistant-Surgeon of H.M.S.V. "Torch," Tender to H.M.S. "Herald," Capt. Denham, R.N., F.R.S., Commanding the Exploring Expedition in the South Seas.

[With a Plate.]

During our late cruises between Sydney and the islands of the Pacific, different species of Lesueur's curious genus *Atlas* were taken in the towing-net, and the following short anatomical account of them may prove interesting to the zoologist, more especially as—like *Phyllirrhoë*—their position in the animal kingdom has been so much a matter of doubt.

These little animals are of a rounded, oval, or elongated form, according to the amount of contraction of the longitudinal and circular muscular fasciculi; and they are usually between $\frac{1}{8}$th and $\frac{1}{10}$th of an inch in length.

Many of their movements resemble those of Annelida, particularly the manner in which they protrude and retract the head and proboscis. They frequently draw up their bodies into the form of a sphere, enabling them to resist a very considerable pressure, or elongate themselves so as to assume a vermiform appearance. The specimens which I selected for examination were so continually undergoing those changes of form of which their pliant bodies were susceptible, that it was difficult to find them long enough in one position to portray them with much accuracy.

The proboscis is supported on a kind of neck, which presents a series of circular creases when partially retracted. The integument round the base of this neck forms an annular spreading fold, bearing on its free border a dense circlet of cilia so large as to be distinctly visible to the naked eye. Although these are the only organs available for swimming, the animals possess the power of rising or sinking in the water at will, without any apparent effort. The motion of the cilia is under voluntary control, and the undulations produced by their successive action proceed in a direction from left to right, with a precision and beauty of effect far surpassing those of the ciliated circlets of the Rotifera.

The species of *Atlas* creep upon their proboscis, which much resembles both in form and function the foot of a minute Gasteropod, but the mouth is situated on the inferior or creeping surface. The anterior lip especially expands so as to form a subquadrilateral locomotive disk; but behind the mouth a moderately long and bifid lobe projects in a backward direction, the hollow between the two divisions being richly ciliated.

The upper and fore part or frontal surface of the proboscis meets the creeping disk in front at an angle of about 45°. It is also subquadrilateral in form, presenting a number of rudimentary visual organs superiorly, couched in four small patches of black pigment-cells disposed in a transverse row, while on either side it is bounded by a linear elevation, which, together with the superior border, is clothed with large vibratile cilia.

The oral orifice when open is of a triangular shape, the base corresponding with the posterior lip, but when closed it appears like a simple transverse slit.

There are no dental organs in *Atlas*, but the lining membrane of the wide pharynx and œsophagus is thrown into numerous longitudinal folds, tinted with a deep purple pigment. The alimentary canal having formed an elongated gastric dilatation, takes a tortuous course towards the anus, which is situated at the anterior part of the dorsal region, some little distance behind the ciliated circle.

The liver is massive, minutely lobulated, and lined with secreting cells containing globules of a rich golden-yellow oil. The gland is in close relation with the intestine, and the passage of the biliary fluid into the latter is so free, that on the slightest pressure the stomach becomes distended with it.

The generative pit lies at the posterior extremity of the body, and may be retracted or protruded by the action of the longitudinal or circular muscular fibres of the integuments.

A large intestiniform tube commencing near the inferior part of the base of the proboscis takes a flexuous course backwards in close contact with the abdominal wall, and terminates in an elongated tapering and protrusile organ at the lower part of the generative pit.

On either side of the œsophagus a convoluted glandular tube, with a ciliated lining, gives rise to a long and narrow duct which passes directly backwards, and ends in a simple orifice lying superior and a little external to the male opening (?) As I have not been able to trace unequivocal spermatozoa or ova in any of these tubes, I am doubtful as to the actual function of the particular organs, but enough has been said to show that *Atlas* is bisexual.

The coverings of the body are composed of an external epithelium containing purple, brown, or green pigment-granules, and a muscular tunic consisting of an external longitudinal, and an internal circular or subspiral set of fibres. The former are disposed in fasciculi with intervals often exceeding their own breadth, but the latter form a continuous layer.

The interior of the body appears to be lined with vibratile cilia, by the agency of which minute globules may be seen coursing in a definite route through all the open spaces between the viscera. This would appear to be the only representative of a circulatory apparatus; and that of respiration is most probably combined with it, no heart, distinct blood-vessels or gills having been detected.

This genus would seem to be made up of gigantic Rotifers, in which the miniature outline, as it were, presented by the microscopic forms is filled up with a more complex internal organization in animals constructed on a much larger scale. It may be also mentioned, that they present characters which give them an intermediate position between the Bryozoa and Tunicata. There is no essential difference between the ciliated circle of *Atlas* and the circle of tentacula in a polype of *Bowerbankia* for example. Were the former produced at regular intervals into tentacular processes, *Atlas* would then only differ from a Bryozoon in those particulars which would naturally associate it with the Tunicata. On the other hand, it would appear to represent permanently the larval state of *Sipunculus* (see Max. Müller, Mull. Archiv, 1850, v.); and in fact it may be regarded as a common centre, connected, as it were, by radiating affinities with a circle of forms differing considerably amongst themselves.

Cuvier was unable to class the genus, from the ambiguity of the account given of it; but De Blainville did not hesitate to place it under the head of *Akera*, conceiving that it was closely allied to *Gasteropteron*; and after his example, this error has been repeated in the able Monograph of the Bullidæ by Mr. Adams, published in the second volume of Sowerby's 'Thesaurus Conchyliorum,' a work which is yet in progress. The characters there given are as follow:—"Head with two small tentacular lobes. Body divided into two parts by a narrow pedicle. Foot dilated circularly and ciliated at the margin. Shell none." Now all these points may be reconciled with the actual state of the case by reference to the accompanying figures; but from what has been stated above, I think I may hazard the assertion that *Atlas* has nothing whatever to do with the Gasteropoda.

EXPLANATION OF PLATE IV.

Figs. 1-5 represent different views of a species of *Atlas* occurring very plentifully off the coast of New Caledonia.

Fig. 1. Front view, showing the aperture of the mouth, the foot-like anterior lip, the bilobed posterior lip, and the ciliated fold in a quiescent state.

Fig. 2. Posterior view, showing the eye-specks near the upper margin of the frontal aspect of the proboscis.

Fig. 3. A foreshortened view, with the ciliated circle in active motion: the arrows show the path of the undulations produced by the successive action of the cilia.

Fig. 4. A back view of the animal creeping on its labial disk, with the proboscis and ciliated band retracted. The dorsal position of the anus is also distinctly seen.

Fig. 5. A lateral view.

Fig. 6. A species of *Atlas* of a brilliant green colour, not so plentiful as the last, but occurring in the same localities: *a*, the constricted anterior extremity, the proboscis and ciliated band being retracted to the anus, *b*; *c*, the generative openings.

Fig. 7. Natural size.

Figs. 8, 9 & 10. Different stages in the eversion of the ciliated band.

Fig. 11. Diagrammatic figure of the animal, showing the relative anatomy of its internal organs: *a*, the wide pharynx; *b*, the liver; *c*, the intestine; *d*, the anus; *e*, a protrusile organ connected with the intestiniform tube *f*, noticed in the text. At the opposite extremity of this tube two small glandular-looking sacculi, *g*, are indicated; *h*, the small ducts of the lateral convoluted tubes.

Fig. 12. Natural size of the animal.

Fig. 13. Loop of one of the generative tubes (seen at 11 *h*) highly magnified, showing a deposit of dark pigment on one side.

Fig. 14. A few of the hepatic lobuli also highly magnified.

Port Curtis, Feb. 13, 1855.

XIII.—*On the Development of* Arenicola piscatorum; *with Remarks upon that of other Branchiferous Annelides.* By Dr. Max Schultze*.

[With a Plate.]

Most of the Branchiferous Annelida, of which the earliest forms have yet been observed, leave the egg-capsule or the embryonic receptacle of the mother in a condition by which they are enabled to swim about freely. They are furnished with strong bands of cilia, or with a uniform ciliary coat, so that they can roll about in the water at pleasure.

By fishing with a fine net in the neighbourhood of the coast or on the high sea, a considerable number of such roving Annelidan larvæ come to the hands of the zoologist. As these, without exception, when in their earliest stages of development, possess a very different form from their parents, and are destitute of any organs by which the determination of their origin might be rendered possible, a long series of investigations upon their further evolution is necessary to obtain certain indications of their parentage. It is rarely that such larvæ can be kept alive in the experimental glasses long enough to enable us to follow their further metamorphoses upon one and the same individual. Naturalists have therefore generally been compelled to confine themselves to collecting the different young forms of the same animal one after the other, by repeated fishings, and uniting these to form a general picture of the development. Frequently however it happens that, notwithstanding constant exertions, a form once observed never again comes into the net, or occurs so rarely, that the origin of the single larvæ has remained unknown, whilst others which were taken plentifully and at different periods continued so obstinately in a certain early stage of development, that all endeavours to ascertain their subsequent fate were vain. It is therefore not to be wondered at if, amongst the great number of young Annelides which have been fished up from the sea and described, there are but few which we can refer to their parents. A remarkable example how, with the greatest perseverance, the goal is often reached only after the lapse of a long period, is furnished by the *Mesotrocha sexoculata*, recently ascertained by Max Müller to be the larva of *Chætopterus*, although J. Müller and Busch were repeatedly led to investigate it during their excursions without being able to observe any considerable progress in its development.

The employment of artificial impregnation will be of importance to the study of the metamorphoses of the Annelida. As yet this has only been tried once by Quatrefages, who by this

* From the Abhandl. der naturforsch. Gesellsch. in Halle, vol. iv. Communicated by the Author and translated by W. S. Dallas, F.L.S. &c.

means obtained young *Hermellæ*, and was enabled to follow their development for a considerable time. When we possess a series of similar observations, the forms discovered swimming freely, whose mature state is still unknown, may be gradually determined. Thus, R. Leuckart remarks*, that the larvæ represented by Busch, 'Beobachtungen,' &c. tab. 7. figs. 5, 6, which were taken up from the open sea, remind one of the young *Hermellæ* just mentioned, by their long stiff bristles. But in this case it cannot be supposed that the former are actually the progeny of *Hermella*, as the latter, according to Quatrefages, lose their cilia before the appearance of any segmentation of the body.

Our knowledge of the development of the Annelida has also been advanced by the circumstance, that certain branchiferous worms bear their eggs about with them until the evolution of the young. Thus, in *Eunice sanguinea*, according to Koch, the young are brought to maturity in the cavity of the body of the mother, where they are retained until they reach a length of from one to two inches, and acquire from 100 to 120 segments. No trace of cilia appears to exist in these young animals. The progeny of *Nereis diversicolor* quit the cavity of the mother at a much earlier stage of development. In female specimens of this Annelide taken in April on the coast near Greifswald, where it is very abundant, I observed that the oval or pyriform embryos, which are uniformly covered with cilia, and, from their reddish-yellow colour, remind one of the young of *Medusa aurita*, came in hundreds out of small apertures on the sides of the body, under the pedal tubercles. These embryos (Pl. II. figs. 11 & 12), which swim about rapidly, measure $\frac{1}{10}$th to $\frac{1}{8}$th of a line; they are rather opake, in consequence of the numerous fatty vitelline granules imbedded in the body. They swim with the narrow end forwards, and the little animal constantly turns on its axis. Near the anterior extremity is the mouth, marked out by longer cilia arranged in a circle, and from this a canal passes inwards, the hinder extremity of which did not appear to be formed. In front of the mouth there are one or two dark eye-spots, without refractive bodies. I did not observe any further metamorphosis, as the larvæ soon died in my glasses.

Instead of the cavity of the body, the embryos of other Annelida are developed in peculiar sacs situated on the dorsal or ventral surface of the mother, where they generally attain a proportionably high development. This is the case in *Sacconereis*†,

* Jahresbericht, 1848–53, and Wiegmann's Archiv, 1855, i. p. 21. See Annals, 2nd Series, xvi. p. 264.

† *Sacconereis helgolandica* has recently been ascertained by Krohn (Müller's Archiv, 1855, p. 489) to be the result of the division of *Autolytus prolifer*, a great step in the history of the development of this interesting

according to the observations of Johann and Max Müller, and of myself, in *Cystonereis*, Kölliker, *Exogene*, Oersted and Kölliker, and *Syllis pulligera*, Krohn. In *Sacconereis* the young appear to issue in swarms from the ventral sacs of the mother, as they are provided with several bands of cilia, and when the sac is artificially destroyed, possess the power of swimming in a high degree; whilst the evolution of the young of *Cystonereis, Exogene*, and *Syllis pulligera* takes place on the body of the mother until the disappearance of the cilia (which are certainly present in the earliest stages of *Exogene cirrata* and *Syllis pulligera*) and the appearance of the segments and lateral bristles.

In a considerable number of Branchiferous Annelides, again, the eggs are deposited enclosed in a mass of jelly, and develope themselves in this covering, without any connexion with the mother, until the young are furnished with bristles and other locomotive organs like those of the mature animals. These do not enable them to swim freely for any length of time, but only to creep along the sea bottom. Examples of this kind occur in the Tubicolar families of the *Terebellacea* and *Serpulacea* in the genera *Terebella* and *Protula*, with whose young Milne-Edwards has made us acquainted. As the masses of eggs of these animals are attached to the exterior of their tubes, no doubt can exist as to their origin, when they are collected at the same time with the mother; and the tracing of their further development is extraordinarily facilitated by the fact that they require no change of water, at least as long as they remain enclosed in the gelatinous masses, and therefore survive in the glasses.

An example of this mode of development is also presented by *Arenicola piscatorum*, the egg-masses of which I collected near Cuxhaven, on the 22nd March 1852, and brought with me to Greifswald, where the further development took place. On the island of Neuwerk, which lies a few miles to seaward of Cuxhaven, the traces of *Arenicola piscatorum* occur in extraordinary numbers. In passing, during the ebb-tide, over a surface of sand but slightly covered with water, I saw, lying on the sand, close to almost every one of the little heaps thrown up by the worms

gemmiparous worm; and the same is probably the case with the second species, *S. Schultzii*, from the Mediterranean, described by J. Müller. I have no doubt that the animal of this genus taken by me at Heligoland, and mentioned by J. Müller from my letters, is identical with that observed by Max Müller (Müller's Archiv, 1855, p. 13). I took no notes of the number of segments in the body; but the young animal is represented at fig. 10 (Pl. II.). It represents a further step in the development of the young worm represented by M. Müller, *l. c.* tab. 2. figs. 5–8, and is particularly distinguished by its four bands of cilia. Of the fine cilia which at an earlier period covered the whole body, only those on the head are still in existence.

at this period, which were here scarcely six inches apart, a pyriform gelatinous mass about half an inch long and of a fine rose colour. On examining them more closely, I found that each of them was fastened into the sand by a gelatinous stem of about two inches long, and that the red colour was caused by an aggregation of red granules in the interior of the greenish-yellow jelly. These are the eggs of *Arenicola*, of which from 300 to 400 are enclosed in the gelatinous mucus (Pl. II. fig. 1).

From microscopic examination of some of them, it appeared that the yelks lay close together in the gelatinous mass, only enclosed in an extremely delicate vitelline membrane, something like those of *Nemertes* in their pyriform vesicles; and as I found no traces of the commencement of segmentation, I concluded that the eggs were only just deposited.

Unfortunately I was unable to trace their development on the spot, and only recommenced my observations nine days afterwards on the egg-masses which I took with me to Greifswald. I then found that the process of segmentation was completed in most cases, and that the oval embryos had acquired a fringe of extremely fine cilia, in the form of a broad band, near what I afterwards ascertained to be the anterior extremity (fig. 2). Other eggs, which were rather backward in their development, although they certainly gave no satisfactory clue to the course of the process of segmentation, showed at all events that this was complete, and that the vitelline membrane had taken part in it so far as to furnish envelopes for the globules of segmentation, and consequently gave off the materials for the walls of the embryonal cells. The embryos could therefore have been enveloped in no other capsule, but lay quite free in the semifluid jelly, in which they began to move about slowly after the development of the cilia. The animals soon became rather more elongated (fig. 3), and with this change of form new circles of cilia made their appearance (fig. 4), one close before and a second close behind the first ciliary band, and a third at the hinder extremity of the body. All three of these are very narrow, and consist only of a few series of very fine cilia, which can only be seen with a high magnifying power, and never exhibit the rotatory motion which is often so remarkable in the free-swimming Annelidan larvæ. At the same time two dark-red eye-spots made their appearance in the neighbourhood of the first circle of cilia. This was the condition of the embryos on the twelfth day.

The length of the animal now gradually increases, whilst the circles of cilia undergo no change in number or form. On the other hand, distinct annular constrictions make their appearance in the middle of the body, the first close behind the last circle of cilia, whilst the following ones are at first rather close together (fig. 5), but gradually become more distant with the further growth of the animal (fig. 6). The body, which hitherto had been quite opake, now separated into a lighter peripheric portion, lying under the skin, which still continued rather dark, and an opake central portion. The former represents the cavity of the body, the latter the intestine, in which a cavity may be recognized by the granules which move about in it. The intestinal canal does not, however, lie free in the general cavity, but is attached to the inner surface of the skin by annular bands corresponding in number with the developed segments of the body. A mouth exists behind the eyes, on the ventral surface; the anal opening occupies the extreme hinder end of the body. No traces of a nervous or vascular system are perceptible.

On the twentieth to the twenty-fourth day the bands of cilia disappear entirely, and the young animals, which had previously moved slowly about in the gelatinous mass, now quit it in the form of sluggish, helpless worms. Their length is now $\frac{1}{2}$ to $\frac{3}{4}'''$. Their form is cylindrical, somewhat widened towards the anterior extremity, which terminates in a point, and truncated behind (fig. 7). The mouth lies close behind the red eye-spots, which are destitute of a refractive medium; it leads into a muscular œsophagus (*a*), and this into the intestine, which runs straight backwards to the anus. The number of segments in the body has increased to 10 or 12 by additions at the hinder extremity (between the last and penultimate segments). On the most anterior of these the first lateral bristles are perceptible, standing in groups of from two to four; they are delicately serrated on one edge (fig. 9), in this respect resembling the infinitely larger bristles of the mature *Arenicola*.

My endeavours to keep these young worms any longer failed entirely. I put them into a glass upon a thin stratum of sand which I had brought with me from the island of Neuwerk, containing a variety of Infusoria and Algæ which might possibly have served them for nourishment, but they died without undergoing any further change of form. I think, however, that I saw indications of the formation of the auditory vesicle, as I observed on each side, in front of the eyes, a small vesicle with a tolerably sharp outline, and with irregularly granular, but not calcareous, contents, which would probably afterwards be the otolithes.

It is to be expected that the young *Arenicolæ*, after creeping out of their gelatinous envelope, would bore into the sand in the neighbourhood of their parents, and then gradually acquire their mature form. The next thing to be done, therefore, is to seek the young in this situation at the proper season.

From the foregoing statements, the development of *Arenicola* has the greatest similarity with that observed by Milne-Edwards in *Terebella* and *Protula*. In these, also, the eggs are deposited without any envelope besides the vitelline membrane in gelatinous masses, in which the young are developed to a certain point. They also obtain an anterior and posterior circlet of cilia, by means of which they move about in the soft jelly, and do not quit this until their more powerful locomotive organs, the bristles, are developed, and the cilia have disappeared, so that a free swimming condition does not occur. Nevertheless there is a difference in the number of bands of cilia, as the last-mentioned forms do not acquire the two fine circles which occur in *Arenicola* before and behind the broad band. But no great stress can be laid upon this difference, as the increased number of ciliary circles appears in this case to be rather a division of the original simple anterior band, and they are all situated upon the same segment, the head. Milne-Edwards supposes that the young animals, after the development of the first cilia upon their surface, creep out of the vitelline membrane, which is afterwards absorbed. It appears to me more probable, that in *Terebella* and *Protula*, as in *Arenicola*, the vitelline membrane passes into the embryo itself, by furnishing the envelopes of the globules of segmentation, or the future embryonal cells, and that consequently no egg-capsule exists from which the embryos must escape. Milne-Edwards did not observe the process of segmentation, and was consequently in uncertainty as to the part taken in it by the vitelline membrane.

Remak, in his recent investigations upon the development of the Vertebrata, has described the part played by the vitelline membrane, which he calls the *egg-cell-membrane* (*Eizellenmembran*), in the segmentation of the egg of the Frog, as consisting in its furnishing envelopes for the segmentary divisions by the agency of constrictions, which it acquires simultaneously with the vitelline mass itself. I have confirmed this statement in the eggs of *Petromyzon Planeri*, which also undergo a total segmentation*. I doubt, however, the propriety of adopting the name of egg-cell-membrane for the membrane immediately enveloping the yelk, as this and no other deserves the name of vitelline membrane. I believe we must regard the vitelline membrane as having the same signification in the eggs of *Arenicola* as in these eggs.

In other Branchiferous Annelides, however, the behaviour of the membranes of the egg appears to be different. At least in the case of *Hermella*, Quatrefages asserts that during segmenta-

* See Annals, May 1856, p. 443.

tion the vitelline membrane retains its form of a simple vesicle, but afterwards unites with the surface of the embryonal cells, forming the skin of the embryo, and acquiring cilia on its outer surface. And this statement acquires more force from those of O. Schmidt with regard to the development of *Amphicora* (*Fabricia*) *sabella**. This little Annelide, which has been classed amongst the Cephalobranchiate worms, although, according to Schmidt, it bears its branchiæ on its tail, lays its eggs in the tube which it inhabits, but which it then quits. Their development resembles that of *Exogene* and *Cystonereis,* and in the course of it the vitelline membrane becomes converted into the skin of the embryo, as in *Hermella.* New observations must prove the reality of the occurrence of such a participation of an egg-capsule in the formation of the embryo, which would differ from all known modes of animal development.

If we attempt, in conclusion, to refer the numerous and variously formed Annelidan larvæ hitherto observed to a few typical forms, in order to facilitate the examination of their further metamorphoses, and acquire an approximate knowledge of the mode of development common to all, the nature of the ciliary coat, and the number and arrangement of the bands of cilia when such occur, present us with a constant character applicable to this purpose, as has already been pointed out by others.

In this way Busch† distinguishes two groups of Annelidan larvæ,—one, for which Lovén's larva‡ serves as the type, *possessing a circlet of cilia at each end of the body* (the anterior generally situated between the eyes and the mouth), *between which the segments of the worm are afterwards developed.* These have been subsequently named *Telotrochæ* by J. Müller (Archiv, 1855, p. 12); and besides Lovén's larva, the destiny of which is unknown, this series includes a portion of Busch's larvæ, which also cannot be referred to their parents, the larvæ of *Polynoë* (Sars), *Nereis* (Busch, *l. c.* tab. 9. fig. 11), *Terebella, Protula,* and *Arenicola.* Perhaps also the young *Hermellæ* may be referred to this position, as Quatrefages thinks (Ann. des Sc. Nat. 3 sér. x. p. 189), although, according to the description and figure, they are destitute of a hinder circle of cilia.

The second group established by Busch is that of the *Mesotrochæ, with a simple or double wheel-like organ situated in the middle of the body.* To this belong all the larvæ to which the generic name of *Mesotrocha* has been applied, one of which, the *M. sexoculata,* as already stated, is now ascertained to be the young state of a *Chætopterus.*

* Neue Beiträge zur Naturgeschichte der Würmer, p. 29.

† Beobachtungen, &c., pp. 57, 62.

‡ Wiegmann's Archiv, 1842, p. 302.

All Annelidan larvæ, however, cannot be referred to these divisions. For instance, the young of *Sacconereis*, as already mentioned, possess several (four) bands of cilia at equal distances on the body. The same is the case with a larva from Trieste, described by J. Müller (Monatsber. der Berl. Akad. 1851, p. 471); it measured $\frac{2}{10}'''$, and possessed no bristles, but was distinguished by the presence of bacillar corpuscles, like those in the skin of the *Turbellaria*; and also with the larva from Trieste with 2 strong and 10–14 weaker circles of cilia, figured by Busch, tab. 9. figs. 9 and 10, which was traced further by Max Müller (Diss. Inaug. Berol. 1852, p. 25, tab. 3. figs. 14–17), but without arriving at its definite form. These young Annelida may be denominated *Polytrochæ*, after J. Müller.

Lastly, the general coating of cilia, which frequently occurs in the earliest period of embryonic life (*Chætopterus*, *Sacconereis*, *Nereis diversicolor*), but generally gives place to the isolated circles, appears to be persistent in the same form throughout the whole larval existence of many Annelides. For such J. Müller proposed the name of *Atrochæ*; he observed one of them at Trieste, measuring $\frac{1}{10}'''$, which was already furnished with developed setæ (Monatsber. 1851, p. 472).

All the young Annelides referred to these four divisions agree in their development from the egg in the form of globular or oval, *non-annulated* embryos, in receiving indications of division into segments from the circlets of cilia when these are present, but only acquiring the form of an Annelide, with distinct body-segments and lateral bristles, after the lapse of some time. A considerable deviation from this plan of development is presented by *Cystonereis Edwardsii*, and *Exogene Oerstedii* and *cirrata*, described by Kölliker, as also by *Exogene naidina* according to Oersted, and *Amphicora sabella* according to O. Schmidt. The young of these animals acquire, whilst still in the egg, a form similar to that of the mother, as they appear at their first formation divided into several segments, like the embryos of the Articulata. In the embryos of *Cystonereis Edwardsii*, Kölliker counted 8–9 segments, and 6 in *Exogene cirrata*. In these there are no traces of circles of cilia, and even a general coat of cilia is wanting; whilst, on the other hand, fine cilia occur on certain regions of the body, as in the embryo of *Exogene cirrata* on the ventral surface. In these animals, therefore, we cannot speak of a larval state, as they pass through all those changes of form whilst still in the egg, which gradually occur in the others during their free-swimming period, and long after their embryonal existence. They are therefore destitute of the provisional, transitory organs which characterize the larval condition of the others.

To this short summary of the present state of our knowledge of the development of the Branchiferous Annelides, I add a tabular view, in families, genera and species, of all those worms whose earlier states have hitherto been observed, whether singly or in complete series. The systematic arrangement is that of Grube, in his 'Familien der Anneliden.' It shows how extremely small, in comparison with the number of known species, is that of the observations of their developmental forms, a number however which would certainly be doubled, if we were acquainted with the parentage of all the larvæ hitherto observed.

Tabular View of those Branchiferous Annelides of which the Young States have already been observed.

Rapacia.

Aphroditea ..	*Polynoë cirrata*......	Sars, Wiegm. Arch. 1845, i. p. 11.
	Polynoë............	M. Müller, Arch. 1851, p. 323; Desor, Bost. Journ. vi. p. 12.
Eunicea	*Eunice sanguinea*	Koch, Neue Denkschr. der schweiz. Gesellsch. viii.
Lycoridea ..	*Nereis diversicolor* ..	Schultze, in this paper.
	Nereis, sp. dub.......	Milne-Edwards, Annales des Sci. Nat. 3 sér. iii. p. 166; Busch, Beobachtungen, &c. p. 69. tab. 9. figs. 11, 12.
Phyllodocea.	*Phyllodoce*, sp.......	M. Müller, Arch. 1855, p. 17, note.
Syllidea	*Syllis pulligera*	Krohn, Wiegm. Arch. 1852, i. p. 251.
	Autolytus prolifer....	Krohn, Wiegm. Arch. 1822, i. p. 66; Müller, Arch. 1855, p. 489.
	(*Sacconereis helgolandica.*	M. Müller, Müll. Arch. 1855, p. 13; Schultze, in this paper.
	Sacconereis Schultzii.)	J. Müller, Ueber den allgem. Plan. in der Entwickelung der Echinodermen, p. 7, note.
	Cystonereis Edwardsii.	Kölliker, in Koch, Neue Denkschr. der schweiz. Gesellsch. viii. p. 21.
	Exogene naidina	Oersted, Wiegm. Arch. 1845, p. 20.
	Exogene Oerstedii and *cirrata.*	Kölliker, Neue Denkschr. der schweiz. Gesellsch. viii. pp. 15, 22.
Ariciea	*Nerine* (*Malacoceros*) *longirostris.*	Leuckart*, Wiegm. Arch. 1855, i. pp. 63 & 77; Busch, Beob. tab. 8. figs. 1–4.
	Leucodore ciliata	Oersted, Annul. Dan. Consp. p. 39. tab. 6. fig. 96 (?); Frey and Leuckart, Beiträge, &c. p. 98. tab. 1. fig. 19 (?).

* See Annals, 2nd Series, xvi. p. 259.

Limivora.

TELETHUSA ..	*Arenicola piscatorum.*	Schultze, in this paper.
TEREBELLACEA.	*Terebella nebulosa*, &c.	Milne-Edwards, Ann. des Sci. Nat. 3 sér. iii. p. 145.
HERMELLACEA.	*Hermella*	Quatrefages, Ann. des Sci. Nat. 3 sér. x. p. 153.
SERPULACEA ..	*Protula*	Milne-Edwards, Ann. des Sci. Nat. 3 sér. iii. p. 161.
	Fabricia (Amphicora) sabella.	O. Schmidt, Neue Beitr. zur Naturgesch. der Würmer, 1848, p. 27.
CHÆTOPTEREA.	*Chætopterus*	M. Müller, Arch. 1855, p. 1. *Mesotrocha sexoculata*, J. Müller, Arch. 1846, p. 101; Busch, Müll. Arch. 1847, p. 187; Beob. &c. 1851, p. 59.

EXPLANATION OF PLATE II.

Fig. 1. Mass of eggs of *Arenicola piscatorum*, enclosed in a pedunculate gelatinous envelope: natural size.

Fig. 2. Embryo of *Arenicola* after the process of segmentation has reached the stage in which the embryo commences its movements in the gelatinous mass by means of a broad band of cilia at the anterior end (about 10 days old). 150 diameters.

Fig. 3. The same embryo, rather more elongated (one day older).

Fig. 4. An embryo in which the body has become more elongated, with the appearance of new bands of cilia (12 days old).

Fig. 5. An embryo, in the interior of which the differentiation of the central cord (the alimentary canal) has commenced, with the appearance of the first traces of segments (13 days).

Fig. 6. An embryo in which the intestinal canal and the segments are still more distinctly developed; the general cavity is traversed by transverse walls, corresponding in number with the segments, and attaching the intestine to the inner surface of the walls of the body: the circles of cilia are still unaltered (17 days).

Fig. 7 A young larva, 24 days old, which has escaped from the gelatinous envelope. The circlets of cilia have disappeared, the number of segments has considerably increased, and the anterior extremity of the intestine passes into a barrel-shaped œsophagus, the wide anterior opening of which is close to the mouth (*a*). The anterior segments of the body are furnished with setæ. 80 diam.

Fig. 8. Anterior extremity of the same embryo, seen from the side to show the position of the mouth on the ventral surface.

Fig. 9. Setæ from the anterior segments of the body. 400 diam.

Fig. 10. Young of *Sacconereis*, with four circles of cilia, from Heligoland.

Figs. 11 & 12. Young of *Nereis diversicolor*, just escaped from the cavity of the mother; fig. 11, from the ventral side, showing the mouth, *a*; fig. 12, from the back.

XIV.—*Notes on the Freshwater Infusoria of the Island of Bombay.* No. 1. *Organization.* By H. J. Carter, Esq., Assistant Surgeon H.C.S., Bombay.

[With three Plates.]

For some time past, when circumstances would permit, I have paid considerable attention to the Infusoria and Freshwater Algæ of the Island of Bombay, which being the same, generally, as those of Europe, have not occupied me much in specific description, while they have left me comparatively uninterrupted in their structural and physiological observation. How much has been gained by the latter the following summary of my "Notes" will show.

I shall commence with the freshwater Rhizopoda, the *Astasiæ* and *Euglenæ*; but before proceeding to remark on them separately, I would premise some observations on the general organization of Infusoria, and these will be arranged under the following heads:—

Pellicula, or skin.
Diaphane, or transparent moving matter.
Sarcode, or abdominal mucus.
Moleculæ, or minute grains.
Granules, or large grains.
Digestive Globules, or spherical spaces which enclose the food.
Spherical Cells, or biliary organisms. (?)
Vesicula, or "contracting vesicle."
Nucleus.
Ovules, or embryonic cells.
Spermatozoids. (?)
Impregnation.
Development of Ovule.

Pellicula.—This term has been proposed by Mohl for the consolidated surface of material which has no distinct enclosing membrane*. Dujardin, in allusion to the tegumentary covering of *Amœba*, &c., likens it to the film which occurs over "flour-paste or glue allowed to cool in the air†;" and the same view of it will be taken here. It is at first inseparable and undistinguishable from the tissue which lies beneath it, yielding in every way to the form which the latter assumes. As, however, *Amœba* progresses in development, and its activity begins to diminish, the pellicula appears to thicken and harden, al-

* Mohl on the Structure of Chlorophyll. Ann. & Mag. Nat. Hist. vol. xv. p. 325, foot-note. May 1855.

† Hist. Nat. des Zoophytes Infusoires, p. 29 *et seq.*

though it still retains great tenacity; and thus the expansions of the subjacent tissue are seen to burst through it in much the same manner that the end of a stream of lead bursts through its pellicle. Finally, when all activity ceases, and the *Amœba* becomes stationary (by fixing itself to some neighbouring object through a pedicular prolongation of the pellicula), a new layer of the latter is formed below the old one, and thus the capsule is formed, and the pellicula replaced on the body of the *Amœba*, until the latter becomes firmly encysted (Pl. V. figs. 6, 8)*. To what part of the body of the *Amœba* the pedicular process corresponds, I am ignorant; but it is interesting to see that in *Euglena*, where a similar process takes place, it is the anterior extremity which is next the pedicle (fig. 9). Many freshwater Rhizopoda secrete a testaceous covering, which increases in size with the animal; but the fleshy part of the body being for the most part free, is of course still covered with pellicula. The pellicula forms the surface-covering of *Astasia* and *Euglena*†, as well as that of all the *holo-*, *poly-*, *diplo-* and *mono-*ciliated flexible animalcules and zoospores. Here too, probably, the cilia themselves are also covered with it, though secreted by subjacent organs, analogous perhaps to those which secrete the hairs on the bodies of higher animals,— a supposition that would appear ridiculous did we not find such a correspondence between the vital processes of the highest and lowest developments as to induce us to think the latter are but a repetition of the others on a smaller scale; that is to say, effected by similar agents, of corresponding minuteness, conducted on the same principle. Taking the above view of the pellicula, we must regard it as a structureless product, which hardens after secretion. May we not infer that there is a layer below, specially organized for its formation?

Diaphane.—By this name I would designate the moving substance on which the pellicula rests (figs. 1–3). *Amœba*, whose primary figure is spherical, has the power of changing this into an almost unlimited number of secondary forms, most of which, being attended with root-shaped prolongations, this Infusorium is justly entitled to a place among the Rhizopoda.

* After this the numbers alone of the figures will be inserted, as they are continuous throughout the three plates.

† Although *Astasia* and *Euglena* are here mentioned together, it seems that, in classification, one should be on the animal, and the other on the vegetable side of *Amœba*; for *Astasia* possesses a mouth and complicated buccal apparatus for biting off and taking in food, while *Euglena* appears to have no mouth, and to be nourished by endosmosis. The half-developed cilium, too, in *Euglena*, compared with the strong prehensile organ which occurs in *Astasia*, with many other points which will be mentioned hereafter, allies the former as much more to the zoospore or gonidium of the Algæ, as the reverse does the latter to the higher Infusoria.

That the diaphane is structureless and transparent, so far as our microscopic powers extend, may be seen by the travelling of some kinds of *Amœba* across the field of the microscope, in which the coating of the diaphane, though broader all round than the diameter of the turbid mass of contents in the centre, only now and then, when the light is favourable, comes into view. The radii in *Actinophrys* are wholly devoid of turbid material, except towards the base; and the advancing border of the *Amœbæ* generally is always transparent (figs. 2 *a*, 3 *a*). But whether granules are mixed with it or not, the diaphane by itself, that is the contracting material, in the present state of our microscopic powers, must be characterized by transparency and motion, without apparent structure. It has the same appearance and polymorphic power in *Difflugia*, *Euglypha*, and *Arcella*, as in *Amœba*; but in *Astasia* and *Euglena*, though still possessing great latitude in this respect, it can put forth no prolongations, and, consequently, the primary forms of these families are never entirely lost. This latitude is still more limited in *Oxytricha*, *Plæsconia*, *Paramecium*, &c., though in many Infusoria of this class it has still the power of temporarily producing considerable alteration in shape. It might be stated that the diaphane cannot be demonstrated in these animalcules; but the great power of motion of their tegumentary covering, combined with transparency, warrants the use of the term here just as much as in Rhizopoda, where it is only more striking, because, for want of cilia, the animalcule is compelled to put it forth in delicate expansions and prolongations, in progression, and for the capture of its food;—indeed, these are the two great modes in which all its vital movements are effected.

Some might think, from what has been stated, that there is no difference originally between the pellicula and diaphane, and that the latter passes into the former when the animalcule becomes encysted. But neither appears to be the case; for if we watch *Amœba* or *Euglena* undergoing this process, the activity and accompanying polymorphism of the diaphane are diminished only by the thickening and consolidation of the cyst, until the latter is fully formed, when they cease altogether. Subsequently, however, in *Euglena*, when this animalcule becomes temporarily encysted, the diaphane separates itself from the last layer of pellicula which completes the cyst, and thus the *Euglena* becomes free within it; after which it will force off the constricted peduncle of attachment from the object to which the cyst may have been fixed, and, projecting its cilium through the broken part, swim about for some time, until (perhaps by increase of size) the cyst is altogether burst, and its liberation restored (fig. 9). Yet it might still be observed, that this is no proof of the cyst and diaphane having been originally distinct structures, —the diaphane may have been re-formed; in which case I can only refer to what I have suggested respecting the origin of the pellicula, and add that what takes place generally in the higher organisms appears to me to be applicable to the lower ones. Certainly we do not find one structure erected by the organism of another in the former, but the production of each structure dependent on the presence of its proper organism *ab initio*; that is, that the structure does not appear before it is accompanied by the fully developed form of the cell or organism which produces it. I do not question that, under the laws of vitality, one organism may occasionally take on the excretory or secreting functions of another, nor that, from a common stock, all organisms, in obedience to the same laws, may be adapted to that which is particularly required of them; but I think that when once a being is fully developed, each organ of which it may be composed has its peculiar organism, and that organism its peculiar duties, which, except in unusual instances, are the only ones that it is capable of performing. That the diaphane, therefore, should pass into the pellicula, or the pellicula be secreted by the diaphane, seems untenable.

Related to the diaphane is the transparent intercellular substance of *Spongilla*, which has a polymorphism equally great with the fully developed cells. This, however, can only be satisfactorily seen when the new sponge is growing out from the seed-like body, at which time it spreads itself over the glass in a transparent film, charged with contracting vesicles of different sizes, and in various degrees of dilatation and contraction. How this substance is produced so early it is difficult to conceive, since it seems to come into existence independently of the development of the sponge-ovules, which are seen imbedded in it, and there undergoing their transformation into sponge-cells. The spicula too are developed synchronously with the advancing transparent border, from little glairy globules about the size of the largest ovules, which send out a linear process on each side, and thus gradually grow into their ultimate forms. Perhaps the only way of accounting for the early appearance of this intercellular substance is to consider that it is a development from some remnants of the original protoplasm, and then that it has the power of secreting a general pellicula, while at the same time it is in part the general diaphane; and perhaps possesses also the power of producing new sponge-cells, as we see the protoplasm in *Vorticella* and the roots of *Chara* producing new buds, viz. independently of the cell-nucleus.

Sarcode.—This name was proposed by Dujardin for the "glutinous substance of the interior" of Infusoria*; and we shall here understand it as applicable solely to what, in other words, might be termed the "abdominal mucus" (figs. 1 *b*, 2 *b*, 3 *b*). The sarcode occupies the centre, while the diaphane and pellicula form the circumferential layers of Infusoria; besides this, it is the seat of the "granules" and other organs of the interior, and appears to receive the food directly into its substance. From the greater latitude of the particles which are situated towards the centre, that portion may be inferred to be of less density than the rest; and sometimes, when the animalcule is rendered spherical by aqueous distension, there appears to be an actual cavity here (fig. 2 *d*); but as I am not certain about the real situation of the water under these circumstances, I shall return to this point again by-and-by. In the Rhizopoda generally, the sarcode appears to have no external communication, and hence the food must pass into it directly through the diaphane; but in most of the other Infusoria it communicates with the surrounding medium by one orifice at least. The same kind of substance occupies a good portion, if not the whole, of the internal or abdominal cavity of *Astasia* and *Euglena*, *Vorticella*, *Paramecium*, and the Infusoria of this class. When death is about to take place, it comes forth from *Vorticella*, *Paramecium*, &c. in round, transparent, structureless expansions; and even during life in *Stentor* a portion may be made, by pressure, to issue through a rupture of the pellicula without any apparent injury to the animalcule†. *Otostoma*‡, also, when under pressure, throws off portions of its sarcode through the anal orifice, containing a number of the "spherical cells," to be mentioned hereafter, with which it is charged in this kind of infusorium. As we shall presently find that the portions of food which are received into the midst of the sarcode are circulated round the abdominal cavity, it seems necessary to admit, also, that the sarcode is endowed with a power of motion, in which we cannot help seeing an analogy to that motion which exists in the alimentary canal of higher animals.

In *Euglena* the sarcode is separated from the diaphane by a layer of pointed, sigmoid fibres, arranged parallel to each other, so as to form in *Crumenula texta*, Duj., a conical cell, which, as soon as the ovules have become developed, and the diaphane and other contents of the sarcode have died off, becomes transparent, but still retains its conical form until the resiliency of the fibres,

* *Op. cit.* p. 35.

† Ehrenberg, *ap.* Dujard. *op. cit.* p. 34, foot-note. It is the same with *Nassula*.

‡ Ann. & Mag. Nat. Hist. vol. xvii. pl. ix. figs. 6–8, 1856.

now unrestrained by the diaphane and other soft parts, cause dehiscence, and the ovules are set at liberty (Pl. VI. fig. 60). May we not infer that the siliceous frustule of *Navicula* is similarly situated to this fibrous layer, and that it also derives its power of motion from an external coating of diaphane? That there is a gelatinous layer external to the frustule probably in all *Diatomeæ*, may frequently be seen, although it may not be always endowed with mobility. In a species of *Palmellea* too, like *Glœocapsa granosa*, Kg.*, which I have had under observation, the transparent external covering ("envelope-cell" of Cohn) not only at one period presents an actinophorous form, but also moves about under this condition, bearing the green elliptical cell within (singly, or divided into two or four, &c. as the case may be), whose form depends upon the presence of a more or less firm (skeleton) coat, that corresponds in position and office to the spiral coat in *Euglena* and the siliceous frustule in *Navicula*, viz. in supporting the contents of the sarcode and chlorophyll-bearing protoplasm, and in sustaining their form in all these organisms respectively (fig. 19). In *Oscillatoria* (*princeps*, Kg., mihi) again, although, like *Navicula*, the presence of a layer of substance endowed with motion round the cells cannot be seen, yet, when we observe the whole chain of a fragment moving slowly backwards and forwards within its sheath, and even extending beyond it, so as to force out the loosened cells at either end (probably for the formation of new filaments), we can come to no other conclusion, that I see, than that each cell, which corresponds in office to the frustule in *Navicula*, &c., is surrounded by a transparent, gelatinous substance, endowed with motion, and that, *en masse*, they perform this act: although this substance cannot be seen when the cells are undergoing simple elongation or filamentous development, yet it becomes evident enough when they are undergoing crucial division without the sheath for the multiplication of filaments. In none of these instances does this envelope, if existing in *Navicula*, as well as the rest, present any change on the addition of iodine but a yellow tinge, even when assisted by sulphuric acid; and it therefore appears to be entitled just as much to the term of diaphane in *Navicula* (if present), *Glœocapsa granosa* (?), and *Oscillatoria*, as in the Infusoria. In *Closterium* there are no signs of an organ of this kind externally, except at the extremities, where it may be an extruded part of the ciliated protoplasm within; for *C. lunula*, as Morren has stated, can fix itself by one end, and partially rotate upon that end; while in *Spirogyra* this much extrusion of the protoplasm

* *Hæmatococcus granosus*, Hassall, pl. 81, fig. 6, British Freshwater Algæ;—but with cells scattered, not continuous.

is not permitted, and the cell is here closed after the manner of vegetable cells generally. What further strengthens the view that there is in some Diatomeæ (*e.g. Navicula* and *Nitzschia*) a layer corresponding to diaphane on the surface, is, that there is some prehensile and transporting organ here, which undoubtedly has the power of seizing particles that come in contact with it, and of conveying them partially or wholly backwards and forwards from one extremity of the frustule to the other, or of retaining them on any part of it stationarily.

Moleculæ.—We will apply this term to the minute, colourless granules with which the sarcode is charged (fig. 3 *b*). They differ in size, and are the first bodies that appear in it; but whether they be of different kinds, have any particular office, or undergo any further development, I am at present ignorant. *Amœba, Astasia* (fig. 45), and *Euglena* (fig. 46), in the earlier part of their existence, respectively seem to contain nothing else but this molecular sarcode, the nucleus, and contracting vesicle; afterwards the "granules" appear, and last of all the ovules, both of which are developed in the sarcode amongst the moleculæ. By the time the ovules have become fully formed, the sarcode and its moleculæ have died off, or disappeared (figs. 26, 46, 56).

Granules.—This name is intended for certain large granules, which make their appearance among the moleculæ, and are circulated round the abdominal cavity in the manner of the digestive globules and particles of food (figs. 4 *a*, 5 *c*, 65 *a*). They are of different sizes, but chiefly characterized by being much larger than the moleculæ, few in number, of a circular, elliptical, elongated, sub-round, or irregular shape, with thick dark edges, apparently produced by obstruction to the passage of light,—colourless, or of a yellowish-green tint. When large, and with no other granular matters present but the moleculæ, they form a striking feature in the interior of *Amœba, Vorticella, Oxytricha, Paramecium aurelia*, &c.; but at times they are so insignificant in size as to be undistinguishable from the moleculæ, even if present at all. That they are not ovules may be satisfactorily seen when both are together; the dark, thick, and frequently irregular edges and colourless state of the former contrasting strongly with the thin, circular margin and faint yellow tint of the latter (fig. 5 *c*). They appear to increase in size and number with the age of the infusorium, and, when fully developed, to remain unaltered in size, though apparently somewhat shrivelled in form, until their dissolution. On one occasion, while watching the metamorphosis of an *Oxytricha* (similar to, but not the same as that described by M. Jules Haime*, and of which I

* Ann. des Sci. Nat. t. xix. p. 109, Zool. 1853.

hope to give a detailed account hereafter), these granules, during the formation of the globular cell within the body, which enclosed the materials from which the *Plæsconia* was ultimately developed, became congregated together at the posterior extremity of the *Oxytricha*, and remained there in a roundish mass, shut out from the cell, until the latter burst for the liberation of the *Plæsconia*, when, with the deciduous coverings, they passed into dissolution. Of the nature of their office I am ignorant, but they are sufficiently remarkable and constant to demand particular notice.

In the development of the sponge-cell, a similar set of large granules makes its appearance at a very early period, and increase in number and size until they form as remarkable a feature as those above noticed. At this time they are about $\frac{1}{10000}$ of an inch in diameter, of an elliptical shape, and of a light amber colour by transmitted light; they are the colour-bearing granules or cells of *Spongilla*, and give the colour of chlorophyll to this organism when it becomes green.

Such granules would appear to be present also in the earliest forms of *Amœba*, since they may be seen in *mono*- and *diplo*-ciliated monads, which, on losing these appendages, become polymorphic, and assume all the characters of *Amœba*. Here they not only resemble the granules of the sponge-cell, but at the same time appear to be of the same kind as those above described. Neither is it uncommon to see polymorphic cells, precisely like *Amœba*, bearing granules coloured like those of the sponge-cell; but the resemblance between the two organisms is so great, when the latter is free, that it is impossible to say which is which: however, they are greenish-yellow and elliptical-elongate in the foot of *Difflugia proteiformis*, Ehr., which cannot be confounded with the cell of *Spongilla*. That these granules are not ovules in the sponge-cell, any more than in the Infusoria, their colour alone is sufficient to determine.

Digestive Globules.—We shall use this term for spherical spaces of the sarcode, which are filled with water, and generally contain more or less food (figs. 3 *e*, 65 *b*, 74 *d*). They are formed in *Vorticella* and *Paramecium* in the following way, viz. as the particles of nutritive matter are drawn into the vortex of the buccal cavity, by the cilia which are disposed around its orifice for this purpose, they are forced down, with a certain amount of water, into the sarcode at the end of it, where they at first form a pouch-like dilatation, which sooner or later becomes constricted close to the buccal cavity, and, having been thus separated from it, passes off in a spherical form into the midst of the sarcode (figs. 65 *c*, 74 *c c*). The formation of one globule is soon followed by that of another; and so on successively the food, with a large quantity of water, is taken into the abdomen; sometimes the globule appears to contain nothing but water. When in the sarcode, it is continually undergoing circulation round the abdominal cavity, until the whole of its contents are digested, and resolved into a fluid, or until their nutrient parts are abstracted; the remainder then, still in a globular form, if there be sufficient water left to sustain this, is cast off through the anal orifice, as it arrives opposite this point during rotation (fig. 68 *b*). Frequently, however, nothing but the crude ingesta remain; for as soon as the globule begins to be circulated, the watery contents begin to be absorbed,—hence some particles of food are almost always present, without any globule round them (fig. 5 *d*); added to which, in many instances bodies pass directly into the sarcode without any globule at all (fig. 74 *e*). I cannot, with some others, think, that there is any intestinal canal in the abdominal cavity, because the digestive globules and other particles of food are constantly undergoing circulation round the *whole* of its interior. In *Vorticella*, particles of food may occasionally be seen to circulate throughout, and accumulate, in every corner of its interior, particularly those which do not happen to be enclosed in globules (fig. 74 *e e*). Moreover, the intimate resemblance which exists between the alimentary organs of higher Infusoria, viz. *Nassula*, *Otostoma*, &c., and those of the binocular and so-called blind *Planariæ*,—in the distance of the mouth from the anterior extremity, the presence of a buccal apparatus, and a simple sac-like stomach in the latter, lined with a layer of mucous substance (sarcode?), charged with the "spherical cells" about to be described, is so great, that with such a simple gastric organ in an animal so closely allied to these Infusoria as *Planaria*, I do not see what reason we have, in descending the scale, to expect a more complicated digestive apparatus; but, on the contrary, one still more simple, in which there would be no stomach at all;—a condition which appears to me to be common to all the Infusoria that have come under my notice.

In the *Amœba*, for want, apparently, of a channel of communication with the exterior, the introduction of food seems to take place directly through the diaphane; and it is only now and then that the process by which the digestive globule is formed can be distinctly seen. Thus, on one occasion, where the particle about to be enclosed was a small *Amœba*, the latter, after struggling for some time, got under the former, when the large *Amœba* raised its diaphane in a dome-shaped cavity over the small one, and then, closing in below, after the manner of a sphincter, shut in the small *Amœba*, which, with a portion of water, immediately passed into the sarcode, under the form of a spherical digestive globule*. That the food is broken down by a digestive process in this way may be seen in the *Amœba*, where it frequently appears in all degrees of solution in the same individual; viz. from an opake, crude mass, to a blue or brownish fluid, according to the colour which the material may assume under its altered condition. In *Astasia* digestive globules also appear; but here the food is taken in through a distinct mouth, while in *Euglena* the absence of such vesicles would appear to indicate that its support is of a different kind, if not introduced in a different way.

Spherical Cells.—These cells, to which I have just alluded, abound in the sarcode of *Otostoma*†, and apparently in many of Ehrenberg's Allotreta (fig. 92). In *Otostoma* they are of different sizes, because they are in all stages of development; and, to keep up their numbers, without distending the animalcule, they must be continually undergoing rapid decay, as well as reproduction. The most remarkable feature in them is, that the largest, besides other granular bodies, contain several small cells, filled with a brownish-yellow fluid, and these cells are also found free among the general group; but what their ultimate destination is, as they do not appear to grow larger, or to become reproductive, I am ignorant. In the *Planariæ* to which I have alluded, as well as in Rotifera, such cells nearly fill the stomach, and the large ones being more or less grouped together in the former, at the same time that they chiefly contain the yellow cells, the whole acquires a sub-acinous or glandular appearance, very like the hepatic element surrounding the alimentary canal of some of the lower worms. It is also interesting to find here that each possesses a lash of cilia (about 50) projecting from one part of the cell, which, for some time after they are forced into the water through the oral orifice, or a rupture of the body, act by their whipping movements as imperfect locomotive organs, while, when these cells are fixed *in situ*, the same whipping movement must keep up a continued agitation of the gastric contents, which, if not conducted in a similar way in the Infusoria, has its analogue there in the circulation of the digestive globules, and granular matters of the sarcode (fig. 92 *a*, *g*). Although ovules may occasionally issue together with these cells from *Otostoma*, &c. as well as from the *Planariæ*, yet the two can hardly be confounded; as in the *Planariæ* the peculiar character of the ovule not only distinguishes it, but by careful manipulation the whole generative apparatus may be exposed outside the stomach.

* Ann. & Mag. Nat. Hist. vol. iv. p. 93, 1849.
† *Idem*, vol. xvii. pl. ix. fig. 6 *b b*.

That these cells in *Planaria* and *Otostoma* are homologous organs can hardly be doubted, both from their general characters and their correspondence in position; but what their office may be is at present unknown. Occurring, however, as they do, in the stomach of *Planaria* and Rotifera, where there is no other analogue of the so-called biliary follicles of the lower worms*, and being almost identical in *Otostoma* and *Planaria*, they not only ally these two organisms, but, at the same time, appear to be the homologue of the biliary follicles in each.

I have never seen any cells of this kind in *Amœba*, unless the "granules" already described be their analogues. It appears evident that these are the same both in *Amœba* and the sponge-cell, and that they are the seat of the green colour in the latter. Are the green granules of the sponge-cell analogous to the parts or cells respectively which hold the colouring matter or endochrome in the *Diatomeæ*, *Closterium*, *Spirogyra*, *Cladophora*, &c., and (through the latter) to the "green disks" or peripheral layer of chlorophyll-bearing cellules in the internode of *Nitella*, and those which, scattered irregularly through its moving protoplasm, are circulated round the cell of *Serpicula verticillata* (figs. 63 *a*, 64 *a*)? If so, the chlorophyll-bearing parts of the protoplasm in vegetables may be the analogue of the liver in animals. In some Rotifera the spherical cells appear to bear bile as green as grass or chlorophyll†, while in others it is yellow. The same diversity of colour occasionally manifests itself in the *Diatomeæ*; while in *Spirogyra* especially, the oil-globules and amylaceous deposits, which abound in abortive conjugation, are entirely confined to the green spiral-bands, thus corresponding, in one identically, and in the other transitionally, with the fat and sugar which are formed in the liver of man; the colouring matter in all of course being, when present, a mere indication *cæt. par.* of the nature of the organ. How the colour-bearing cellulæ of the spherical cells are produced in *Otostoma*

* By this I do not mean to class the Planarians with the Worms. Mr. C. Girard, who has followed out the "Embryonic Development of *Planocera elliptica*," would ally them to the Gasteropoda,—'Researches upon Nemerteans and Planarians,' 4to, Philadelphia, 1854.

† Since writing this, I have seen *Diglena catellina*, Ehr., discharge the green matter from its alimentary canal, and retain nothing but the ordinarily coloured biliary cells; also *D. caudata* to have the whole of the soft tissues of its body coloured in this way, unless there be diverticulations of the stomach to this extent; so that I now begin to think this colour, which at first appeared persistent, to be adventitious, and gained from the *Euglenæ*, and, perhaps, chlorophyll-bearing protoplasm on which these species chiefly feed. Accidentally, perhaps, the bile may become green in any species of Rotifera, as in animals generally; and this appears to be the case with the endochrome of *Diatomeæ*.

and *Planaria*, I am ignorant; but in some Rotifera (*e. g. Brachionus Pala*, Ehr.) they present themselves at an early period in a circular or discoid group, attached to the cell-wall, and thus, with the absence of the nucleus, closely resemble a granulated state of that organ.

Vesicula.—I would propose this name for the "Contracting Vesicle," on account of the latter being a loose and inconvenient term in description (figs. 3 *c*, 4 *b*). It is certainly the most striking organ of the Infusoria, from its defined circular outline when distended, its hyaline aspect, and above all its sudden disappearance and gradual return at intervals, which give it a pulsatory character, so like that of a heart, that at first we are inclined to conclude that it must be the representative of this organ in the Infusoria. Spallanzani considered it a respiratory organ*; Ehrenberg the male organ of generation†; and Siebold a circulatory organ‡. The following facts, however, would seem to show that it is neither of these, but an excretory organ, viz.:—

1st. It is always seen either close to the pellicula, or close to the buccal cavity, and always stationary. Thus, in *Paramecium aurelia*, it is close to the surface, and although it of course passes out of view as the animalcule turns on its long axis, yet it always reappears, after contraction, in the same place (figs. 68 *a a*, 74 *f f*); while in *Vorticella* it is attached to the buccal cavity, and, being centrically situated, seldom passes out of view, except when it disappears under contraction, after which it also reappears in the same place.

2nd. In *Actinophrys Sol*§, and other *Amœbæ*, during the act of dilatation, the vesicula projects far above the level of the pellicula, even so much so as occasionally to form an elongated, transparent, mammilliform eminence, which, at the moment of contraction, subsides precisely like a blister of some soft tenacious substance that has just been pricked with a pin (fig. 24 *a*).

3rd. Lastly, when we watch the contraction of the vesicula in a recently encysted *Vorticella*, we observe that at the same moment that it contracts the buccal cavity becomes filled with fluid; and further, that this fluid disappears from the buccal cavity, and all trace of the latter with it, long before the vesicula reappears; thus proving at once, that the fluid comes from the vesicula and does not return to it, whatever may become of it afterwards (fig. 78).

The position of this organ, then, its manner of contracting,

* *Ap.* Dujardin, *op. cit.* pp. 103, 104. † *Idem*, pp. 105–108.

‡ *Ap.* Claparède, Ann. & Mag. Nat. Hist. vol. xv. p. 212, 1855.

§ *Idem, loc. cit.* pl. viii. fig. 1.

and the buccal cavity of encysted *Vorticella* becoming filled with fluid the moment it disappears (where we know it to be attached to the buccal cavity, and not to the pellicula), are almost conclusive of its excretory office. We have now to find out how this fluid is brought to the vesicula.

It will be remembered that there is a series of fusiform sinuses which surround each of the vesiculæ in *Paramecium aurelia*, and some other animalcula of this class, on which Spallanzani made the important observation, that as they become empty the vesicula becomes filled*. This may be easily seen, as well as that they do not reappear until some time after the vesicula has contracted. Thus we infer, that the fluid with which the vesicula is distended comes through the sinuses, but is not returned by them to the body of the *Paramecium*.

Now in some cases, faint hyaline or transparent lines may be seen to extend outwards† from each of these sinuses, which lines, Eckhard has stated, "traverse the body in a stellate manner." Hence, when we add Eckhard's evidence (which I have been able to confirm in a way that will be presently described) to the observation of Spallanzani, and connect this with the facts already adduced in favour of the excretory office of the vesicula, it does not seem unreasonable to conclude that the whole together forms an excretory vascular system, in which the vesicula is the chief receptacle and organ of expulsion.

While watching *Paramecium aurelia*, I on several occasions not only observed that the vesiculæ were respectively surrounded by from seven to twelve pyriform sinuses of different sizes, and that lines extended outwards from them in the manner described by Eckhard; but I further observed that these lines were composed of a series of pyriform or fusiform sinuses, which diminished in size outwards; and frequently I could trace as many as three in succession, including the one next the vesicula (fig. 66 *b b*). Hence I am inclined to infer, that this vascular system throughout is more or less composed of chains of such sinuses, and that all have more or less contractile power like that of the vesicula. Just preceding death, when *Paramecium aurelia* is compressed, and under other favourable circumstances, these sinuses run into continuous hyaline lines, and may not only be seen extending in a radiated, vascular form across the animalcule, but even branching out round the position of the vesicula, which, having now become permanently contracted, has thus poured back the contents which render them visible (fig. 67 *b b*). They enter

* Spallanzani *ap.* Dujard. *op. cit.* p. 103; Spall. Opusc. Phys. trad. Franç. t. i. p. 248.

† Ann. & Mag. Nat. Hist. vol. xviii. p. 448, 1846.

the lower or inner part of the organ, and at this point, therefore, are pushed inward as the vesicula becomes distended (fig. 68 *a a*). Under the same circumstances, also, when the vesicula is slowly dilating and contracting, it may be seen to be attached to a small papilla on the surface, about twice the diameter of those which surmount the trichocysts*, and through which it probably empties itself (fig. 68 *a a*). In *Otostoma* there appears to be a similar arrangement of vessels round each vesicula, and here also they seemed to me to be branched,—at least such was my impression after having watched this animalcule for a long time, in order to determine the point.

In *Amœba* and *Actinophrys* the vesicula is generally single; sometimes there are two, and not unfrequently in larger *Amœbæ* a greater number. In *Euglypha* I have not been able to recognize them, but in *Arcella vulgaris* and *Difflugia proteiformis* (figs. 79, 80) they may be seen in great number, situated round the margin of that part of the animalcule which is within the test; and from their always reappearing, after contraction, in the same places respectively, we may perhaps infer that the situation of the vesicula in *Amœba* and *Actinophrys* also is fixed, though from their incessant polymorphism it appears to be continually varying in position. In *Paramecium*, and Ehrenberg's Enterodela generally, the vesicula is either single or dual. When it exists in great number in any of these (*e. g. Chilodon cucullulus*, Ehr.), this appears to depend on accidental dilatations of the sinuses in connexion with it. Thus, in the animalcule just mentioned, where the vesicula is single, and seems to be subterminal and lateral in its normal position, it is not uncommon to meet with a group in which every member presents a variable number of contracting vesicles, variably also and irregularly dispersed throughout the body, without one being in the true position of the vesicula (figs. 82, 83). That the vesicula does make its appearance now and then may be inferred, as it perhaps may also be inferred that from over-irritability, or some such cause, it does not remain under dilatation long enough to receive the contents of the sinuses; and hence their accidental dilatation,

* These are narrow, fusiform cells, arranged perpendicularly, and at some little distance from each other, under the pellicula, where they thus form a layer all over the body, and each, according to Dr. Allman, contains a delicate, resilient thread, coiled up in its interior, which, just after the cells have been forcibly pressed out into the water, by crushing the animalcule, causes them to assume, for a second, a circular form, and then burst, through which the thread is set free, and, lying rigid on the glass, presents the form of an acicular crystal, terminated at each end by a pointed extremity, one of which, being more attenuated than the other, appears like an appendage. To these cells Dr. Allman has given the name of "trichocysts." (Quart. Journ. Microscop. Sc. vol. iii. p. 177, 1855.)

and the appearance of a plurality of vesiculæ. That, also, the sinuses which are in the immediate vicinity of the vesicula do empty themselves into it may be easily seen, when both are present; and what takes place near, it seems not unreasonable to infer may, through a concatenation of communication, take place from a distance. At the same time, the sinuses of this system in the sarcode of *Amœba* not only seem to burst into each other, and into the vesicula, but when the latter has contracted, another sinus, partially dilated, and situated near the border, may be seen to swell out and contract after the same fashion, before the reappearance of the vesicula (fig. 81 *a a*). Then there is no knowing how many vesiculæ there may be in *Amœba*; while *Actinophrys Sol*, Ehr., is surrounded by a peripheral layer of vesicles, which, when fully dilated, appear to be all of the same size, to have the power of communicating with each other, and each, individually, to contract and discharge its contents externally as occasion may require; though, generally, one only appears and disappears in the same place. In *Oxytricha* the vesicula is single or dual, but in *Plœsconia*, as far as my observation extends, always single. The vesicula is always single in *Vorticella*, where it is attached to the buccal cavity close to the anal orifice, as in *Rotifera* and the young of *Cyclops quadricornis* (fig. 74 *f*, *h*). In one species of *Vorticella* there is a distinct pouch for these excretory orifices, about half-way up the buccal cavity (fig. 75 *a*). In *Colepina* the vesicula occupies the posterior extremity.

Its existence in *Astasia*, *Anisonema*, and *Euglena* can only be determined by inference. They all have a transparent vesicle situated close to the anterior extremity; and in *Astasia* we know that it is thus situated close to the buccal cavity (fig. 45 *e*). In *Anisonema* it seems to alter in size and shape, as it does in some *Amœbæ*, without completely contracting; and in *Astasia* also it is at one time more defined and apparent than at another; but this may be owing to change of position in the entire animalcule. In *Polytoma Uvella* it is similarly situated, but double, and has been seen to contract by Schneider*; and in a small colourless animalcule, very much like a young *Astasia*, as well as in a minute species of *Chlamidomonas*, Ehr., I have frequently seen this vesicle contract and dilate in the manner of the vesicula; so that there can be little doubt about the vesicle in the anterior extremity of *Astasia*, *Anisonema*, and *Euglena* (fig. 49 *b*) being the homologue of the vesicula, though in the latter the red body be appended to it; this, however, is not the case in the *Chlamidomonas* mentioned, where the red spot is nearly in the middle of

* Ann. & Mag. Nat. Hist. vol. xiv. p. 322, 1854.

the body, and peripheral, while the vesicula is in the anterior extremity.

The apparent quiescent state of the vesicula in *Astasia*, *Euglena*, &c. may be an approach to its disappearance altogether as a distinct organ, and therefore a step nearer to the vegetable kingdom. But Schneider, in allusion to this, quotes a passage from Cohn, in which the latter observes, that "internal pulsating spaces" have been discovered in "certain genera of Algæ;" on which Schneider justly remarks, that if they "occur in the swarm-cells of *Confervæ*, they certainly cease to be a characteristic of animal nature*;"—thus rendering useless another distinguishing point between animals and plants at this part of the organic kingdom, which after all, perhaps, may be found to have its homologue in the vacuoles of the vegetable protoplasm.

That the vesicula is a distinct organ, and not merely a space like the digestive globule, might be inferred from its always occurring in the same place in the same species; but in addition to this, the fact was on one occasion most satisfactorily demonstrated to me by its remaining pendent in a globular form to the buccal cavity of a *Vorticella*, when, by the decomposition of the sarcode, and evolution of a swarm of rapidly moving monadic particles, these two organs, with the cylindrical nucleus or gland, though still slightly adhering to each other, were so dissected out as to be nearly separate; and thus yielding in position from time to time, as they were struck by the little particles, their forms and relative positions respectively became particularly evident (fig. 76 *a*).

Although globular in shape, yet, as before stated, it is accompanied in *Paramecium aurelia* by a variable number of pyriform sinuses, which are arranged around it in a stellate form. In most of the other animalcules these are globular, and, under exhaustion of the animalcule from various causes, are frequently so distended, and thus so approximated, as to assume the appearance of an areolar structure, immediately in contact with the vesicula (fig. 84). Each globular sinus, however, would appear to be the proximal or largest of a concatenation of smaller ones, which diminish in size with their distance from the vesicula (fig. 82 *d*). The vesicula becomes doubled preparatory to fissiparation, and therefore appears dual in *Vorticella*, and quadruple in *Paramecium*, &c. (fig. 69); and it is interesting to find that in the metamorphosis of the former into *Acineta* it frequently acquires a plurality similar to that which obtains in the Rhizopoda generally†.

* *Loc. cit.* p. 330.

† See particularly Stein's work on the Development of Infusoria.

Of the use of the vesicula, and its vascular system, we are at present ignorant, further than that its functions are excretory; and when we observe the quantity of water that is taken into the sarcode with the food, and try to account for its disappearance, it does not seem improbable that the vesicula and its vessels should be chiefly concerned in this office. Another service, however, which it performs, is to burst the spherical membranes of *Vorticella* and *Plæsconiæ* when they want to return to active life after having become encysted: this it effects by repeated distension, until the lacerated cyst gives way sufficiently for the animalcule to slip out. At these times, also, the animalcule is rendered so spherical by this distension that it is also evidently one way by which the Infusoria might assume this form (fig. 12). Hence, in describing the sarcode, I have expressed a doubt whether the water in an *Amœba*, when distended in this manner, be in its centre or in the cavity of the vesicula. Certainly, when *Amœba* is in the form of a sphere, I never have been able to see the vesicula, while all the other elements of the cell have been perfectly plain; added to which, under these circumstances, a part of the cell-wall is generally transparent, from the absence of the sarcode and its granules, which would be the case if the vesicula were the cause of the distension, since in *Amœba* it is attached to the pellicula, and therefore no sarcode exists immediately opposite this point (fig. 13).

Should it have any other uses, they are probably similar to those of the "Water Vascular System" of Rotifera, which in *Brachionus Pala*, one of the largest species of this class, consists of a corrugated sac when empty (like the bladder of mammalia), opening by a constricted neck into a heart-shaped cloaca close to the termination of the alimentary canal; and, when distended, presenting (*mihi*) a single vessel opening into its fundus, and then passing down through its side towards the neck, where it divides into two, which respectively run up laterally to the anterior extremity of the body, bearing in their course four monociliated (Huxley)* pyriform diverticula, and probably terminating, as in *Lacinularia*†, partly in junction and partly in blind tubes. The vacuolar structure attached to these vessels may be analogous to the vacuolar structure connected with the vesicula in the Infusoria, and it would be interesting to determine if the vacuoles in it occasionally diminish in size or disappear, or become dilated when from disease or approaching death the vesicula itself is unnaturally and permanently distended. Should the lateral vessels not terminate in *Brachionus Pala*, as above mentioned, then they must, as appears to be the case in the other

* Quart. Journ. Microscop. Sc. vol. i. p. 7. † *Idem.*

Rotifera open into the vesicula close to its communication with the cloaca.

It might be asked here, if all vacuolar dilatations of the sarcode belong to this excretory system of sinuses; that is, excepting those made by the buccal cavity in the manner mentioned? Certainly, where there is a plurality of actively contracting vesicles, without the appearance of the vesicula, as in *Chilodon cucullulus*, we may, as before stated, attribute this to a kind of over-irritability or constrictive spasm of the vesicula, and, therefore, consider that these vesicles are accidental dilatations of the sinuses in connexion with it; as we may set down the dropsical state of *Himantophorus Charon* (Ehr.), and other animalcules of the kind, to an opposite condition of this organ, viz. that in which it is unable to relieve itself of its contents (fig. 84): this I have often seen occur under my own eyes. But there is an intense vacuolar state of the sarcode that occasionally presents itself in *Amœba*, which makes it look like an areolar tissue composed of vesicles diminishing to a smallness that cannot be determined by the microscope,—such as is seen in the advancing border of *Spongilla* when issuing from the seed-like body, and in the protoplasm of the vegetable cell: whether this still be a part of the vesicular system or not, I am unable to decide; at the same time, the contracting vesicles in the transparent growing border of the new-developing sponge are so numerous, and so like those which are seen in the protoplasm of the last cell under formation of the stem and roots of *Chara* when budding from the nucule, that we cannot fail to see a most striking analogy between the two, even if we cannot reconcile ourselves to the former being a part of the vascular system attached to the vesicula; indeed, in the new nucleus itself of the roots of *Chara*, vesicles do appear and disappear.

Lastly, from the presence of the vesicula in *Spongilla*, and its being so constant in the Rhizopoda generally, and so numerous in *Arcella vulgaris*, it does not seem altogether unreasonable to infer that the streams of water which issue from the great canals of *Spongilla* are produced by the continued pouring into them, from the vesiculæ of the different sponge-cells, the superfluous water which they imbibe by endosmosis, apparently, during nutrition; for the type of *Spongilla* is to be surrounded with a general pellicula, in which there is only one excretory opening, and through which pellicula the ends alone of the spicula project in bundles; nor does it seem altogether far-fetched to conceive that the offices of glandular organs in higher developments may be performed, in some instances, after this fashion.

[To be continued.]

XV.—*Monograph of the genus* Catops. By Andrew Murray, Edinburgh.

[Continued from p. 24.]

Group II. (Subgenus Catops (true).)

Mesosternum not keeled; body oblong; antennæ more or less club-shaped or thickened towards the apex, eighth joint decidedly smaller than seventh and ninth. The posterior trochanters not more developed in the males.

1st Subdivision. *Base of thorax decidedly narrowed or cut in, so that the thorax and elytra do not form a continuous outline. Middle tarsi widened in the males.*

6. *C. acicularis*, Kraatz.

Catops acicularis, Kraatz, Stett. Ent. Zeit. xiii. 406. 6.

Oblongus, ferrugineus; antennis subfiliformibus; thorace transverso, postice latiore, angulis posticis obtusiusculis; *elytris* substriatis *transversim strigosis.*

Long. $1\frac{3}{4}$ lin.

Of the slender form of the species in the foregoing group, but proportionally not so elongate; ferruginous brown; easily distinguished from the remaining species of this group by its transversely strigose elytra. The antennæ are slender, reddish brown, not quite so long as the elytra; first joint somewhat shorter than the second; second equal to the third; third equal to the fifth; fourth somewhat longer and stouter than the sixth; eighth only one-third of the length of the seventh, and somewhat narrower than those on each side of it; ninth somewhat shorter than the seventh, almost somewhat stouter, and equal to the tenth; eleventh of the stoutness of the preceding, about half as long, from the middle forward cone-shaped acuminate. The head is densely and finely punctate, pitchy-black. The thorax is nearly of the breadth of the elytra, wholly light, twice as broad as long, slightly arched, the sides wholly rounded, somewhat more strongly behind than in front, so that the greatest breadth is behind the middle; the anterior angles are somewhat bent down, strongly rounded, the posterior angles are obtuse-angled. The basal margin is extremely lightly sinuated on both sides towards the scutellum; the upper side of the thorax is moderately densely and finely shagreen-punctured. The elytra are uniform oblong, gradually narrowed towards the apex, each being rounded; they have feeble traces of longitudinal striæ, and besides are transversely strigose almost parallel with the base of the thorax. The legs are ferruginous brown and slender.

I have not seen this species in nature, and have merely copied M. Kraatz's description. It appears to be readily recognized among its neighbours by its transversely strigose elytra. It is found in Sicily, and appears to be rare, M. Kraatz having only seen three specimens.

7. *C. fuscus*, Panz.

Helops fuscus, Panz. Fn. Germ. 18. 1.
Luperus fuscus, Fröhl. Naturf. 28. 24. 2. t. 1. f. 16.
Catops sericeus, Payk. Fn. Suec. i. 342. 1.
Catops rufescens, Fab. Syst. El. ii. 563. 1.
Choleva sericea, Spence, Linn. Trans. xi. 145. 6.
Catops festinans, Gyll. Ins. Suec. iv. 314. 1–2.
Catops fuscus, Erichs. Käf. d. M. Br. i. 235. 3; Sturm, Deutschl. Fn. xiv. 13. 5. t. 274. f. *a*. A; Heer, Fn. Helv. i. 379. 4; Redt. Fn. Austr. 164. 11; Kraatz, Stett. Ent. Zeit. xiii. 407. 8; Fairm. & Laboulb. Fn. Ent. Fr. i. 101. 7.

Breviter ovatus, *fuscus*; antennis subfiliformibus; thorace transverso, *postice latiore*, angulis posticis rectis; elytris rufo-brunneis, substriatis.
Long. 2 lin.

Dark brown, short oval. Antennæ ferruginous brown, very feebly thickened towards the extremity, not quite so long as the head and thorax; first joint longer than the succeeding joints; second very little shorter than third; third and fourth very nearly equal; fifth and sixth equal, both a little shorter than fourth; seventh not much if at all longer than sixth, but a good deal broader; eighth shorter than those on each side of it, but not greatly narrower; ninth and tenth about same size, and eleventh acuminate and nearly twice as long as the tenth. Head and thorax black, very densely punctate, with a yellowish grizzly adpressed pubescence; mouth reddish; edges of thorax ferruginous brown. *Thorax* rounded on the sides, *broadest behind the middle*, at the base almost twice as broad as long, *very slightly rounded in at the posterior angles*, which are right-angled and have a slight tendency to project behind. *Elytra reddish brown*, covered with a bluish-grey bloom; a little widened in the middle, *apex almost acuminate*; densely punctate, and with striæ visible towards the apex, scarcely perceptible in front. Legs reddish brown.

Fig. 6.

This species is easily distinguished from the rest of the section by the breadth of its thorax behind, which gives its outline at first sight, and before the junction of the thorax and elytra is examined, very much the appearance of being a continuous oval slightly interrupted at the base of the elytra.

It is widely distributed, being found both in England and Scotland, France, Germany, and most of Europe. Kraatz says that it is seldom or never found under leaves or fungi, but in cellars, stables, potato-heaps, &c. Fairmaire and Laboulbène mention it as having been also taken in moss at the roots of trees. Stephens gives "carcases" as its habitat, and rightly enough so far as regards the species he has under this name (viz. a pale variety of *chrysomeloides*), but incorrectly as regards the true *fuscus*. It is, however, easy to predicate of each species by a simple inspection of its antennæ whether it is a carcase-feeder or not. Those species with filiform or slightly thickened antennæ are found among leaves and moss, &c. Those with heavy, thick, clubbed antennæ are found under dead birds or small mammals. In other words, those which have to seek out putrescent matter for their food, or a nidus for their eggs, are furnished with largely developed antennæ to enable them to smell it out.

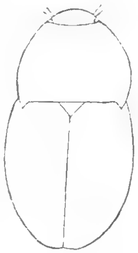
8. *C. meridionalis*, Aubé.

C. meridionalis, Aubé, Ann. Soc. Ent. Fr. viii. 326. 34. t. 11. f. 2; Kraatz, Stett. Ent. Zeit. xiii. 428. 10.

Ovatus, convexiusculus, piceus; antennis pedibusque ferrugineis; thoracis angulis posticis valde productis; elytris oblongiusculis, striatulis.

Long. $2\frac{3}{4}$ lin.

Fig. 7.



Pitchy-brown; in general appearance occupying the middle between *fuscus*, Panz., and *picipes*, Fab. Head black and finely punctate. Antennæ and palpi ferruginous; antennæ of the length of the head and thorax, only feebly thickened towards the point; first joint equal in length to the third, and nearly twice as long as the second; fourth equal to the fifth, also to the sixth, and somewhat shorter than the third; seventh equal to the second, yet somewhat stronger than those on each side of it; eighth scarcely half so long as the seventh, scarcely more slender, somewhat shorter than the ninth; tenth equal to the ninth; eleventh acuminate. The thorax is pitchy-brown, moderately convex, transverse, of the breadth of the elytra, once and a half as broad as long, emarginate in front, cut almost straight behind, where it is broadest; the sides are broadly rounded; the anterior angles depressed and rounded, *the posterior projecting behind and somewhat acute.* Scutellum tolerably large, finely punctate and reticulate. Elytra brown, oblong oval, nearly twice as long as broad, finely punctate and reticulate, and marked on each side of the suture with a sufficiently distinct stria, and with several others on the disk much less perceptible, particularly in front. Legs ferruginous.

This species at first sight looks very like an overgrown *fuscus*, Panz., but closer examination shows that it is a good species,—the proportions of the joints of the antennæ as well as other particulars being wholly different. In a specimen which I owe to the kindness of M. Kraatz, I observe that the development of the posterior angles of the thorax is considerably exaggerated in the outline I have given, which is copied from Aubé's own figure. Aubé also states it is larger than *picipes*, Fab., which had hitherto been considered the largest known *Catops*; but my specimen is scarcely so large as the smaller individuals of *picipes*, from which I should infer that it ought perhaps rather to be stated as being about the same size as *picipes*. Its entirely ferruginous colour and the projecting posterior angles of the thorax furnish a tolerably good *primâ-facie* guide to the species.

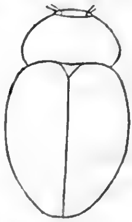
It is found in Sicily, and is as yet scarce in collections.

9. *C. picipes*, Fab.

Hydrophilus picipes, Fab. Syst. El. i. 251. 10.
Ptomaphagus picipes, Illig. Käf. Pr. 893.
Catops striatus, Duft. Fn. Aust. iii. 74. 3.
—— *blapsoides*, Germ. Ins. Sp. Nov. 84. 142?
—— *picipes*, Erichs. Käf. d. M. Br. i. 236. 5; Sturm, Deutschl. Faun. xiv. 17. 7. t. 274. f. c. C; Heer, Fn. Helv. i. 378. 5; Redt. Fn. Aust. 144. 10; Kraatz, Stett. Ent. Zeit. xiii. 428. 9; Fairm. & Laboulb. Fn. Ent. Franç. i. 300. 4.

Ovatus, convexus, niger; antennis subfiliformibus pedibusque piceis, apice testaceis; thorace transverso, basi sublatiore, angulis posticis obtusis; elytris apice profunde striatis.
Long. $2\frac{1}{2}$ lin.

Fig. 8.



This is the largest species of the genus, with the exception of the last. Oval, *convex*, black. Antennæ scarcely thickened at the end, reddish brown at the base, blackish at the extremity, excepting the last joint, which is light yellow. Head very densely and finely punctate, mouth reddish. The *thorax* is likewise very densely and finely punctate, with a fine silky pubescence, black, strongly rounded on the sides, *narrowed both in front and behind, but most in front*, posterior angles obtuse, posterior margin very slightly sinuated on each side, *the greatest breadth behind the middle*. Elytra oval, very convex, black, with a slight grey hoar-frost bloom upon them, very densely punctate, with striæ faint in front, deeper behind. Under side black, abdomen and legs brown, tibiæ ferruginous brown, tarsi pale ferruginous.

The only species with which there is any risk of this being confounded is *C. nigricans*, Spence. Its large size removes it from all but it and *C. meridionalis*, Aubé, and *C. chrysomeloides*, Spence. Independent of other distinctions, its colour at once distinguishes it from *meridionalis*, which is ferruginous, while this is black. It likewise wants the projecting posterior angles of the thorax. Its subfiliform antennæ distinguish it from *C. chrysomeloides*, which has the heaviest and thickest clubbed antennæ in the genus; and there only remains *C. nigricans*, to which it is much more allied. Both have subfiliform antennæ, pale at the base and apex, and the proportionate length of the joints of the antennæ is much the same; they are both black, with ferruginous legs; and I have specimens of *nigricans* very little inferior in size to *picipes*, but *picipes* is a broader and more robust-looking insect. It has the clytra much more convex and bellied out, and its thorax is differently shaped, being more contracted in front; and very commonly *nigricans* has two or three depressions on the disk of the thorax, which *picipes* has not. The posterior angles of the thorax in *nigricans* have a slight tendency to project behind, which is not the case in *picipes*.

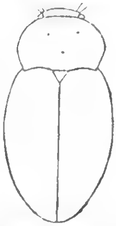
This species is found over the greater part of Europe, but is rare. I have not yet seen a British specimen. Kraatz observes that it is principally found in fungi. Fairmaire and Laboulbène say it is taken in the trunks of trees (I presume decayed).

10. *C. nigricans*, Spence.

Choleva nigricans, Spence, Linn. Trans. xi. 141. 3.
Catops nigricans, Erichs. Käf. d. M. Br. i. 237. 6; Sturm, Deutschl. Fn. xiv. 18. 8. t. 273. f. *c*. C; Heer, Fn. Helv. i. 380. 6; Redt. Fn. Aust. 144. 11; Kraatz, Stett. Ent. Zeit. xiii. 429. 11; Fairm. & Laboulb. Fn. Ent. Fr. i. 303. 16.
Catops var. minor, *C. fuliginosus*, Erichs. Käf. d. M. Br. i. 239. 10; Sturm, Deutschl. Fn. xiv. 28. 13; Redt. Fn. Aust. 771.
C. caliginosus (Mus. Berol.).
Catops var. major, *C. longipennis*, Chaud. Bull. de Mosc. 1845, No. 111. 196.

Oblongo-ovatus, niger seu piceo-brunneus; antennis longioribus, *obsolete clavatis*, ferrugineis, apice plerumque fuscescentibus; thorace transverso, postice latiore, *angulis posticis acuminatis*; elytris apice substriatis.
Long. $1\frac{3}{4}$ lin.–2 lin.

Fig. 9.



Oblong-oval, convex. Black or piceous brown. *Antennæ* a little longer than the head and thorax, *very slightly thickened towards the extremity*, sometimes entirely ferruginous, more generally ferruginous at the base and becoming fuscescent towards the point. Head finely punctate, mouth reddish brown. *Thorax* very densely and finely punctate, finely pubescent, *a little narrower than the elytra*, sides rounded, *the greatest width at the middle*; very generally with two or three depressions on the disk; *posterior angles* with a point, *projecting a little behind*, which makes the posterior margin appear to be visibly sinuate on both sides. Elytra blackish brown, sometimes paler, *elongate*-oval, somewhat convex, densely and finely punctate; faintly striate, the striæ perceptible towards the extremity, effaced in front. Under side black; legs reddish brown, thighs blackish.

Kraatz gives the following remarks on the larger and smaller varieties which have been described under the names of *C. longipennis*, Chaud., and *C. fuliginosus*, Erichs.; viz.—

"A. Larger, for the most part female specimens, differ from the smaller males in many particulars, so that one may easily be led to suppose them distinct species. In the first place, the antennæ of these larger examples are somewhat more elongate than those of the smaller specimens, and when they belong to females are also somewhat less stout, which makes them when taken as a whole look much longer than the antennæ of the smaller individuals. Then the elytra are more bellied out, so that the whole animal assumes a more convex appearance; at the same time also the striæ of the elytra are more feebly marked in this than in the other kind. Such examples are generally found along with the rest, but not frequently, and are not of the typical form. If there had not been laid before me by himself one of the original typical examples from Germar's fine collection, it would not have been possible for me, from the short and imperfect description which Chaudoir gives of his *C. longipennis**, to perceive in it the just-described variety of *C. nigricans*, Spence."

The description by M. Chaudoir to which M. Kraatz refers is as follows, viz.:—

"Near the *umbrinus*, a little larger, form more elongate: thorax broader, more rounded on the sides: elytra less swollen out, flatter, longer: antennæ more slender, last joint of these smaller and more pointed.

"A male, found at Kiew in the garden of the town under dry leaves, in the beginning of September†."

As to Erichson's *fuliginosus*, M. Kraatz goes on—

"B. The type of *C. nigricans*, sp., is the one described as *C. fuliginosus* by Erichson, according to two specimens left by Dr. Meuer to the Royal Museum (of Berlin). Those specimens which are in the Royal Museum as *C. nigricans* are not fully coloured, and, when we have only a few specimens for comparison, such have altogether a different appearance from the full-coloured specimens. If we compare more minutely Erichson's clear descriptions of both species, we find, besides an agreement

* Kraatz in *loc. cit.*

† Chaudoir in *loc. cit.*

on the most important points, only two differences. One is that the antennæ of *C. fuliginosus* are darker, which proceeds from the perfectly full colouring of the animal. The other again is that the sinuation of the hind margins of the thorax (which particularly characterizes this species) is in *C. nigricans* distinct, in *C. fuliginosus* feeble,—a mark, which in individual cases is not always present in equal force, and which also appears to the eye of the observer in different aspects stronger or weaker than is really the case. There are no specimens named *C. fuliginosus*, Erichs., in the Royal Museum, but instead of it are *C. caliginosus*, Erichs., evidently projected from the description of *C. fuliginosus*. We must suppose that Erichson had originally given his specimens of *C. fuliginosus* the name of *C. caliginosus*, and as such also determined them to his acquaintances, but subsequently allowed it to remain for reasons unknown to me*."

In dealing with a description emanating from Erichson, it will probably be better that I quote his description of *C. fuliginosus*, leaving the reader to form for himself his opinion of its value as a species. It is in these terms:—

"Oblongo-ovatus, niger; antennis obsolete clavatis, rufo-piceis, apice nigricantibus; thorace basi apiceque latitudine æquali, angulis posticis acuminatis; elytris obsoletissime striatis.

"Long. $1\frac{2}{3}$ lin.

"Very closely allied to the foregoing (*nigrita*, Erichs.). The antennæ have the same form and the same proportions, but are differently coloured; they are brownish red, the last four or five joints including the terminal blackish. The thorax is somewhat shorter than in the foregoing, a little narrower than the elytra, lightly rounded on the sides; the posterior angles pointed; the posterior margin on each side between the edge and the middle twice feebly sinuated. The elytra are oblong oval, very indistinctly striated. The colour of the body is black; the head and thorax have a fine yellow-grey pubescence; the elytra are more brownish black, with a grey hoar-frost rime on them. The legs are ferruginous brown, the thighs blackish †."

The impression the description rather leaves upon my mind is, that Erichson's intended *fuliginosus* may have been the species subsequently described by Kellner under the name of *coracinus*. The yellow pubescence on the thorax for instance, and the ash-grey rime on the elytra, apply well to it, but not to *nigricans*: on the other hand, the size, $1\frac{2}{3}$ lin., is too much for *coracinus*. Again, it may be that the small examples of *nigricans* standing under the name of *caliginosus* in the Berlin Museum collection, were not published by Erichson from a doubt of their being

* Kraatz in *loc. cit.*

† Erichson in *loc. cit.*

distinct, and that *C. fuliginosus* may have been described from other specimens, although they are not now in the collection in the Berlin Museum.

Still, in the face of M. Kraatz's deliberate opinion, fortified as it is by the specimens in the collection of the Berlin Royal Museum, and also doubtless by the traditions which must remain of Erichson's own views in a place which has only so recently been deprived of him, I have not ventured to carry my difference of opinion further than to submit the above suggestions for the consideration of the reader.

I have only to add with reference to this species (*C. nigricans*, Sp.), that the readiest distinction between it and such others (except *C. picipes*) as are likely to be mistaken for it, is furnished by the longish almost subfiliform ferruginous antennæ. In my observations on *C. picipes* I have already noticed the *primâ-facie* differences existing between it and this species.

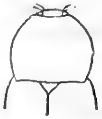
Widely distributed, being found in Scotland and England, France, Germany, and most of Europe, but nowhere common.

11. *C. coracinus*, Kellner.

Catops coracinus, Kelln. Stett. Ent. Zeit. vii. 177. 3; Redt. Fn. Aust. 771; Kraatz, Stett. Ent. Zeit. xiii. 431. 12.

Ovatus, niger; antennis obsolete clavatis, *rufopiceis*; thorace transverso, basi latiore, *angulis posticis distincte rectis*; elytris obsoletissime striatis. Long. $1\frac{1}{2}$ lin.

Fig. 10.



This has a considerable resemblance to *C. nigricans*, Spence, in the form of the elytra and antennæ, but is smaller, and more continuous in its outline: the hinder angles of the thorax are very slightly acuminate, so slightly as to be scarcely observable except by minute examination: the elytra are indistinctly striated. The antennæ are as long as the head and thorax, slightly thickened towards the point, in some individuals a little thicker than in others, reddish brown; the club usually blackish, but the depth of colour varies. The head and *thorax* are black, densely and finely punctate, *with a fine short yellowish pubescence.* The thorax is almost as broad as the elytra, broadest in the middle, straight at the base, the anterior angles rounded, *and the posterior angles right-angled at the very angle*; that is, when looked at superficially the angle would appear obtuse, but when examined more carefully there appears a very short space of right angle before the thorax takes its curved outline: the scutellum is proportionally large, and clothed with the same coloured pubescence as the thorax. The elytra are oval, densely and finely punctate, black, clothed with an ashen-grey pubescence or bloom indistinctly striated: *no yel-*

low pubescence along the base of the elytra. The legs are reddish brown.

Its small size, shorter and more thickened antennæ, more uniform and less bellied outline distinguish this species from *picipes*, Fab. Its shorter and more thickened antennæ, the yellow pubescence on the thorax and scutellum, want of depressions on the disk of the thorax, and the want of the produced posterior angles of the thorax distinguish it from the smaller specimens of *nigricans*, Spence. Its antennæ only slightly thickened, as well as its smaller size, distinguish it from *chrysomeloides*, Spence. From most of those which have a decided yellow pubescence on the thorax it is distinguished by the want of yellow pubescence along the base of the elytra. This separates it from *tristis*, Panz., including *abdominalis*, Rosenh., *montivagus*, Heer, *longulus*, Kelln., *grandicollis*, Erichs., and *rotundicollis*, Kelln., and from *neglectus*, Kraatz, and *nigrita*, Erichs. Its yellow pubescence also is finer, shorter and more delicate than in any of these. The only remaining species with which it may be confounded is *morio*, Erichs., but the more elongate shape and slenderer form of *morio* and the difference in the posterior angles of the thorax distinguish it. *Morio* has not got the slight acumination which *coracinus* has at these angles, and in it they are gently obtuse instead of being at first right-angled. The thorax in *morio* is also flatter.

It is found in Scotland and England, and in various parts of the Continent.

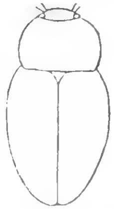
12. *C. morio*, Fab.

Catops morio, Fab. Syst. El. ii. 564. 4.
Choleva dissimulator, Spence, Linn. Trans. xi. 150. 11.
Catops sericeus, Gyll. Ins. Suec. iv. 313. 1–2.
—— *morio*, Erichs. Käf. d. M. Br. i. 240. 11; Sturm, Deutschl. Fn. xiv. 29. 14. t. 276. fig. *b*. B; Heer, Faun. Helv. 382. 14; Redt. Faun. Aust. 144. 13; Kraatz, Stett. Ent. Zeit. xiii. 431. 13; Fairm. & Laboulb. Fn. Ent. Franç. i. 301. 8.

Oblongo-ovalis, niger; antennis obsolete clavatis, articulis duobus primis ultimoque et pedibus ferrugineis; thorace basi apiceque latitudine subæquali, angulis posticis obtusis; elytris obsoletissime striatis.

Long. $1\frac{3}{4}$ lin.

Fig. 11.



The antennæ are as long as the head and thorax, imperceptibly but not greatly thickened towards the point; the first two joints are ferruginous yellow, the rest, with the exception of the last, blackish, the last joint yellow: rarely the whole antennæ are ferruginous, which Erichson observes is the case with the examples in Fabricius's collection. The body is black; the head densely and distinctly punctate; the parts of the mouth red. The *thorax* is rather *depressed* and is thickly and finely punctured, with a fine yellowish-grey dense pubescence; it is half as broad again as long, lightly rounded on the sides, somewhat narrowed in front, but behind only a very little narrower than in the middle; the posterior angles are nearly obtuse-angled; the posterior margin is truncate and straight. The scutellum has the same pubescence as the thorax. The elytra have an ashy-grey bloom, no yellow pubescence along their base, are densely punctate, nearly without traces of striæ, a little widened in the middle, behind obtusely acuminate. The legs are ferruginous red, the thighs brown.

The same characters which distinguish *coracinus* from the other species in this group apply also to *morio*, and under that species I have already given a comparison of the differences between them. They are however closely allied.

This appears to be a rare species. So far as I know, it has not yet been taken in Scotland. It is found in England, and is widely spread over the Continent. It is included by Gebler in his list of insects found in South-west Siberia. M. Kraatz says it is found under leaves and in the chinks of wood.

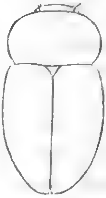
13. *C. nigrita*, Erichs.

Catops tristis, Gyll. Ins. Suec. iv. 311. 1.
—— *morio*, Payk. Fn. Suec. i. 344. 2.
—— *nigrita*, Erichs. Käf. d. M. Br. i. 239. 9.
—— *tristis*, Sturm *, Deutschl. Faun. xiv. 24. 11. t. 275. fig. *c*. C.
—— *nigrita*, Heer, Fn. Helv. 381. 12; Redt. Fn. Aust. 144. 13; Kraatz, Stett. Ent. Zeit. xiii. 432; Fairm. & Laboulb. Fn. Ent. Franç. i. 301.

Oblongo-ovatus, niger; antennis obsolete clavatis *rufo-piceis, clava nigra, apice testacea*; thorace basi apiceque latitudine æquali, *angulis posticis fere rectis* leviter acuminatis; elytris obsoletissime striatis.

Long. $1\frac{2}{3}$ lin.

Fig. 12.



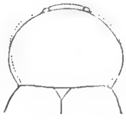
Oblong-oval. The antennæ are as long as the head and thorax, imperceptibly thickened towards the point. The first six joints are reddish brown, the remainder brown, the 8th joint not much smaller than the rest, the last joint oval, acuminate, yellow. The thorax is scarcely a half broader than long, rounded on

* Both from his figures and descriptions it appears to me evident that Sturm has transposed the names of *nigrita*, Erichs., and *tristis*, Panz. This has not been noticed by Kraatz or subsequent authors, but a very short perusal will I think convince them of it. For instance, of *tristis*, Panz., he says, "the thorax *broad*, short," &c., and of *nigrita*, Erichs., "the thorax *narrower* than the elytra, transverse," which is just reversing the characters of the thorax; and his figures speak for themselves.

the sides, broadest in the middle; nevertheless only a little narrowed in front and behind, in front rather narrower than behind; the posterior angles sometimes a little pointed *, the posterior margin straightly truncate, and only towards the middle very slightly sinuated. It is covered with a yellow silken pubescence. The elytra, as well as the whole body, are black; they have a brownish-blue or purplish peachy bloom, with a yellowish pubescence more conspicuous at their base and basal margins than on the disk. They are finely punctured, very imperceptibly striated, longish oval, in the middle a little widened, behind obtusely acuminate. The legs are ferruginous red, the posterior thighs sometimes brownish.

This is the first of a little group of species, which, with a decided yellow pubescence on the thorax, has a brownish-blue or purplish bloom on the elytra, accompanied with yellow hairs or pubescence conspicuous along the base and basal margins of the elytra,—a character which will limit our comparison to only two or three species. The two species just described, *C. coracinus* and *C. morio*, have also yellow pubescence on the thorax, but their elytra have not a purplish bloom, but a greyish-ash bloom, and want the yellow hairs along the base. The yellow pubescence on the thorax of these two also is feeble both in colour and consistence compared with those which follow. The form of the thorax of this species distinguishes it from all the others. Figure 13 shows the relative form of the thorax of *nigrita* and *tristis*, the plain line being the outline of *nigrita*, and the dotted line that of *tristis*. These two species are in other respects extremely alike. The antennæ however also furnish characters of discrimination—the club of *tristis* being heavy and thick, while the antennæ of *nigrita* are only obsoletely clubbed. The great breadth of the thorax of *grandicollis*, Erichs., easily distinguishes it; and the form of the thorax of *rotundicollis*, Kelln., which is an exaggerated form of that of *tristis* as above delineated (fig. 13), will prevent *nigrita* being confounded with that species. The elytra in both *nigrita* and *tristis* are elongate and give a long character to the whole insect, while *rotundicollis* has the elytra short and rapidly acuminate.

Fig. 13.



* Erichson in his description states that the posterior angles are pointed, but Kraatz says that he cannot agree with him in that respect:—"according to my view," he says, "they are right-angled, in not a few examples passing into obtuse-angled." I have examined a considerable series carefully with a view to determine this point, and find that both are right. I possess specimens which have the posterior angles pointed, and others where there is no appearance of a point, but the line of the base of the thorax perfectly straight. This is another proof of the variable character of the genus. It also shows us how inadequate are Spence's sectional divisions which are founded on this very character.

This species is widely spread, and is found under leaves, and under the carcases of birds and small mammals.

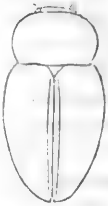
14. *C. tristis*, Panz.

Helops tristis, Panz. Fn. Germ. 8. 1.
Cholera Leachii *, Spence, Linn. Trans. xi.
Catops tristis, var., Gyll. Ins. Suec. iv. 312. 1.
—— *tristis*, Erichs. Käf. d. M. Br. i. 238. 8.
—— *nigrita*, Sturm, Deutschl. Faun. xiv. 24. 11. t. 275. f. c. C.
—— *tristis*, Heer, Fn. Helv. i. 380. 8; Redt. Fn. Aust. 144. 12; Kraatz, Stett. Ent. Zeit. xiii. 433. 18; Fairm. & Laboulb. Fn. Ent. Fr. i. 302.

Oblongo-ovatus, niger; *antennis abrupte clavatis, clava fusca, articulo ultimo breviori*; thorace transverso basi apiceque latitudine subæquali, angulis posticis rectis; elytris obsoletissime striatis.

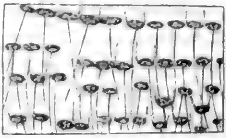
Long. $1\frac{3}{4}$ lin.

Fig. 14.



Of the same size and general form as the last species (*nigrita*, Erichs.); the thorax, however, is not so broad, particularly behind. Perhaps the commonest impression it makes on a first introduction is that of an insect with longish elytra and a disproportionately short, narrow, somewhat square thorax. The antennæ are nearly as long as the head and thorax, strongly thickened towards the point; the first six joints slender, reddish brown, those following brown, broader than long, the eighth not only much shorter but also narrower than the remainder of the club, the last a little larger than the preceding, with a cone-shaped point, generally pale at the tip†. The head and thorax are black, densely punctate, more or less wrinkled transversely, *and thickly covered with a close yellow pubescence*; the hairs springing from the wrinkled punctuation as shown in the magnified sketch represented in fig. 15. The thorax one-half broader than long, rounded on the sides, broadest in the middle, or perhaps rather a little before the middle, giving the *primâ-facie* effect of being narrowest behind; but on comparing the narrowness both in front and behind it is found nearly equal, or rather narrower before than behind. The posterior angles are sharply right-angled, the straight edge proceeding a little forward before

Fig. 15.



* As already mentioned, I have been unable to make out satisfactorily what the *tristis* of Spence is, and therefore have not added that as a synonym here.

† Erichson says that the last joint is brown like the preceding, but this is only the case sometimes; generally speaking it is paler.

the outward curve commences: the posterior margin is almost straight, only a little sinuate towards the middle. The elytra are covered *with a brownish-blue or purplish bloom, and with some yellow pubescence most observable at the base and along the basal margins**. Under the bloom the elytra themselves are brownish, lightest at the base; they are densely punctate, with feeble traces of striæ, in the middle somewhat expanded, behind oval-acuminate. Under side and thighs dark brown, tibiæ ferruginous brown, tarsi ferruginous yellow.

Erichson adds that in the males the extreme termination of each elytron is produced into a single point. In the females the point is commonly rounded. My experience is that it varies indifferently.

Fig. 16.

This is a variable species, and under it, I think, should be comprehended not only the *C. abdominalis* of Rosenhauer, the *longulus* of Kellner, and the *montivagus* of Heer, but also the *grandicollis* of Erichson, and probably the *rotundicollis* of Kellner. These I shall include as varieties under this species, giving however a separate description of each, and where I have not seen the variety in nature, quoting the words of the author who described it.

Var. A. *C. abdominalis,* Rosenh. Beitr. Ins. Fn. Eur. i. p. 22.

"Oblongo-ovatus, niger; antennarum basi, abdominisque segmentis 2 primis ferrugineis; prothorace basi apiceque latitudine æquali, angulis posticis rectis; elytris obsoletissime striatis, antennis abrupte clavatis.

"Long. $1\frac{3}{4}$ lin., lat. 1 lin.

"Very similar to the *C. nigricans,* but smaller and not so convex; particularly like the *C. montivagus,* Heer, Fn. Helv. i. 381. I should consider it perhaps to belong to the latter, were it not that the posterior part of the abdomen of two examples which I possess from different districts of the Tyrol is uniformly of a different colour from that of the rest, a character which is not known to me in any other *Catops,* and which Heer must certainly have observed in describing his species had it existed in it. In the new species also the colour of the base of the antennæ and of the feet is much darker and the thorax is broader.

* It is perhaps scarcely necessary to say, that in speaking of the bloom and the pubescence on these species, I am speaking of perfectly fresh specimens in good condition. When the insect gets greasy and dirty the bloom no longer exists, and the yellow hairs get clogged together so that they look black. The best way in such cases is to turn them about in different directions, till the eye catches the light in which the pubescence or bloom best shows itself.

The head is not large; black, finely and densely punctate, with a yellowish-grey pubescence. The mouth is brownish. The antennæ are somewhat longer than the head and thorax, the first six joints brownish red, slender, the remainder black, broader than long, and thickened into a club towards the outer side; the eighth joint much shorter and more slender than the rest, the last somewhat more slender and about a half longer than the preceding, with an obtuse point. The thorax is densely wrinkled-punctate, and thickly clothed with close-lying yellowish hairs, transverse, about a half broader than long, rounded on the sides, broadest in the middle, narrower in front than behind, the anterior angles obtuse, the posterior straight, the posterior margin scarcely sinuated. The elytra are a little broader than the thorax, somewhat bellied out in the middle, oblong oval, usually attenuated to a point at the apex, densely and finely punctate and transversely wrinkled, covered with a grey pubescence and bluish hoar-frost, the sutural striæ very distinct, and in the middle of the elytra we perceive the trace of several striæ. Under side black, the thighs dark brown, the tibiæ ferruginous brown, the tarsi ferruginous yellow; the first two segments of the abdomen are of a lively ferruginous red, the remainder black, finely and densely punctate, delicately pubescent.

"Found in the Tyrol near Steinach and on the Franzenhöhe, 4000–8000 feet above the level of the sea*."

The reader will see that the above is a pretty accurate description of *C. tristis*, with the exception of the colour of the first two segments of the abdomen. Colour is at all times a character of very doubtful value in Coleoptera, and the constant symptom of immaturity or of not fully developed colour is the substitution for black of a ferruginous brown or red of greater or less intensity, or over a greater or less extent.

I have not seen specimens of this variety in nature, but M. Kraatz, who had authentic specimens through his hands, states that it is a mere variety of *tristis*.

Var. B. *C. longulus*, Kellner.

Catops longulus, Kellner, Stett. Ent. Zeit. vii. 176; Redt. Fn. Aust. 771; Kraatz, Stett. Ent. Zeit. xiii. 433. 17.

Oblongus, niger; antennis obsolete clavatis, basi apiceque testaceis; thorace basi apiceque latitudine æquali, angulis posticis rectis; elytris obsoletissime striatis.

Long. $2\frac{1}{4}$ lin.

According to M. Kellner's description this species is distin-

* Rosenhauer in *loc. cit.*

guished by its long and slender form, and thereby easily separated from the remaining varieties or species in this division.

The antennæ are of the length of the head and thorax, moderately strong, black in the middle, the basal joints reddish, the terminal joint yellowish, the club a little thickened; the head and thorax are densely punctate, clothed with yellowish-grey hairs; the latter is gently rounded on the sides, narrowed in front and behind; the posterior margin is cut straight, and only slightly sinuated on each side of the scutellum. The elytra are long and uniform in their shape, densely and finely punctate, indistinctly striated, lightly covered with yellowish-grey hairs and hoar-frosted. The legs are black-brown, the feet brownish red.

M. Kellner states that he found this kind on high hills near the mountains (of Thuringia) "under moss and on exposed dead birds: very rare."

The only discrepancy which the above description shows between this variety and *tristis* is that the club is but little thickened, and that the elytra are long and uniform in their shape. The degree of thickness of the club of the antennæ varies in all the thick-clubbed species (of course within certain bounds); and the circumstance of its being found under dead birds sufficiently shows that this is one of the thick-clubbed species. Moreover, owing to the kindness of M. Kraatz, I have seen authentic examples of it, and am thus enabled to say that the antennæ are not of less thickness than they are in many other specimens of *C. tristis*. The length of the elytra, which is in point of fact the characteristic mark of this variety, is of no value as a character, scarcely any two examples of *tristis* having the elytra of the same proportions. In some they are more bellied out than in others, which makes them look not so long, and others are longer in point of fact, but they all have the same character which cannot well be mistaken, and this supposed species is only a variety with disproportionately elongate elytra.

I have found this variety in Scotland and England.

Var. C. *C. montivagus*, Heer, Faun. Col. Helv. i. 381.

"Oblongo-ovatus, niger; antennis basi, tibiis tarsisque rufo-testaceis, pronoto subtransverso, basi apiceque latitudine subæquali, angulis posticis rectis, acutis; elytris obsoletissime striatis; antennis abrupte clavatis, articulo ultimo penultimo vix longiore.

"Long. $1\frac{3}{4}$ lin.

"Very similar to *C. tristis*; chiefly to be distinguished by its thorax being a little longer, but narrower. The first five joints of the antennæ are rufo-testaceous, the eighth the smallest, much shorter and narrower than those that follow, the last shortly ovate, scarcely longer than the preceding; the thorax much narrower than the elytra, a little broader than long, with the sides lightly rounded, behind subsinuate, very densely punctulated, clothed with a dense yellow silky pubescence; elytra oblong ovate, very closely punctate, but evidently impressed with a sutural stria; thighs pitchy black.

"Very rare in the Alps. (At the Gemmi near the Daubensee*.")

The above description can I think be referred to nothing but *tristis*; the greater relative length of the thorax, which M. Heer specifies as the chief distinction, being doubtless either the result of variation in the length of the elytra, or one of the variations to which this species is subject. The next variety, which I refer to the same species, shows a much greater variation in the relative dimensions and proportions of the thorax.

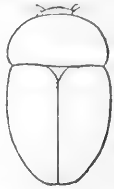
Neither M. Kraatz nor myself have seen authentic examples of the above species, but M. Rosenhauer speaks of it (*supra*) as if he was familiar with it, and says that but for the colour of the last segments of the abdomen in his *abdominalis*, he would have referred that species to *montivagus*. M. Kraatz having ascertained *aliunde* that *abdominalis* was an immature specimen of *tristis*, differing only in the colour of these segments, it follows that *montivagus* is what the description would lead us to suppose, viz. a variety or synonym of *tristis*.

Var. D. *C. grandicollis*, Erichs.

C. grandicollis, Erichs. Käf. d. M. Br. i. 237; Heer, Fn. Col. Helv. i. 380; Redt. Fn. Aust. 144; Kraatz, Stett. Ent. Zeit. xiii. 432. 15; Fairm. & Laboulb. Fn. Ent. Franç. i. 300.

Ovatus, nigro-fuscus; antennis obsolete clavatis pedibusque rufis, illis apice nigricantibus; thorace transverso, coleopteris latiore, angulis posticis obtusis; elytris obsoletissime striatis. Long. $1\frac{3}{4}$ lin.

Fig. 17.



Somewhat of the form of the *C. nigrita*, but larger, and especially broader. Black-brown. The antennæ are not quite so long as the head and thorax, gradually slightly thickened, towards the point reddish brown, the last joint blackish. The head and thorax are densely punctured and granulated exactly as in *C. tristis*, clothed with close-lying yellow hairs. The latter is considerably broader than the elytra, more than one-half

* Heer in *loc. cit.*

broader than long, strongly rounded on the sides, the anterior angles rounded, the posterior angles obtuse-angled, the posterior margin cut straight, of the breadth of the elytra. These are oblong oval, somewhat convex, densely and finely punctate, indistinctly striated, brownish blue or purplish hoar-frosted, with a yellowish pubescence along the base and basal margins. The legs are brownish red.

This variety stands in a very different position from those which have gone before. They are so near the type, that they might without much harm have been described as synonyms. The present, on the contrary, differs in some respects widely from the type, and it is by no means surprising that it has hitherto been considered one of the best characterized and most distinct species.

The great breadth of the thorax is the prominent distinguishing character; its shape also is somewhat different, being nearer that of *C. nigrita*, Erichs. The grounds on which I have deemed it a variety of *tristis*, are first, that all the specimens of *grandicollis* I have taken have been in company with *tristis*, and they were generally without the admixture of another species except *rotundicollis*, which, as I have already said, I suspect to be another variety of *tristis*. The examples of *grandicollis* were almost invariably males*, and those of *tristis* for the most part females. In my earliest captures it so happened that I found nothing but males of *grandicollis* and females of *tristis*, and naturally came to the conclusion that they were the two sexes of the same thing. Subsequent researches have convinced me to the contrary, as I have now a good many male specimens of *tristis*, and one female of *grandicollis*. Still the great preponderance is as I have stated, and the result to which I have come is, that *grandicollis* is the normal form of the male, and *tristis* of the female; although, as is known sometimes to take place in other orders of animals, the female occasionally assumes the form of the male, or *vice versâ*. Another ground for assuming them to be the same species is their great general resemblance to each other, notwithstanding that the one has got such a broad thorax, while in the other it is narrow. This similarity is owing perhaps to the thorax in both being transverse, and the rest of the body of the same figure. The pubescence, colouring, wrinkling and punctuation are identical, and when two fine fresh specimens with their pubescence and bloom untarnished are placed together, I think it is almost impossible to avoid the conclusion that they belong to the same species. The differences that exist other than the broad thorax are very trifling. The antennæ of *grandicollis* are perhaps a trifle thinner and not

* Erichson founded his description on a "single male specimen."

so dark in the middle as in the generality of *tristis*, and the terminal joint is usually not paler than the rest of the club. But these are all variable items in *tristis* itself. I have specimens with their antennæ in every respect to the most minute particular the same in both kinds. The only other discrepancy is, that the slight sinuation on the hind margin of the thorax of *tristis* seems wanting in *grandicollis*. In a word, the only permanent difference is in the form of the thorax, which, in the face of the circumstances I have adverted to, does not in this instance appear to me a sufficient ground for constituting it a different species.

Another curious confirmation of this view is, that similar variations in the form of the thorax take place in *C. chrysomeloides*. In fact, I possess specimens of the latter having exactly the form of *tristis*; the sole difference being that they are larger; the thorax is more coarsely granulated, its pubescence darker; the elytra more rounded and not so acuminate at the apex, their bloom also is ash-grey instead of purplish, their base is black instead of brownish, and the yellow hairs at the base are wanting. The antennæ are thicker and darker and the last joint is longer. These particulars serve to show that it is not *tristis*; and in addition these varieties are found mixed with large numbers of the normal form of *chrysomeloides*. For instance, among about 200 specimens of *chrysomeloides* which my friend Mr. Bates recently sent me, all taken together at one time, I found three or four with the form of *tristis*; also a specimen or two having in like manner exactly the form of *grandicollis*, but with the elytra not as in the variety of *tristis* bearing that name, but as in *chrysomeloides*; the antennæ are thicker and darker, but there is no other difference in the relative proportions, except in the last joint, which is not long, as it is in *chrysomeloides*. Further, there were a few specimens in the same lot having the shorter form and more acuminate elytra of *rotundicollis*; and lastly, there were examples having the form of the thorax of *nigrita*. The result to which I have come therefore is, that similar variations in form exist both in *C. tristis* and *C. chrysomeloides*; that as we have a variety of the former with a broad thorax (*C. tristis* var. *grandicollis*), we have also a variety of the latter of like form (*C. chrysomeloides* var. *grandicollis*). In like manner of each we have *C. tristis* var. *rotundicollis* and *C. chrysomeloides* var. *rotundicollis*, and *C. tristis* var. *nigrita* and *C. chrysomeloides* var. *nigrita*. We have a var. of *chrysomeloides* like *tristis* (*C. chrysomeloides* var. *tristis*), but I have not found any like resemblance to *C. chrysomeloides* in *tristis*.

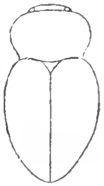
In all these varieties, however, there are certain general characters which appear to be constant, and enable us to refer each variety to its proper species. These are the colour of the elytra and of its bloom, and the colour of the pubescence at the base of the elytra. There are also other characters, which, although they vary in individual species on the one side or other, are on the whole pretty constant. The antennæ of *chrysomeloides* are almost invariably considerably thicker than in *tristis*, and the last joint longer. The pubescence of the thorax (except in the same variety) is browner than in *tristis*, and, except in the var. *rotundicollis* of *tristis*, is more coarsely granulated. The form of the apex of the elytra, except in the same variety, is also rounder in *chrysomeloides* than in *tristis*.

Var. E. *C. rotundicollis*, Kellner.

C. rotundicollis, Kellner, Stett. Ent. Zeit. viii. 176. 2; Redt. Fn. Aust. 771; Kraatz, Stett. Ent. Zeit. xiii. 434. 19; Fairm. & Laboulb. Fn. Ent. Fr. i. 302.

Ovatus, nigro-fuscus; antennis obsolete clavatis; pedibus rufo-piceis; thorace transverso subruguloso, lateribus fortiter rotundatis, angulis posticis rectis; elytris apice obsoletissime striatis. Long. $1\frac{1}{2}$ lin.

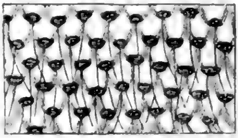
Fig. 18.



The antennæ are scarcely so long as the head and thorax, thickened towards the point, reddish brown, lighter at the base. The head and thorax are densely punctate, or rather granulated and densely covered with yellowish grizzly hairs; the latter is strongly rounded on the sides, most so towards the front, narrowed behind, the anterior angles rounded, the posterior angles almost pointed and right-angled, the posterior margin cut straight, and slightly sinuated on both sides near the scutellum. The elytra are oval, a little convex, densely and finely punctate, indistinctly striated, with a bluish or purplish bloom or hoar-frost on them, and also with yellowish hairs particularly at the base, and are narrowed to a point at the apex. The legs are brownish red, the feet lighter.

This variety or species is found along with *tristis* and *grandicollis*, but it is not without hesitation that I remove it from the list of distinct species. The characters, however, which distinguish it being all variations in degree, and at times approaching more or less to the type of *tristis*, I have come to look upon it as a variety of that species. It is well known that carcase-feeding beetles are always more subject to variation than others, owing to the chance of the food of the larvæ becoming exhausted before they are full fed. This species may be a starved variety. The particulars however by which it is most readily distinguished are its smaller size, the strongly rounded edges of the thorax inflexed towards the base, and perhaps more than any other, the more strongly marked punctuation or rather granulation on the thorax; but none of these distinctions appear to me sufficient to justify its being kept as a distinct species. As to its size, although it is only about half the size of *grandicollis*, I have undoubted specimens of *tristis* quite as small as it; and even of *grandicollis* I have seen a specimen received by M. Kraatz from Thuringia not much larger. The general cut of the thorax is that of *tristis*, but broader in front. The elytra terminating sharply is a character also shared by *tristis*. The bluish or purplish bloom on the elytra is perhaps not quite so marked a feature as in *tristis*, but it is still well developed, and the yellow pubescence on the thorax and along the base of the elytra is the same. The distinction most appreciable is the punctuation or rather granulations on the thorax. To the naked eye, or under a weak lens, the thorax looks as if it were more coarsely punctate and of a coarser texture than in *tristis*. Under a higher magnifying power it assumes the aspect shown in fig. 19, and a comparison of that with fig. 15 and fig. 20, exhibiting the marks on the thorax of *tristis* and *neglectus* (next species), will show that it occupies a medium place between them. This punctuation in *rotundicollis* however is not always equally coarse, showing gradations to the feebler granulations of *tristis*.

Fig. 19.



It is not a rare variety, and is found under dead birds, &c. both in England and Scotland and all over the Continent.

15. *C. neglectus*, Kraatz.

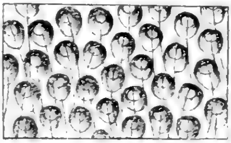
Catops neglectus, Kraatz, Stett. Ent. Zeit. xiii. 434. 20.

Ovatus, nigro-fuscus; antennis obsolete clavatis pedibusque rufo-piceis; thorace transverso, postice angustiore, *variolariter punctato*; elytris apice substriatis.

Long. $1\frac{1}{2}$ lin.

Shape entirely that of *tristis*. Antennæ obsoletely clavate, reddish brown. The head is black, deeply, densely and distinctly punctate. The thorax is in the middle almost of the breadth of the elytra, nearly half as broad as long, somewhat convex, the sides moderately strongly rounded (exactly as in *tristis*), more narrowed behind than in front, so that the greatest breadth is before the middle. The posterior angles are right-angled, the posterior margin feebly sinuated on each side in front of the scutellum. It is covered with a dense yellow pubescence as in *tristis*, but is not granulated like it, but covered with shallow punctures, so that under a strong lens it looks exactly as if pitted with the small-pox, and out of each shallow flat pit issues a yellow hair (sometimes two, springing from the same centre); these pits are arranged in a sort of irregular transverse order (see fig. 20), which gives the thorax to the naked eye the appearance of being strongly transversely wrinkled. The elytra are densely and finely punctate, with indistinct, very evanescent traces (when highly magnified) of similar depressions being scattered over them, and with indistinct traces of striæ at the apex; they are clothed with a purplish brownish bloom similar to that of *tristis*, and with yellowish hairs principally seen at the base. The legs are brownish red, feet lighter.

Fig. 20.



Till this species was made known by M. Kraatz, it had been always overlooked. On a hasty glance it looks exactly like *tristis*; a little better inspection, particularly of the apparent granulations on the thorax, leads one to suppose it is *rotundicollis*, but a careful examination brings out the much deeper and differently formed punctuation of the thorax. This is the only character to be relied on to separate it from *tristis*; for although the antennæ are not so abruptly or heavily clavate as in that species, and are entirely of a reddish brown instead of having a blackish club, still in neither particular are they so different as to be beyond similar variations to be found in the true *tristis*. I therefore felt great difficulty in making up my mind whether they were distinct species or not. Thanks to the liberality of M. Kraatz, who supplied me with specimens of his *neglectus*, I was enabled to examine them all very carefully, which I did under high powers of the compound microscope, and although there is in one sense undoubtedly a transition between *tristis* and *neglectus* through *rotundicollis*, inasmuch as while the sculpture of the thorax in *tristis* is slightly wrinkled, that of *rotundicollis* is granulated, and that of *neglectus* variolose, still there did appear a greater difference between *neglectus* and *rotundicollis* than between the latter and *tristis*. It is not easy to embody the difference in words, but I am enabled by the kind assistance of Dr. Greville, whose qualifications as a microscopic observer and microscopic draughtsman are unsurpassed, to submit the differences to the reader, in the woodcuts, figs. 15, 19 and 20, drawn by him, which show the sculpture of the thorax of the three kinds as seen under a magnifying power of 280 diameters. These I think prove the close relationship of *rotundicollis*, fig. 19, with *tristis* and *grandicollis* (both of which are exactly the same), fig. 15: the punctures from which the hairs issue are only a little larger and deeper in the former than in the latter, which also shows the first faint traces of the circular depressions between these punctures in the former. In *neglectus* however, although there are deep circular depressions, these are on a totally different arrangement from those in the other species. Here they surround the puncture from which the hairs spring, while in *rotundicollis* they are placed between the hairs. In *neglectus* the concave curve of the depression is turned towards the hair, in *rotundicollis* it is the convex curve which is turned to it.

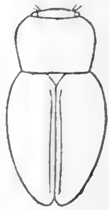
Although the character is narrow, I incline to think that this is a good species, more especially as M. Kraatz mentions that nothing approaching to a transition between it and *rotundicollis* has been found.

This interesting species was taken by M. Kraatz in Hessia, but I have not yet observed it in any collection made in this country.

16. *C. quadraticollis*, Aubé.

Catops quadraticollis, Aubé, Ann. de la Soc. Ent. de Fr. 1850, viii. 326. 35. t. 11. f. 3; Fairm. & Laboulb. Fn. Ent. Fr. i. 302.

Fig. 21.



Oblongo-ovalis, convexiusculus, niger; antennarum articulis primis et ultimo, tibiisque ferrugineis; *thorace quadrato*, vix postice angustiore, angulis posticis rectis.

Long. $1\frac{3}{4}$ lin.

Oblong-oval, convex. Brownish black, covered with a sparing yellowish-grey pubescence; mouth and base of the antennæ obscure ferruginous. Antennæ gradually clavate, a little longer than the head and thorax. Thorax almost as broad as long; sides feebly arched, almost straight, except in front, where they are pretty strongly rounded; posterior angles right-angled, a little sharply pointed; very finely and densely punctate. Elytra with a more marked punctuation, very dense; sutural stria deep, disappearing on the anterior third. With a strong lens some traces of striæ are perceptible. Thighs brownish black, tibiæ and tarsi obscure ferruginous.

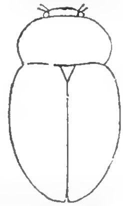
This species is almost of the size of *tristis*, which it comes very near in form and colour. It is however a little more elongated and generally deeper in colour, and the antennæ are less clavate; but the principal difference is in the form of the thorax, which is nearly as long as broad and rectilinear on the sides, in fact nearly square; the posterior angles also are straighter. Dr. Aubé says that the lateral margins are a little more rounded in the males than in the females, but always less so than in *tristis.*

I have seen one female example of this species, in the collection of M. Chevrolat. At first I was disposed to consider it as a variety of *tristis,* but on closer examination I became satisfied that it is a distinct species; at least, that we must hold it so until a closer study of its affinities and alliances shall teach us otherwise.

17. *C. chrysomeloides,* Panz.

Helops chrysomeloides, Panz. Fn. Ger. 57. 1.
Choleva chrysomeloides, Latr. Gen. Crust. et Ins. 29. 4; Spence, Linn. Trans. xi. 146. 7.
Catops chrysomeloides, Erichs. Käf. d. M. Br. i. 697. 7 *a*; Sturm, Deutschl. Fn. xiv. 22. 10. t. 275. f. *b*. B; Heer, Fn. Helv. 380. 9; Redt. Fn. Aust. 144. 10; Kraatz, Stett. Ent. Zeit. xiii. 432. 16; Fairm. & Laboulb. Fn. Ent. Fr. i. 302.

Fig. 22.



Ovatus, nigro-piceus; antennis *abrupte clavatis, clava nigra nitidula, articulo ultimo oblongo*; thorace transverso, basi latiore, *angulis posticis rectis*; elytris obsoletissime striatis.
Long. 2 lin.

Ovate, convex; deep brown or black, with a pretty dense pubescence. Antennæ shorter than head and thorax, strongly and abruptly clavate, the base (first six joints or so) red, the club black or deep brown, the fourth, fifth and sixth joints not longer than thick, also not thicker than those preceding, those following considerably thicker, the seventh, ninth and tenth somewhat thicker than long, brown; the eleventh oblong oval; the eighth narrower than the other joints of the club, very short. Thorax one-half broader than long, rounded on the sides, narrowed a little more in front than behind; at the posterior margin a little narrower than the base of the elytra; the posterior angles right-angled, pointed; the posterior margin lightly sinuated on each side, covered with a coarse yellowish grizzly pubescence. Elytra like the thorax, very finely and densely punctate, very indistinctly striated, with an ashy grey bloom; no yellow pubescence. Legs ferruginous red, often brown on the thighs.

This very distinct species is distinguished at once by the large black club of its antennæ. When seen along with other species, its gloomy black opake appearance, combined with a larger club of the antennæ than any other species, at once point it out. The only other large black species in this group are *picipes* and *nigricans,* and neither of these has heavy thick-clubbed antennæ. From the other thick-clubbed species (none of which however have antennæ equal to it in thickness), it may be quickly distinguished by its gloomy black colour, and by the dull ash-grey bloom on the elytra. The pubescence on the thorax is dull grizzly yellow, a good deal coarser than the strong rich russet yellow of *tristis* and the other thick-clubbed species; and the bloom on the elytra wants the purplish tinge observable in these species; and there are no yellow hairs along the base or margins of the elytra, which are not lighter in colour themselves than the thorax. Immature specimens wholly ferruginous brown are occasionally met with. The thickness of the club of the antennæ is also not always equally great, but always greater than in any other species.

As I have already mentioned in speaking of the varieties of *tristis*, similar varieties occur of this species, viz.:—

Var. *grandicollis*, with larger broad thorax.

Var. *tristis*, with narrow short thorax and broad elytra.

Var. *rotundicollis*, of the shape of *rotundicollis*, but larger.

Var. *nigrita*, of the shape of *nigrita*.

For the differences between these varieties and the similarly named varieties of *tristis*, see the remarks on page 150.

As I have already mentioned, this species used very generally to be made to represent both *tristis* and *chrysomeloides* by British and even foreign entomologists.

It is found under small dead birds and mammals. Mr. Bates of Leicester has taken hundreds (and supplied me largely) by a simple trap which is very useful for taking some of our rarest *Claricornes*. He puts three or four rabbits' feet into a soda-water bottle, buries it in a favourable locality, so that the mouth of the bottle is level with the ground, and in a week or ten days the interior of the bottle is swarming with insects, among which great rarities occasionally occur.

[To be continued.]

XVI.—*On a new British species of* Skenea. By W. Webster, Esq.

[With a Plate.]

To the Editors of the Annals of Natural History.

Gentlemen,

Through the kindness of C. Spence Bate, Esq., I am enabled to send you a drawing (Pl. VIII. figs. 12, 13) of an extremely minute *Skenea* which I found in sand, taken amongst *Corallina officinalis* from rock-pools at Gwyllyn Vase near Falmouth.

It is involute, like *Skenea nitidissima*, and equally umbilicated both above and below; but the whorls, which are three, instead of two and a half, do not increase quite so rapidly in size. Its distinctive feature consists in having three spiral ribs or carinæ of a shining fulvous tint, which contrast strongly with the whitish ground colour of the shell; one is situated on either side extending from the apex to the orifice, and the third, which is not so distinctly elevated, on the centre of the body.

The entire volutions appear under a good lens strongly wrinkled longitudinally, more especially on the inner sides, and under a still higher power finely striated spirally. The mouth, which is well rounded and does not turn to either side, embraces a considerable portion of the body-whorl. The operculum I have not been able to examine: its diameter hardly equals the twentieth of an inch.

As yet I have only obtained four specimens, but have still some small portion of the sand in which they were found, remaining unexamined.

If the shell as described above is already known, I should feel greatly obliged if any of your scientific correspondents would favour me with the name.

I am borne out in my opinion that it is new to the British fauna by Dr. Battersby of Torquay, who has kindly examined the shell; should it prove equally new to science, *Skenea tricarinata* would be a very appropriate designation.

It may be interesting to some of your readers to know, that I met with several fine specimens of the rare *Crenella costulata* in rock-pools in Mount's Bay, and also with *Modiola phaseolina* in some abundance in the same locality.

Yours faithfully,
W. Webster.

Upton Hall, near Birkenhead,
June 21, 1856.

EXPLANATION OF PLATE VIII.

Fig. 12. The shell highly magnified. *Fig.* 13. Natural size.

XVII.—*Description of a New Species of Dolphin* (Steno) *from the upper parts of the River Amazon**. By J. E. Gray, Ph.D., F.R.S. &c.

Mr. H. W. Bates has sent to the British Museum the skulls of two Dolphins which he has procured from the upper parts of the Amazon.

The *first* is named *Bouto* by the natives, and found near Ega. It is evidently the *Delphinus Geoffroyii* of Desmarest,

[* A brief abstract of a notice of two species of Dolphins occurring in the Amazon, by M. Paul Gervais, appeared in the Annals, vol. xvii. p. 521.—Ed. *Ann. Nat. Hist.*]

described from a specimen procured by the French from the Lisbon Museum during their occupation of that town, and which the Portuguese most probably received from the Brazils. M. F. Cuvier, in his 'Cetacea,' p. 112, described this species under the name of *Delphinus frontatus.*

M. D'Orbigny discovered the same, or at any rate a nearly allied species, in the River Moxos in Upper Peru or Bolivia, and described and figured it under the name of *Inia Boliviensis,* Voy. Amér. Mérid. t. 22.

The measurements of the Brazilian skull are as follows, in inches and parts of inches :—

	inches.
Length of skull	$21\frac{1}{2}$
——— of beak	13
——— of teeth-line of upper jaw	$12\frac{1}{4}$
——— ——— of lower jaw	11
——— of lower jaw	$17\frac{1}{3}$
——— of symphysis of lower jaw	$8\frac{1}{2}$
Width of skull	10
——— in front of orbits at notch	6
——— of beak at notch	3

Teeth $\frac{28}{26}\,\frac{28}{27}$.

It is only the hinder eight or nine teeth which have a distinct internal heel; the succeeding ones gradually assume the usual conical form, but all the teeth are more or less rugulose.

Mr. H. W. Bates observes: "The animal from which the skull was taken is very large, and wholly of a pinkish flesh-colour. I have seen them rear themselves entirely above the surface of the water when the sexes are sporting in shoaly bays. It goes in pairs, rolling together. . . . . There are black dolphins of the larger species, but I do not know if a variety or a separate species. They also roll in pairs, and are abundant towards the Delta of the Amazon. I cannot say whether the flesh-coloured species is found in the Delta; one fact only I can mention—I have never seen a black and a pink dolphin together in pairs. They are always both either black or pink."—*Letter, Feb.* 17, 1856.

The *second* species is named *Tucuxi* by the natives. Mr. H. W. Bates has sent the skull of each sex. They are similar, but the skull of the female is considerably smaller than that of the male. These skulls evidently belong to a species of the genus *Steno,* which has not before come under my observation. It may be described in the Catalogues as

Steno Tucuxi. The Tucuxi.

Nose of the skull depressed at the base, convex and attenuated at the tip, rather ($\frac{1}{17}$th) longer than the length of the head, nearly three times as long as the width at the notch; frontal triangle elongate, continued considerably in front of the notch-line. Teeth $\frac{30}{30}$, slender, conical. The lower jaw rather slender and slightly bent up at the tips; symphysis rather keeled beneath in front.

Inhabits the upper parts of the Amazon River near Santarem.

The measurements are as follows, in inches and parts of inches:—

	Male.	Female.
Length of skull	13	12
—— of beak	$7\frac{1}{4}$	$6\frac{1}{2}$
—— of tooth-line	6	$5\frac{3}{4}$
—— of lower jaw	$10\frac{1}{4}$	$9\frac{1}{2}$
—— of symphysis	2	$1\frac{3}{4}$
Width of skull	6	$5\frac{1}{2}$
—— of beak at notch	$2\frac{1}{2}$	$2\frac{1}{4}$
—— of forehead over notch	$4\frac{3}{4}$	$4\frac{1}{4}$

Mr. H. W. Bates, in his letter of the same date, observes:—"The *Tucuxi*, pronounced *Tucoshee*, is of a darkish black or fuscous colour. It does not roll over like the *Bouto*, but comes slowly to the surface to breathe."

BIBLIOGRAPHICAL NOTICES.

Manual of Geology, Practical and Theoretical. By John Phillips, M.A., F.R.S. &c. Griffin and Co., London and Glasgow, 1855.

The foundation of this work was laid twenty-five years ago,—in the 'Encyclopædia Metropolitana,'—and, without changing its general character, it has been enlarged and improved by the materials collected by the author and numerous fellow-labourers in the same field during the interval. Among the most important geological researches of late years has been the examination of the older rocks of Wales and the Border Counties, and the newer and not less interesting deposits of the tertiary series of Eastern England and the adjoining Continent. The author has devoted considerable space to these subjects; and, by a careful condensation of the evidence brought forward by the multitude of observers conscientiously enumerated in his preface, has given us a lucid and valuable *résumé* of *palæozoic and cainozoic* facts, which, together with the revised chapters on mesozoic history, form a really useful Manual of physical and topographical geology. Unlike many elementary works, this is far from being a compilation; for the author, without neglecting the observations of others, has observed for himself, and brings us his own enlarged and practical experience,—the fruit of years of scientific labour, both under official engagements and as separate undertakings. The man who has worked for himself in the field can best recognize the educational wants of others, and thus offer them the necessary elementary knowledge by which the inquiring mind may be led in the right direction to comprehend the philosophy of the closet and the facts of the field. The mode of inculcation of such facts varies too much with books and teachers. The mere exercise of memory in learning a table of classification is a poor substitute for the knowledge obtained by the student from a good practical teacher.

After a succinct notice of the history of the science, in which the origin of inductive geology forms an interesting and instructive section, the author enters upon elementary views of the structure and composition of the crust of the earth and of the preservation and distribution of organic remains.

To this succeeds a series of chapters descriptive of the primary, hypozoic, palæozoic, mesozoic, and cainozoic strata, in the ascending order. In this respect we regard this plan of arrangement as preferable, inasmuch as it provides the student with the true successional ordination of the various geognostical phænomena. Thus he is better enabled to trace the origin of the successive and derivative strata,—the varying hydrographical areas more or less defined by these deposits,—and the gradual advance, in different directions and under varying circumstances, of vegetable and animal organisms; —and hence he is presented with a comprehensive view of the various phases of the earth's physical history.

Following the chapters on descriptive geology is a chapter devoted to modern causes in action,—a section which we are inclined to think should take its place at the commencement of the work; for the ordinary mind, when acquainted with existing physical agencies, not only better appreciates the present operations of nature, but possesses an index and a key to the multitude and apparent mystery of ancient physical phænomena.

Inorganic phænomena, more especially those connected with the effects of heat, are fully treated of in the next following divisions of the work;—one chapter being devoted specially to the subject of Mineral veins.

In a subsequent chapter, on the state of geological theory, we would particularly recommend to notice the section on geological chronology, in which the probable rate of accumulation of deposits is inferred from the study of the mechanical and chemical origin of strata,—the alternations of beds of different lithological characters, and of different natures, such as marine, freshwater, and igneous,—the succession of races of imbedded organic beings,—and lastly, the repetitions of convulsions, and the metamorphism of rock-masses. In the same chapter we find two useful tables illustrative of the distinct groups of animal life which have followed one another in a settled order of geological time. The one, adapted from M. A. d'Orbigny, affords a rough estimate of the proportional number of species of all animals in the several geological groups; the second, repeated from the author's work on Yorkshire, has reference to the distribution in time of the more prominent vertebrate types specially characteristic of the great geological periods.

The appendix of tables and calculations contains also some practical observations on the instruments used by the working geologist, namely, barometers, clinometers, &c., with directions for the benefit of those persons who are anxious to furnish satisfactory data for the elucidation of questions connected with the general and special structure of rocks, such as dip, strike, divisional planes, faults, dykes, veins, cleavage, &c. One page only, and that in the Appendix, is devoted to the constituent ingredients of rocks,—a subject too little attended to, and for which might have been found a fitter and ampler space in the body of the work. A careful and useful glossary is added.

Without entering into any detail respecting the geological descriptions in this work, as regards the mineral character, distribution, and fossils of local deposits, we can but advert to a novel and extremely useful feature presented by Prof. Phillips's Manual. We allude to the lists of genera of organic remains occurring in each group or terrain of the geological formations. These lists are so arranged and printed that the genera peculiar to certain strata are at once recognizable, and the numerical proportion of genera and species are seen at a glance. In our notice of Morris's 'Catalogue of British Organic Remains' in Annals, vol. xv. p. 54, we recommended that such tabulated lists of genera and species should be made under the superintendence of the author of that work. Prof. Phillips, however, has with considerable labour eliminated the materials required for such categorical arrangement, in conformity with the geological classification adopted in that work, and has thus, with excellent judgement, enabled the student to comprehend at one view the numerical proportions, in family, generic, and specific groupings, of animal and vegetable life during the several geological periods; and those interested specially in the lower palæozoic rocks will find at p. 122 a table exhibiting the generic relations of the then existing great divisions of animal life during the Cambrian and the Lower and Upper Silurian periods.

One excellent feature of Mr. Phillips's book consists of the many well-executed illustrations of landscape-scenery illustrative of topographical geology. We wish that we could equally approve of the cuts intended to portray the characteristic fossils. Generally speaking, the imperfection of the specimens selected and the want of accuracy in the drawing render the majority of the figures almost useless for comparison.

This work, having features of its own both in palæontological and geological aspects, and being well stored with modern information, and characterized by the experience and philosophic opinions of the author, takes a high rank among elementary works on geology. As a text-book, embodying the real methods of geological investigation, this edition necessarily offers more complete evidence of the unity of the laws of nature, and of the correctness of the principles of geology enunciated in the previous edition,—principles which amidst all the activity of research are still unaltered, the methods of research and the lines of reasoning remaining the same.

Much remains to be done; the geologist has still great questions before him waiting for solution; his labours will be well directed and much lightened by such manuals of the science as those provided by Lyell, Mantell, Ansted, and Phillips.

Tenby : a Sea-side Holiday. By Philip Henry Gosse, A.L.S. London, Van Voorst, 1856. 12mo.

Amongst the numerous caterers to the appetite for popular books on Natural History, which is rapidly, whether for good or ill, becoming a more and more fashionable craving, Mr. Gosse has undoubtedly taken a very leading position. This is due not only to the numerous works of this nature which owe their existence to his prolific pen, for in this respect he is certainly not without rivals, but to the intimate practical acquaintance which he possesses with those marine creatures with which he principally has to do, and to a second and still rarer quality, springing perhaps to a certain extent from the former, that of treating whatever comes under his hand in a style at once pleasant and elegant, intermixing so much of human interest with his descriptions of what in less skilful hands would furnish intolerably dry reading, at least to the masses, that the dry bones become clothed with flesh and endowed with an astonishing amount of life and vigour. As regards the positive effect of these works, and the policy of consigning original zoological observations to pages which may almost be regarded as addressed exclusively to the unlearned in such matters, there may be two opinions; but there can be no doubt, that those multitudes who at this particular period of the year are always meditating gravely upon the necessity of passing the next two or three months in some dreary watering-place, have good cause to be thankful to Mr. Gosse for his delightful productions, and to wish most heartily that there were more guides and instructors "like unto him."

"Tenby," Mr. Gosse's new sea-side book, does not fall short of its predecessors in general interest, although the amount of new matter for the student contained in it is perhaps rather less. It opens with an amusing account of the railway journey into Wales, and the first acquaintance with the semi-foreign natives of the Principality; the energetic struggles of the Tenby coachmen to secure customers are not forgotten, and the whole journey is described in a style which in these days of unromantic travel is quite refreshing. The first impressions of Tenby and the neighbouring scenery are also graphically described,—Saint Catherine's and its caverns stand out vividly in many pages, and the singularly rapid influx of the tide over the sands serves to introduce a humorous picture of the perplexity of three ladies, whom Mr. Gosse ungallantly describes as "middle-aged" and "somewhat heavy in person," who in their anxiety to view the beauties of the place were somewhat unpleasantly reminded of the fact that the old proverb, "Time and Tide wait for no man," applies with equal truth to the fairer portion of humanity. This and many other passages of a similar nature, including several excellent descriptions of scenery and pieces of local history, must be regarded by the scientific naturalist, however he may enjoy them, as coming parenthetically in the midst of his severer studies;—we shall therefore refer no farther to the lighter portion of Mr. Gosse's book.

We have already said that the number of new facts brought forward in the present volume seems to be less than in Mr. Gosse's

"Devonshire Coast." On the other hand, several of the chapters (or Letters as our author calls them) contain excellent descriptions of things, which although previously well known to zoologists, will undoubtedly be exceedingly interesting to the general reader, in the elegant costume in which they are here presented to him. Amongst these we may notice the development of the Decapod Crustacea and Barnacles, of *Clavellina* and the *Echinida*. One chapter is devoted to the description of the *Pedicellariæ*, which Mr. Gosse, with the principal authorities of the present day, regards as component parts of the Echinoderms on whose surface they are found; our author gives a very full description of the structure of these curious bodies, and besides the three kinds or species described by Müller, notices a fourth form, to which he gives the name of *Pedicellaria stenophylla*. The *Actiniæ* and their beauties naturally take up a good deal of Mr. Gosse's attention,—they are frequently referred to in various parts of the work, and three new species are described in his last letter; whilst in an Appendix he gives some extracts from his paper on *Peachia hastata* in the Linnæan Transactions, in which he establishes the genera *Sagartia* and *Bunodes* at the expense of the old genus *Actinia*, and gives his views as to the nature and affinities of the family of the Sea Anemones.

Mr. Gosse is, however, by no means constant in his attachment to the sea, and two of his letters are devoted exclusively to the freshwater *Rotifera*;—in one he describes the mode of capturing these little creatures, and in the second the way in which they are to be observed under the microscope, and the structure of several striking species.

Two circumstances must prevent our giving any extracts from this charming little book,—one of these is the difficulty of selection where so much is excellent, and the other the want of space. In taking leave of it, however, we cannot but feel that it will do much to open up new sources of delight to thousands who may visit not only Tenby but other watering-places, by awakening in their minds some little interest in the many apparently insignificant, but truly interesting creatures, which they would otherwise pass contemptuously in their objectless saunterings by the sea. We may add that the work is illustrated with twenty-four coloured lithographic plates, executed by the author, most of which are exceedingly good.

Manual of British Botany, containing the Flowering Plants and Ferns arranged according to the Natural Orders. By CHARLES CARDALE BABINGTON, M.A., F.R.S., F.L.S. &c. Fourth Edition, with many additions and corrections. London: Van Voorst, 1856, pp. 446.

An examination of Mr. Babington's fourth edition suggests little that we have not already said, still less that we might not have said, respecting its predecessor. The countless silent rectifications of diagnosis, which give Mr. Babington's writings their chief value, will hardly be appreciated except by assiduous use; but the marks of unwearied observation of living nature and familiarity with the published and unpublished researches of contemporary botanists up to the latest moment are obvious to any reader. The only new feature of this edition is an attempt to introduce all *boná fide* English names, excluding those uncouth Anglo-Latin titles which sound like fond reminiscences of pre-Linnæan nomenclature. Mr. Babington has advanced a little—we wish it had been more—towards distinguishing undoubted and little doubted natives from suspected intruders of all kinds. Some species formerly at liberty are now bracketed; others bracketed with numbers are now bracketed without numbers; others are absolutely rejected. The notation, however, is in this respect somewhat ambiguous and inconsistent. A few probably new species, about which the author has not yet quite made up his mind, are neither excluded nor admitted to full citizenship, but wisely introduced on a doubtful footing: *Utricularia neglecta* and *Potamogeton gracilis* may be taken as examples. The disagreeable but necessary work of correcting the synonyms goes on as before, the result in some cases being the restoration of old names; thus *Myosotis suaveolens* is now once more *alpestris*. Little can be objected against these proceedings except their piecemeal nature. A fearless and thorough revision of the names of our plants on definite principles, whether those of the British Association or others, is much wanted. Mr. Babington did good service in this department in the early part of his career: it is to be wished that he would return to it with increased knowledge on a more methodical plan than he has lately followed. This desultoriness is perhaps not confined to nomenclature. Mr. Babington's observations, extensive and minute as they are, appear to have been too much confined to such plants as have accidentally fallen in his way. For instance, he long ago described, on rather slender evidence, a *Potamogeton* allied to *P. pectinatus* as probably the *P. zosteraceus* of Fries. In his third edition, having become better acquainted with the plant, he named it anew as *P. flabellatus*, at the same time distinguishing *P. pectinatus* in italics as having "*leaves formed of two interrupted tubes.*" This language might surely be too easily taken to mean that the leaves of *P. pectinatus* differ essentially in structure from the upper leaves of *P. flabellatus*. Mr. Babington is of course too good a botanist not to have known, that in plants so closely allied the difference (if such there be) could only be one of proportion, as the leaves of neighbouring species are likewise formed of "interrupted tubes," and the peculiarity of *P. pectinatus* can lie only in the predominance of two over the rest. But though the ambiguity of 1851 may be excused by the want of adequate knowledge of the corresponding structure in *P. flabellatus*, it was surely incumbent on the author of a Flora to have studied his own species a little further before 1856, and not to leave the description as deceptive as ever, especially as Hooker and Arnott had meanwhile challenged the distinctness of the species on definite grounds. Many of the important changes of detail now introduced into the 'Manual' are already known to our readers through the monographs which the author has lately published in this Journal. A great part of them will, we are confident, maintain their ground with, it may be, a few modifications. Others unavoidably excite our scepticism; but, until arguments are adduced on the other side, founded on something like equally cautious and intelligent study, Mr. Babington has a fair right to claim a strong provisional authority. If any one starts, as assuredly he ought to do, at being told that *Arctium majus* and *minus* constitute five species, we can only counsel patience and renewed observation. A large proportion of the novelties occur in the genus *Hieracium*, where the pains bestowed by Mr. Backhouse on the cultivation of doubtful forms supply an excellent check on hasty conclusions in either direction. We should not omit to notice the arrangement of the Grasses, which has been greatly improved, chiefly from Fries and Andersson.

Species introduced or separated in the 4th edition.

Ranunculus trichophyllus, *Chaix.*
R. Drouetii, *F. Schultz?*
R. Baudotii, *Godr.*
R. floribundus, *Bab.*
R. peltatus, *Fr.*
Polygala austriaca, *Cr.*
[Sagina densa, *Jord.*]
Hypericum anglicum, *Bert.*
Rubus pampinosus, *Lees.*
Epilobium rosmarinifolium, *Haenke.*
E. anagallidifolium, *Lam.*
Galium montanum, *Vill.*
G. commutatum, *Jord.*
G. elongatum, *Presl.*
Arctium tomentosum, *Pers.*
A. intermedium, *Lange.*
A. pubens, *Bab.*
Hieracium holosericeum, *Backh.*
H. eximium, *Backh.*
H. calenduliflorum, *Backh.*
H. gracilentum, *Backh.*
H. globosum, *Backh.*
Hieracium senescens, *Backh.*
H. lasiophyllum, *Koch.*
H. Gibsoni, *Backh.*
H. argenteum, *Fr.*
H. nitidum, *Backh.*
H. aggregatum, *Backh.*
H. stelligerum, *Froel.*
Thymus Serpyllum, *L.*
†Salix acutifolia, *Willd.*
Orchis incarnata, *L.*
Epipogium aphyllum, *Sw.*
Arum italicum, *Mill.*
[Potamogeton sparganiifolius, *Laest.*?]
[Eleocharis Watsoni, *Bab.*]
Festuca Myurus, *L.*
Equisetum Moorii, *Newm.*
Pseudathyrium alpestre, *Newm.*
? P. flexile, *Newm.*
? Asplenium acutum, *Bory.*
[Gymnogramma leptophylla, *Desv.*]
? [Botrychium rutaceum, *Sw.*]
? [Ophioglossum lusitanicum, *L.*]

Species omitted in the 4th edition.

Thalictrum majus.
Rubus calvatus.
R. fuscus.
R. Wahlbergii.
Hieracium atratum.
Hieracium anglicum.
[H. oreades.]
H. dovrense.
Salix Helix.
S. Forbyana.

Trees and their Nature, or the Bud and its Attributes. By ALEX. HARVEY, A.M., M.D. &c. London, 1856.

This is an amusing little volume, displaying a great deal of acuteness, and the results of very careful reading within a limited sphere. The object of the work is the discussion of the vexed question of *individuality* in plants, and the advocacy of the claim of the *bud* to the dignity of the 'vegetable individual.' So far as inquiries of this sort tend to direct attention to the physiological laws ruling the growth and multiplication of plants, they are beneficial; but as regards the main question it appears to us only a metaphysical puzzle, calculated to afford much amusement to those whose taste lies that way, but having no practical bearing. The meaning of the word 'individual' must always depend on foregone conclusions. It seems to us that the author is not clear in distinguishing *potentiality* from *actuality*. When a botanist speaks of the annual layers of wood of the stems of Dicotyledons as 'roots,' the term can only be admitted in a figurative sense. A bud may be *capable* of producing a distinct tree, but if it be not detached, it becomes an *individual branch*, not an *individual tree*. Our author does not appear to be aware, either, that roots as well as stems originate in definitely organized 'buds,' formed in the cambium region. The work is agreeably written, and its perusal may serve as a pleasant intellectual exercise, but it must not be accepted by any means as a full exposition of the question.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

July 10, 1855.—John Gould, Esq., F.R.S., in the Chair.

On the Geographical distribution of the Mammalia and Birds of the Himalaya. By B. H. Hodgson, Esq.*

"The Himálayan mountains extend from the great bend of the Indus to the great bend of the Brahmapútra, or from Gilgit to Brahma Kúnd, between which their length is 1800 miles. Their mean breadth is about 90 miles; the maximum about 110, and the minimum 70 miles. The mean breadth of 90 miles may be most conveniently divided into three equal portions, each of which will therefore have 30 miles of extent. These transverse climatic divisions must be, of course, more or less arbitrary, and a microscopic vision would be disposed to increase them considerably beyond three, with reference to geological, to botanical, or to zoological phænomena. But, upon comparing Captain Herbert's distribution of geological phænomena with my own of zoological, and Dr. Hooker's of botanical, I am satisfied that three are enough. These regions I have denominated the lower, the middle, and the upper. They extend from the external margin of the Tarai to the ghát line of the snows. The lower region may be conveniently divided into—I. The sandstone range, with its contained Dhúns or Máris; II. The Bháver or Saul forest; III. The Tarai. The other two regions require no

* Extracted from a memoir by the same author, entitled, "On the Physical Geography of the Himalaya," and printed in the Journal As. Soc. Bengal for 1849, by Frederic Moore.

subdivisions. The following appear to be those demarcations by height which most fitly indicate the three regions :—

Name.	Elevational limits.
Lower region	Level of the plains to 4000 feet above the sea.
Central region......	4000 to 10,000 feet above the sea.
Upper region	10,000 to 16,000* feet above the sea: highest peak measured is 28,176.

"To begin with Man, the upper region is the exclusive habit of the Bhótias, who extend along the whole line of the gháts, and who, with the name, have retained the lingual and physical characteristics of their tramontane brethren. To the central region are confined—but each in their own province from east to west—the Mishmis, the Bors and Abors, the Ákás, the Daphlas, the Lhópás, the Lepchas, the Limbús, the Kirántis, the Múrmis, the Néwárs, the Súnwárs, the Chépángs, the Gúrúngs, the Magars, the Khas or Khasias, the Kóhlis, the Garhwális, the Kakkas, the Bambas, the Gakars, the Khatirs, the Awans, and the Janjúhs. To the lower region are as exclusively limited the Kócch, the Bódó, the Dhimál, the Kichak, the Thárú, the Dénwár, the Sallah, and the Bóksar. Of these races, those of the central region are all of transnivean origin, like the first named; but they are much altered in speech and aspect by twelve to fifteen centuries of residence in a cisnivean climate, and by mixture in some few cases (as Khas or Khasia) with southern blood; whilst the races of the lower region are of the aboriginal Indian or Tamulian stock, and nearly unmixed, though some of them have adopted the speech and customs of the Hindus†. The hill Bráhmans, Rájpúts and Moslems, so common to the westward, so rare to the eastward, are more modern immigrants from the plains. It is very deserving of special notice, that the people of the upper region cannot endure the climate of the central one, nor those of the central region the climate of the lower one; so that the distribution even of the human race in the Himálaya affords a remarkable verification of our triple transverse division from a quarter the least likely to afford any such argument. But to proceed to our zoological enumerations. To the upper region exclusively belong, among the Ruminants, the Bisons (*Poëphagus*) and Musks, the Wild Goats (*Ibex, Hemitragus*) and Wild Sheep (*Pseudois, Ovis*); among the Rodents, the Marmots and Pikas (*Lagomys*); among Plantigrades, the Bears proper (*Ursus*). In the middle region, true Bovines (*Bos*) take the place of the Bisons of the upper region; Caprine Antelopes (*Nemorhædus, Kemas*) replace its Musks and Wild Goats and Sheep; common Rats, and Mice, and Hares, and Porcupines, and Hedgehogs, its Marmots and Pikas; and Sun Bears (*Helarctos*) its true Bears; whilst the Deer family, unknown to the upper region, is here

* This is about the average height of the gháts and of the perpetual snow. It is also nearly the limit of possible investigation, and of the existence of organic phænomena.

† For these tribes see Journ. As. Soc. Beng. for December 1847, and April and June 1848, and May 1849.

represented only* by the anomalous Stilt-horns (*Stylocerus*). In the lower region, the Ox family is represented by Bibos and Bubalus (splendid wild types); the Deer family, here abundant, by Rusas, Stags, Axises, and Stilt-horns to boot; the Antelopes by Tetracerus, or the four-horned kind; the Rodents, by the Bambú Rats (*Rhizomys*) and Spiny Hares (*Caprolagus*); and the Bear family by the Honey Bears (*Melursus*); add to all which, that to this region are exclusively confined all the large Pachyderms, such as the Elephant and Rhinoceros; and the Monkeys also (*Semnopithecus* et *Macacus*), though not so exclusively in their case. The Carnivora, again, are represented in the upper region by Ounces, by Foxes of a large sort (*V. montanus*), by the Weasels proper, and by the *Ailuri* or Cat Lories; in the middle region, by the Wild Dogs (*Cuon*), the Marten Weasels, Leopards, Thick-tailed Leopards (*F. Macrosceloides*, Hodgs.), Wild Cats (*F. Murmensis*, *Pardochrous Ogilbii*), Libyan Lynxes (*Libycus*), Zibets, Screw-tails (*Paradoxurus*), and Prionodons; and in the lower region by Tigers, Leopards, Hyænas, Wolves, Jackals†, insectivorous Foxes (*Kokri*), Bear-badgers (*Ursitaxus*), Urvas, Mangooses, Helictes or Oriental Gluttons, small Civets (*Viverrula*), hirsute Screw-tails, and sharp-faced Cats (*Celidogaster*). Zibets recur in this region but rarely, and one small species of Mangoose is found in special spots of the central region. The Otters in the upper region are represented by the small golden and brown species (*L. aurobrunnea*); in the central, by *L. monticola* and *indigitata*; in the lower, by the large Chinese species *L. Sinensis*. Among the Squirrels, the great thick-tailed and purple species (*S. macruroïdes* et *purpureus*) belong solely to the lower region; the small Lokries (*S. Lokria* et *Lokroïdes*) to the central, and the Siberian to the upper; whilst Flying Squirrels, a numerous group, are confined to the central region, so far as appears. In the Bat group, the Frugivorous species, or Pteropines, all are limited to the lower region, whilst the Horse-shoes (*Rhinolophinæ*) specially affect the central region.

"From the class of Birds we may select as characteristic of the three regions the following:—

"The True Pheasants (*Phasianus*), the Tetraogalli, the Sanguine Pheasants (*Ithaginis*), the Horned and the Crested Pheasants (*Ceriornis*, *Lophophorus*) of the upper region, are replaced by Fowl Pheasants (*Gallophasis*)‡ in the mid-region, and by Fowls proper (*Gallus*)

* I am fully aware that *Rusas* (Sámber) are found in the western hills, but a careful consideration of the facts in that part of the Himalaya, with due advertence to the known habits of the group, satisfies me that these Deer have been driven into the western hills by the clearance of the Tarai and Bháver.

† Jackals have made their way (like crows) to the most populous spots of the central region, but they are not proper to the region, nor Indian Foxes, though some of the latter turned out by me in 1827 in the great valley of Nepal, have multiplied and settled their race there. *Ex his disce alia.*

‡ The influence of longitude on geographic distribution might be singularly illustrated, did space permit, from numerous Himálayan groups, Galline and others: thus, for example, a black-breasted *Ceriornis* is never seen east of the Káli, nor a red-breasted one west of it. So of the black and white crested *Gallophases*; whilst a black-backed one is never seen west of the Arún, nor a white back east of it.

in the lower. In like manner, among the Partridges (*Perdicinæ*), the Grouse Partridges (*Tetraoperdix*) belong exclusively to the upper region; the Chukórs (*Caccabis*) and the Tree Partridges (*Arboricola*) to the central; and the Francolines (*Francolinus*) to the lower, though the black species of this last form are also found in the mid-region. In the Pigeon group, the Blanched Pigeons (*C. leuconota*) belong solely to the upper region; the Vinous Pigeons (*C. Hodgsoni*) to the central, and the Green, the Golden, and the Banded (*Treron, Chalcophaps, Macropygia*), as entirely to the lower; the Trerons alone partially entering the central tract from the lower.

"The splendid Edolian Shrikes (*Chibia, Chaptia, Edolius*) belong exclusively to the lower region. They are replaced in the central tract by plain Dicrurines, and in the upper by plainer Lanians. The Cotton Birds (*Campephaga*) of the south are replaced by gaudy Ampelines (*Cochoa*) and Leiothricinians (*Leiothrix, Pteruthius, Cutia*) in the middle region: but both groups seem excluded from the north. Among the Fly-catchers the gaudy or remarkable species and forms belong wholly or chiefly to the lower region, as *Tchitrea, Rhipidura, Cryptolopha, Myiagra, Hemichelidon, Chelidorynx*; whilst those which approach the Warblers (*Niltava, Siphia, Digenea*) belong to the mid-region; and the plainer and more European types are alone found in the northern.

"Among the *Fissirostres*, Goat-suckers and Swallows are pretty generally distributed; but Rollers, Bee-eaters, Eurylaimi, Trogons, and all such gaudy types, belong to the south, with only occasional alpine representatives, as *Bucia* is of *Merops*. The Tenuirostral birds belong distinctively to the lower region. Yet they have representatives or summer visitants in all three, even among the Sun-birds. Upon the whole, however, it may be safely said that the Sun-birds (*Nectarinia*) belong to the south; the Honey-suckers (*Meliphagidæ*) to the centre and south; and the Creepers, Nuthatches and Wrens*, to the north and centre. The Sylvians or Warblers are too ubiquitarian, or too migratory for our present purpose, even Boreal types being common in the lower in the cold weather. Horn-bills, Barbets, Parroquets (*Palæornis, Psittacula*) belong to the lower region, though they have a few representatives in the central; none in the upper. Woodpeckers abound in the lower and central regions, but are rare in the upper. True Cuckoos (*Cuculus*) are as common and numerous in the central region as Walking Cuckoos (*Phœnicophaus, Centropus*), &c. are in the southern, where also the Golden (*Chrysococcyx*) and Dicrurine Cuckoos (*Pseudornis*) have their sole abode, whilst what few of the group belong to the upper region, are all allied to the European type. The Ravens, Pies, Choughs, Nut-crackers and Conostomes of the upper region are replaced in the central region by Tree Pies (*Cissa, Dendrocitta*), Jays, Rocket-birds (*Psilorhinus*), Pie Thrushes (*Garrulax*), Timalias, and

* I have in this paper followed, without entirely approving, Mr. G. R. Gray's classification of my collections in the printed Catalogue of the British Museum. The geographic distribution is now attempted for the first time. But I will recur to the subject in a separate paper devoted to it.

Hoopoe Thrushes (*Pomatorhinus*); and in the lower region, by the common Indian Crows (*C. culminatus* et *splendens*), Grackles*, Stares, Vagabond Pies and Dirt-birds (*Malacocercus*). Thrushes proper with Rock Thrushes, Ousels, Myophones, Zootheres, Tesias and Hypsipetes are as abundant in the central and upper region as Bulbuls, Orioles, Pittas, are in the central and lower.

"In the Finch family, the Haw-finches, Bull-finches, Gold-finches, and Cross-bills (*Loxia*) are as strictly confined to the upper regions as are the corvine Conostomes, Nut-crackers, Choughs and Ravens. The former are replaced in the central region by the Buntings, Wood-finches (*Montifringilla*), and Siskins; and in the lower region by the Weavers and Mûnias. The Raptorial birds are, in general, too cosmopolitan to subserve the purposes of geographic distribution. Still it may be remarked that the True Eagles belong, *quoad* breeding at least, to the upper region; the Crested Eagles (*Circaëtus*), the Neopuses and Hawk Eagles (*Spizaëtus*) to the central; and the Pernes (*Haliaëtus* et *Pandion*) and Haliasturs to the lower. Among the Vultures the distinction is more marked: for the Eagle Vultures (*Gypaëtus*) belong exclusively to the upper region; the large European Vultures (*fulvus* et *cinereus*) to the central; and the Neophrons and the small Indian Vultures (*Bengalensis* et *tenuirostris*) to the lower. The Himálaya abounds in *Falconidæ*, all the occidental types and species being found there, and many more peculiar and oriental ones; and it deserves special remark, that whereas the former (*Imperialis, Chrysaëtos, Lanarius, Peregrinus, Palumbarius, Nisus*, &c.) affect the upper and central regions, the oriental types (*Hypotriorchis, Haliastur, Hierax, Hyptiopus, Elanus, Poliornis*) are quite confined to the lower region.

"Those perfect cosmopolitans the Waders and Swimmers, migrate regularly in April and October, between the plains of India and Tibet, and, in general, may be said to be wanting in the mountains, though most abundant in the Tarai. The great Herons (*nobilis* et *cinereus*), the great Storks (*nigra* et *purpurea*) and great Cranes (the Cyrus and Damoiselle) of the Tarai are never seen in the mountains, where the Egrets alone represent the first group. But the soft-billed smaller Waders (*Scolopacidæ*) are sufficiently common in the mountains, in which the Woodcock abounds, breeding in the upper region and frequenting the central, and rarely the lower region, from October till April. Geese, Ducks and Teals swarm in the Tarai, where every occidental type (so to speak, for they are ubiquitous) may be seen from October till April; and many oriental non-migratory types; whereas in the mountains the Mergansers (*orientalis*) and the Cormorants (*sinensis* et *pygmæus*) only are found, and that very scantily, with a few Rails and Gallinules and Sandpipers from the vast host of the Waders."

* When Darjeeling was established there was not a Crow or Pastor to be seen. Now there are a few Crows, but no Pastors. Enormously abundant as both are in the lower region, this sufficiently proves that they are not native to the central tract, though common in the great valley of Nepal.

On native impressions regarding the Natural History of certain [Indian] Animals.

By H. Torrens, Esq., B.A., V.P. As. Soc. Bengal*.

The singular impressions current among natives even of the highest rank, as to the habits and nature of certain animals, are not undeserving of record. It is rarely that the credence of the narrators in these things can be elicited, if even they go so far as to mention the existence of the belief; for they dread the ridicule as much as they anticipate the incredulity of a European: consequently these strange stories are but imperfectly known, even to the best informed among us in such legends. I mention one or two, with the circumstances of my acquaintance with them.

While out tiger-shooting with a party of Musulman gentlemen, I was asked, in a confidential way, whether I had ever seen the *Phnew*: I spell the word with the almost undescribable nasal aspirate with which it was invariably pronounced to me. With an air of grave and serious interest, which is the best way of inspiring confidence, I replied, that the nature of the thing or being was unknown to me, and I requested information on the subject. On this there was a little hesitation, when, after a time, it was explained, that as I had seen more of Tigers than my companions, they fancied I might have also seen or heard something of the animal that always preceded the Tiger, called *Phnew*, from the ceaseless iteration of a sound similar to its name. I required further enlightenment as to this creature, when I found it was a "something that preceded the Tiger by six cubits, wherever he went, making the noise '*phnew*' without end, looking for things for it." The old tales of "*the Lion and his provider*" recurred to me at once, and I bethought me of the hospitality of some cat-like sound of *Felis Tigris* having led, during his nightly search for prey, to the creation of the story. I have done all I could, but in vain, to discover whether there were real grounds for the belief, based on such a habit of the animal. I killed several Tigers in company with my friends afterwards, but though we found no *Phnew* with any of them, the silent faith of my believers in the marvellous has remained unshaken as to the existence of the mysterious animal. I subsequently learned that there is in Bengal a like belief respecting it among the Hindus, who term the creature *Ghóg*†.

There are few Englishmen in India who have not perhaps heard some of the strange tales related by the natives regarding Serpents. The most remarkable to me has always been the belief in the *Raj Samp*, or King-snake, who is represented as belonging to a superior order of Serpent, as exacting homage and obedience from his ophite subjects, and sometimes, as appearing with the semblance of a crown, the type of his authority. I was one day in company with a number

* Extracted from the Journal As. Soc. Bengal for 1849. By Frederic Moore.

† According to Babu Rajendralál Mittra, the Hindus distinguish the Ghóg as a different animal from the *P'heu*.—Edw. Blyth, Esq.

of native gentlemen, when the conversation turned upon the nature of antidotes in the case of Snake-bites, the belief as to the cure effected by applying to the wound the head of the identical reptile that had inflicted it, the charms powerful to compel the Snake to appear,—as to all which matters I have never been able to obtain, amid many tales, any relator daring enough to declare himself an eye-witness of the marvels he recounted. At last, mention being made of the King-snake, a party present said—"At any rate I can assure you of the existence of *him*, for it is well known that I have seen," and the story, to the following effect, was then told. The narrator, being at that time, he said, about fourteen years old, had run hastily to the terraced roof of a ground-floor house to recover his kite, when his attention was attracted by a large *Goomna* (Cobra capello) which, without perceiving him, raised itself with dilated hood in the erect attitude common with those Snakes, and uttered a loud cry. Immediately some ten or twelve Snakes appeared from different quarters, and assembled before their king, when, after a short time, he pounced upon and devoured one of the smaller ones, with which arbitrary assertion of regal power the convocation terminated. Now the narrator of this tale had no interest in attempting to mislead me; he had mentioned what he stated again and again to the majority of persons present for years before I ever saw him, and he is naturally of intelligence, and in no sort the man to tell a useless falsehood. It is, I was then informed, by these sort of assemblages that the King-snake asserts his power, and that his subjects are called to them for the purpose of bringing tribute, in the shape of dainties for the royal palate; should, however, no tributary Frog or Cat, or bird be forthcoming, or should even the offering produced be insufficient, one of the luckless ophids pays in person the penalty of the omission, even as had been witnessed by my informant. I ventured with respect to his story to object, in as delicate a way as I could, to the incident of the cry uttered by the King-snake, but in this I was immediately over-ridden. The cry of the large *Goomna* was well known in the ruinous city where we were, and in which they abound, and it was described to me as a strident sound, the attempted imitation of which resembled the acute *staccato* note of a treble hautboy. I heard this sound myself subsequently during a sleepless night, emitted by a large Snake which killed a Rat in my bed-room: as it was pitch dark, I was unable to rise and destroy the intruder, but the sound was too peculiar not to have been that of the ophid, according as it did with the description given me, and being unlike anything I ever heard before, as also contrasting distinctly and remarkably with the cries of its victim. I have noted down these trivial, but not incurious matters, as an inducement to the record of more valuable facts as to the opinions held by natives upon the habits of animals, whence perhaps some really useful information may be elicited.

Note by Mr. Blyth.

The Snake which I have had invariably pointed out to me as the *Raj Samp* by natives of Bengal, is *Bungarus annularis,* which habitually preys upon other Snakes, and is currently said to be a deadly enemy of the Cobra. I have taken a *Tropidonatus umbratus* about two-thirds the length of its devourer from the stomach of this species. Another ophiophagous species with the Cobra hood is *Hamadryas hannah* of Cantor, or *Maia vettata* of Elliot, a specimen of which, 9 feet long, I obtained in the Midnapore jungle.

Mr. Layard some time ago informed me of a popular notion among the natives of Ceylon respecting a "horn" which is said to grow sometimes, but very rarely, on the forehead of the Jackal; and this horn is regarded by them as a specific of innumerable virtues. Strange to say, the same notion is equally current among the natives of Bengal, who believe that it ensures the prosperity of its possessor, and success in every undertaking.

July 24, 1855.—Professor Tennant, F.G.S., in the Chair.

On some New Species of Birds collected by Mr. M'Gillivray. By John Gould, F.R.S. etc.

In exhibiting a portion of the first collection of birds which has been sent to this country by Mr. John M'Gillivray, the naturalist attached to H. M. surveying ship 'Herald,' Captain Denham, I have to remark, that it comprises several species of especial interest, particularly some obtained on the Isle of Pines, and on Lord Howe's Island. It also comprises a new form among the *Turdidæ* or Thrushes, from that isolated spot the island of Tristan d'Acunha, which presents a union of the characters of the genera *Turdus, Chamæza* and *Oreocincla.* This new bird I propose to characterize under the generic and specific appellations of *Nesocichla eremita.* Among the birds from Lord Howe's Island is a singular species of *Merula* or Blackbird, nearly allied in form to, but very different in colour from, the *Merula nestor* of Norfolk Island; to this species the specific name of *vinitincta* is assigned. From the same island are two distinct species of *Zosterops,* entirely new to science. They differ from any other species of the genus which has come under my notice, one of them being a very large bird for a *Zosterops,* and the other a much smaller species, being nearly allied to, but distinct from, the Australian *Zosterops dorsalis*: to these two species I give the names of *Z. strenuus* and *Z. tephropleurus.* A beautiful Parrakeet from Cape York, nearly allied to *Platycercus palliceps,* I propose to name *Platycercus cyanogenys.* Among the birds from the Isle of Pines is a very beautiful Pigeon, appertaining to the genus *Ptilinopus.* This bird, with several others of even greater interest, I propose to make the subjects of a second paper.

Genus Nesocichla.

Bill strong, more powerful than in the genus *Turdus*; gonys nearly straight, with a small notch near the tip in the upper mandible; culmen gradually descending from the base; nostrils seated in an oval depression at the base of the upper mandible; wings short, somewhat concave; first primary very small; the third, fourth and fifth equal and the longest; tail rather shorter than in *Turdus*, and the feathers rather pointed; tarsi very strong, toes strong and much lengthened, particularly the hinder one; front of the tarsi scutellated; under part entire.

This form differs from all others in the great family of the Thrushes, and appears to partake of the characters of the genera *Turdus*, *Chamæza*, and *Oreocincla*.

Nesocichla eremita.

Head and all the upper surface, wings and tail dark sandy-brown, with a darker shade in the centre of each feather, but the primaries have paler edges, and the greater coverts and secondaries are tipped with sandy buff; lores and cheeks rufous; feathers of the under surface deep buff at the base, with a lengthened pear-shaped mark of brown down the apex of each feather, these marks being so large and thickly placed as to give the whole a mottley appearance; on the throat these marks somewhat resemble striæ; thighs buff; bill black; tarsi reddish-brown, toes darker.

Total length, $8\frac{1}{2}$ inches; bill, $1\frac{1}{4}$; wing, $3\frac{3}{4}$; tail, 3; tarsi, $1\frac{1}{2}$.

Hab. The island of Tristan d'Acunha.

Remark.—This bird is about the size of the common Song-thrush, *Turdus musicus*, and similar to it in appearance; on examination, however, it will be found to differ very considerably in structure.

Merula vinitincta.

The male has the head and nape blackish-brown, upper surface and wing-coverts reddish-brown; wings brown margined with olivaceous; tail brown; throat dark bluish grey; under surface vinaceous red; bill bright gamboge-yellow; eye-lash yellow; tarsi and toes yellow.

Total length, 8 inches; bill, 1; wing, $4\frac{1}{8}$; tail, $3\frac{3}{8}$; tarsi, $1\frac{1}{4}$.

The female is very similar, but is of a somewhat paler tint, and has only a trace of the black hood of the male.

Hab. Lord Howe's Island.

Remark. Of the same form, and somewhat allied to the *Merula nestor* of the Norfolk Island.

Zosterops tephropleurus.

Head and upper surface bright olive-green, with a wash of grey across the shoulders; wings and tail slaty brown, margined with olive-green; throat dull yellow; around the eyes a circle of white feathers, below which is a mark of black; under surface pale vinaceous brown, becoming gradually paler on the lower part of the abdomen, and passing into the pale yellow of the under tail-coverts.

Total length, $4\frac{3}{4}$ inches; bill, $\frac{5}{8}$; wing, $2\frac{3}{8}$; tail, $2\frac{1}{8}$; tarsi $\frac{3}{4}$.

Hab. Lord Howe's Island.

Remark. This species is allied to *Z. dorsalis*, but is of a somewhat larger size, and is less richly coloured on the flanks.

ZOSTEROPS STRENUUS.

Head and upper surface bright olive-green, with a wash of dark grey across the shoulders; wings and tail slaty-brown, margined with greenish olive; eyes surrounded by the usual ring of white feathers, beneath which is a narrow line of black; chin and throat yellow; flanks pale vinaceous; centre of the abdomen nearly white; under tail-coverts pale yellow; bill and feet bluish black.

Total length, $5\frac{3}{4}$ inches; bill, 1; wing, $2\frac{3}{4}$; tail, $2\frac{1}{4}$; tarsi, $\frac{7}{8}$.

Hab. Lord Howe's Island.

This is by far the largest species of the genus yet discovered.

PLATYCERCUS CYANOGENYS.

Crown of the head pale sulphur-yellow; cheeks cærulean blue; feathers of the nape, back and scapularies black, broadly margined with sulphur-yellow, stained with green on the lower part of the back; rump and upper tail-coverts greenish yellow, with an extremely narrow fringe of black at the tip of the feathers; shoulder and greater wing-coverts deep blue; lesser coverts black, bordered with deep blue; primaries and secondaries blackish brown, the basal half of their external webs deep blue, the apical half pale blue; tertiaries black, broadly margined with greenish yellow; breast pale greenish yellow, abdomen light greenish blue; all the feathers of the under surface slightly fringed with black; under tail-coverts scarlet, narrowly margined with yellow; two middle tail-feathers greenish blue; the next on each side blue, slightly tipped with pale blue; the remainder blackish brown at the base of their internal webs, and deep blue externally; their apical portions being beautiful pale blue.

Total length, 13 inches; wing, $6\frac{1}{4}$; tail, 7; tarsi, $\frac{3}{4}$.

Hab. Cape York, north-east coast of Australia.

Remark. This species offers a very close alliance to *Platycercus palliceps,* but differs in having no trace of scarlet on the forehead, in the green tinge of the borderings of the feathers of the back, in the greenish yellow of the breast, and in having the cheeks blue instead of light yellow.

NOTES ON THE NESTS AND EGGS OF THE BIRDS OF WESTERN INDIA.—PART XI. BY LIEUT. BURGESS.

Family COLYMBIDÆ.

Genus PODICEPS.

PODICEPS PHILIPPENSIS.

I believe the egg sent with this paper to be that of the Grebe. It was taken from the nest with several others in the month of August. The nests were composed of rotten reeds and grass, fastened between tall reeds*; each nest contained about eight eggs, 1 inch and nearly

* The eggs were carefully covered over, and the heat arising from the nest was most perceptible: the eggs appear to be hatched by the heat arising from the decaying vegetable matter.

$\frac{5}{10}$ths in length, by 1 inch in width. Some of the eggs were nearly white, others much discoloured.

Family PELECANIDÆ. Subfamily LARIDÆ.

Genus STERNA.

Subgenus STERNA.

STERNA MELANOGASTER (Temm.). BLACK-BELLIED TERN.

I found this Tern common on the river Bheena, and was fortunate enough to obtain an egg. On a second occasion, when walking on a sand-bank in the midst of the river where I obtained the first egg, I was beset by a pair of these Terns, and on looking about on the ground, found two eggs deposited in a slight hollow scraped in the moist sand, not far from the brink of the water. These birds, when flying overhead, utter a cry very like the chirp of a Sparrow. One could easily distinguish the different kinds of Terns by their varied notes.

The Black-bellied Tern breeds during the months of March and April, laying two eggs. The egg measures 1 inch and rather more than $\frac{2}{10}$ths in length, by 1 inch in width. It is of a rich stone-colour, spotted chiefly round the centre, and more sparingly over the large end with grey and light brown spots.

Subgenus RHYNCHOPS.

RHYNCHOPS NIGRA.

This large species of Tern I found most abundant on the river Bheena, and had ample opportunities of studying its habits. On a large sand-bank in that river I found that a large colony had established themselves, and found young birds able to fly, nestlings and eggs. The appearance of these birds is attractive, their long orange razor-like beak, long wings, and curious skimming flight, ever and anon dipping their lower mandible under water, their odd shuffling gait when walking on the sand, as if they scarcely knew what to do with their beak, and apparent difficulty in arranging their long swift-like wings, their curious chattering notes when they assemble on some spit of sand at the water's edge,—all these points attract any one fond of natural history.

I first noticed these birds on a mud-bank in the river in the month of January. On visiting the same place in April, I found them on a sand-bank higher up, and suspecting this to be their breeding-time, was conveyed over the water to the bank. On reaching it and narrowly inspecting the ground, I found the remains of broken egg-shells; after a further search, I was rewarded by finding four or five nests, also the nest of a Little Ringed Plover and Black-bellied Tern. The Rhynchops lays four eggs in a hole scraped in the damp sand and gravel. Those which I found were mostly near the water's edge. In some nests I found young ones, and procured one young bird that was able to fly very fairly. Any one at all accustomed to the habits of birds might have told that they were nesting by their restlessness, and the vicious way in which they attacked all intruders. I saw them buffet a large Plover that pitched on the bank, and boldly attack those insatiable pilferers of nests, the Crows. The very young birds, when first hatched, are covered with a whitey-brown down, spotted with dark spots. The curious square end of the beak is very marked. The legs and feet of a dirty greyish-brown. The eggs are rather more than $1\frac{1}{2}$ inch in length, by 1 inch and rather more than $\frac{1}{10}$th in width, of a pale stone colour, spotted and blotched with grey and two shades of brown.

I subjoin the description of a young bird that was able to fly, probably about six weeks or two months old. The beak (after the skin was dried) was of a dull brown tinged with orange; the under mandible sharp, as in the old bird, but scarcely longer than the upper. Feathers on the cheeks pale fawn colour, with a few dusky spots, those on the forehead much the same, but the dusky spots more visible; on the top of the head behind the eye, back of the neck, the feathers are dull black, with pale ferruginous edges; lower part of the back of the neck whitish, with a broad brown bar, and tipped with pale ferruginous; upper tail-coverts, some dusky black, with pale ferruginous edges, some ferruginous mottled with white; tail-feathers, lower portion white, upper portion dusky, with a marked border of pale ferruginous; primaries nearly black, with pale tips; smaller quill-feathers, lower portion dusky, upper nearly white; secondaries much the same, the white being much clearer; greater coverts dusky, with whitish tips; tertials dusky, with pale ferruginous edges; the lesser coverts the same; chin, throat, breast and belly, under tail-coverts white; sides of the neck white, with a few dusky spots; legs and feet dirty orange-brown.

On some Points relating to the Anatomy of the Tasmanian Wolf (Thylacinus) and of the Cape Hunting Dog (Lycaon pictus). By Edwards Crisp, M.D.

Before I proceed to the immediate object of my communication, I may be excused, I trust, for alluding to a mode of investigation that I have followed in all my dissections, viz. that of taking accurate weights and measures of the body of the animal and of the viscera, with drawings the size of life of the organs examined.

By this method, combined with the use of the microscope, I believe hereafter that much light will be thrown upon many physiological subjects which are at present but imperfectly understood. It is, however, only by comparison on a large scale that any important benefit is likely to result.

Thylacinus Cynocephalus.

This animal (a male) died at the Society's Gardens, where it had been for several years. I believe it is the only one that has been dissected in this country. It weighed 33 lbs., and measured from nose to root of tail 2 feet $9\frac{1}{2}$ inches. The tail, 15 inches. The penis curved backwards. The cause of its death was unapparent. It was excessively fat; the fat on its abdomen and other parts weighing probably four or five pounds. The heart, long and pointed; weight, 4 oz. 60 grs. The trachea of moderate size; the connecting membrane at the posterior part very thick. The lungs trilobed; weight, 4 oz. 304 grs. The liver composed of five main lobes; weight, 14 oz. The spleen long, thin and narrow, with a lateral tongue-like process (as in nearly all of the *Marsupiata*) $\frac{1}{3}$ from the upper end. Length of spleen, $10\frac{1}{2}$ inches; its average breadth about an inch; it was seated along the left side of the stomach, imbedded in fat. The kidney of a rounded form; weight, 1 oz. 167 grs. The alimentary canal measured only 6 feet 6 inches. The stomach of moderate size; its coats very thick, and capable of great distension. The rugæ of the lining membrane large and prominent; the pyloric valve strong and muscular; the length of empty stomach 8 inches; the duodenum at its commencement studded with numerous bead-like processes, which emerged into a portion of mucous membrane thickly studded with villi about 3 lines in length, as represented in fig. 1. These were continued for nearly four feet; they resemble much the rumen of the sheep or rein-deer. In the small intestines of the Rhinoceros, fig. 2, the villi are about 6 or 8 lines in length, but far less numerous.

The cæcum absent. The large intestine measured 12 inches; the coats thick and the lining membrane plicated longitudinally. The relative weight of the viscera as compared with that of the body is about as follows:—Liver, $\frac{1}{37}$; spleen, $\frac{1}{382}$; kidney, $\frac{1}{382}$; heart, $\frac{1}{127}$; lungs, $\frac{1}{112}$; the blood-corpuscles about $\frac{1}{4500}$ of an inch in diameter.

Fig. 1.

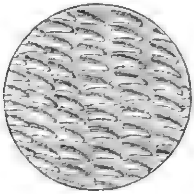
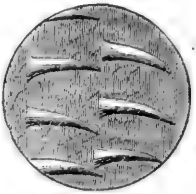


Fig. 2.



I have examined the two skeletons of the *Thylacinus* at the Museum of the College of Surgeons, a description of which is given by Professor Owen in the new Osteological Catalogue (p. 347). The teeth, 46 in number; incisors, 8 above and 6 below; canines, 4; molars, 28, 14 in each jaw = 46. Vertebræ: cervical, 7; dorsal, 13; lumbar, 5; sacral, 2; caudal, 23; ribs, 13.

The time does not allow me to dwell on many points of great interest respecting the anatomy of this animal, but a comparison of the structure of the *Thylacinus* with the Dog I am about to describe will not be unprofitable.

Cape Hunting Dog (Lycaon pictus. S. Africa).

This animal died at the Society's Gardens, where it remained for some months previous to its death, a few days before which period it had several convulsive fits. I could not examine the brain; but Mr. Ward, who stuffed the animal, told me that a large quantity of serum escaped from the cranium, so that probably death was occasioned by inflammation of the brain and effusion of fluid.

In Cuvier's 'Animal Kingdom,' 1849, by Carpenter, p. 91, is the following note:—"This remarkable species is dog-like, but certainly not a *Canis*; its form and colouring (and, there is reason to suspect, its internal conformation) are rather those of a hyæna, and it is known to copulate in the manner of those animals, and not in the peculiar manner of the dogs and foxes. Even its dentition is the same as that elsewhere found (with one other exception, *Proteles*) throughout the group to which we conceive the hyænas to belong, the dental system of which latter appears to be modified in accordance with their much increased and prodigious strength of the jaw."

This dog weighed about 50 lbs.; it measured 3 feet 1 inch from nose to root of tail; tail, 13 inches; height to the back behind neck, 2 feet 3 inches; fore-leg, $16\frac{1}{2}$ inches; ribs, 13. Teeth: incisors, 6 in each jaw, 12; canines, 4; molars, 10 above and 12 below, =38. The age of the animal about $2\frac{1}{2}$ years. *Heart* of a rounded form; weight 8 oz.; the parietes of the left ventricle 10 lines in thickness, of the right 3 lines; the aorta of large calibre, and its coats thick. Lungs, the right four-lobed, the left three-; weight 26 oz. Trachea very large. Liver seven-lobed; weight 21 oz. Bile of a dark yellow colour. Gall-bladder of moderate size. Spleen about 500 grs. in weight; long, lax, thin and narrow, as in all the *Carnaria*. It was in the usual situation in this order of animals, viz. on the left of the stomach, to which it was attached by a wide mesenteric fold; the splenic artery and vein long; no valves in the latter. Pancreas small and elongated. Kidney oblong, less concave on its inner side than usual. The stomach of moderate size, and shaped like that of the dog; length 12 inches; this organ with the œsophagus measured 12 feet 6 inches; the cæcum, which was in $2\frac{1}{2}$ spiral folds like that of the dog, when unfolded was 5 inches in length; the colon and rectum 1 foot 10 inches; total, 14 feet 9 inches. The cæcal valve strong and distinct. The alimentary canal was too much decomposed to allow of my making a microscopical examination of it, but its structure appeared to resemble that of the Dog.

The ribs of the Hyæna are 15; those of the Lycaon 13, as in the Dog, Wolf and Fox. The teeth of the Hyæna, judging from two skulls in the Museum of the College of Surgeons, are, 4 incisors above, 6 below, 10 molars above, 12 below, canines 4, =36. In the skull of the Striped Hyæna 10 molars in each jaw (one specimen), and in some fossil jaws of this animal the number of molars is less than above quoted; but much, of course, will depend upon the age of the animal. In the Pointer, Blood-hound, Dingo, and other dogs, I found 12 molars above and 14 below, the canines being 4 and the incisors 12. The same with the Wolf and Fox.

The only record I can find of the dissection of a Hyæna is one furnished me by Professor Quekett, and in this animal (30 years old) the alimentary canal measured 39 feet $5\frac{1}{2}$ inches. The account is *copied* from Professor Quekett's notes. I was at first inclined to suppose that the copyist had made some mistake, the length mentioned being very great for a carnivorous animal. Professor Quekett suggested "that the large quantity of phosphate of lime taken by the hyæna might explain the anomaly."

On referring, however, to the notes of my dissections of four dogs, in which I carefully measured the alimentary canal of all, the above statement does not appear to be so improbable:—

Small Terrier, alimentary canal 7 feet 4 inches.
Small Terrier (young), 7 feet.
Blood-hound, 21 feet; including large intestines, 2 feet 2 inches.
Large Mastiff (old), weighing 104 lbs., 31 feet; including large intestines, 3 feet.
Common Fox, 10 feet 6 inches.
Young Indian Wolf (four months old), 6 feet 1 inch.

So that, looking to the ribs, teeth, cæcum, length of alimentary canal, and general form of the viscera, this animal must be classed with the Dogs, and not with the Hyænas.

Additional Remarks on the Lycaon pictus.

After the death of the dog, the bitch which was with him became restless, howled frequently, refused her food, and died July 13th, ten days after.

I examined the body a few hours after death. She was about the same size as the dog, and of the same age. She had probably lost 10 or 15 lbs. in weight. The body weighed $31\frac{1}{2}$ lbs., and the subjoined is the relative weight of the viscera, fractions being omitted:—

Heart, 7 oz. $\frac{1}{72}$.
Lungs, 24 oz. $\frac{1}{21}$.
Liver, 18 oz. $\frac{1}{28}$.
Spleen, 790 grs. $\frac{1}{280}$.
Pancreas, 370 grs. $\frac{1}{599}$.
Kidney, 1080 grs. $\frac{1}{205}$.
Alimentary canal, 13 feet 6 inches.

The uterus resembled that of the bitch (*C. familiaris*); the vagina 9 inches in length, the cornua 6 inches each.

But one of the most interesting results of this dissection was the examination of the blood-corpuscles; these were larger than in any carnivorous animal that I have dissected; they measured, the greater part of those examined, about the 3000th of an inch in diameter, being larger than those of Man.

I may add, that I could not discover any morbid lesion in this animal, and that I believe her death was occasioned by the loss of her companion.

BOTANICAL SOCIETY OF EDINBURGH.

May 8, 1856.—Colonel Madden, President, in the Chair.

The following papers were read:—

1. "On the Sexuality of the Algæ," by Dr. Ferdinand Cohn, of Breslau.

After adverting to the various recent discoveries in Cryptogamic reproduction, particularly those of Thuret and Pringsheim, the author gave an account of the phænomena observed by him in *Sphæroplea annulina*. He showed that the cells of one part of the filament became male, and exhibited antheridia filled with spermatozoa, while those of the other part became female, being transformed into sporangia, developing many spores. He then described minutely the mode in which the spermatozoa came into contact with the female cells and fertilized the spores. He also gave an account of the mode of fecundation in the genus *Œdogonium*.

"Having observed," the author remarks, "in the lower plants the necessity of the material and immediate contact and union of spermatozoa and eggs or spores; the want of a peculiar membrane around the latter before impregnation; the formation of this wall and the multiplication of the developed cell as the immediate consequence of fecundation, we may conclude that the same course of development may also be followed in the reproduction of other organisms,—a conclusion which is entirely confirmed by the most recent observations on the fecundation of animals."

2. "On the Preparation of Sugar and Arrack from Palms in Ceylon," by Alexander Smith, M.D.

Three Palms yield sugar in Ceylon: *Cocos nucifera*, *Borassus flabelliformis*, and *Caryota urens*. From each of these the juice of the flowering-stalk is collected, and from it sugar is regularly prepared; but it is from the *Borassus* that almost all the palm sugar is obtained. It is from the sugar of the *Cocos* that arrack is made in Ceylon.

3. "On the occurrence of Scalariform Tissue in the Devonian Strata of the South of Ireland," by Robert Harkness, F.G.S., Professor of Geology, Queen's College, Cork.

The author, after noticing the occurrence of *Cyclopteris hibernica* in the neighbourhood of Cork, remarked that in some of the higher beds of the Devonians of the South of Ireland there had been found great quantities of drifted vegetable matter in the form of more or less perfect stems of trees, exhibiting in their interior a fibrous charcoal-like substance, which when examined by the microscope presented evident scalariform tissue, showing that the plants belonged to the Fern alliance.

4. "Notice of some additions to the Cryptogamic Flora of Edinburgh," by Mr. W. Nichol.

The author remarked that the presence of such plants as *Leskia subrufa*, *Trichostomum flexicaule*, *Anœctangium compactum*, *Encalypta ciliata*, *Tortula tortuosa*, *Bryum Zierii*, and *Blindia acuta*, at Habbies How, indicates an approach to an alpine flora. Habbies How is a narrow chasm running nearly east and west, bounded on each side by precipitous rocks, which are seldom exposed to the rays of the sun. It lies at the base of the northern slope of the highest of the Pentlands (here attaining an altitude of about 1800 feet), and it is on the rocks facing the north that the plants occur.

Professor Balfour read a letter from Mr. Macmillan, in which he stated that he had received a number of Lichens gathered on the Cumbraes, among which were several very rare species, for which no locality had previously been found in Scotland, they being eminently southern species; such as *Parmelia tiliacea* and *corrugata*, and *Opegrapha Lyellii* and *dendritica*.

Mr. Macmillan remarks:—"I found in a wood immediately above Inver, near Dunkeld, an immense number of juniper bushes, the stems and branches of which were profusely covered with magnificent specimens of the *Podisoma juniperi-communis*, a very rare Hypodermous fungus, previously found only, as far as I am aware, in one or two stations in England. Last year, I observed beside the monument in the grounds of Taymouth Castle, a very old juniper bush completely covered with it. In a fresh state, and particularly during damp or rainy weather, it bears considerable resemblance to some species of *Clavaria*; growing in the form of a bundle of thick gelatinous stems of an orange colour, and tapering at one extremity—aggregated together on the part of the branch infested, and completely enveloping it—and thus giving it an appearance not unlike a pine-apple when seen from a little distance. In an old state, and in hot weather, however, it dries up and becomes hard and shrivelled.

June 12, 1856.—Prof. Balfour, V.P., in the Chair.

The following papers were read:—

1. "Elucidation of some Plants mentioned in Dr. Francis Hamilton's Account of the Kingdom of Nepal," by Lieut.-Colonel Madden.

An attempt to determine several of the doubtful species.

2. "On the Duration of the Life of Plants," by Prof. Fleming.

3. "Inquiry into the signs of current Electricity in Plants," by H. F. Baxter, Esq.

After alluding to the researches of Becquerel, Donné, Wartmann, and Zantedeschi, the author proceeded to detail experiments made on plants by means of the electrodes of a galvanometer. He examined the electric currents in the leaves, roots, flowers, fruits, and tubers, and the following are the conclusions drawn:—

1st. That when the electrodes of a galvanometer are brought into contact, one with the surface of the leaf, and the other with the sap flowing from the same leaf, an effect occurs upon the needle indicating the surface and the sap to be in opposite electric states. These effects cannot be referred entirely to ordinary electro-chemical actions, but may be referred, in part, to the organic changes which take place in the leaf during vegetation.

2nd. When the electrodes are brought into contact, one with the external surface of the spongioles of a plant, and the other with the sap ascending from the root, the sap and the external surface are in opposite electric states. The effects which are here observed with the galvanometer may, in the majority of instances, be due to ordinary electro-chemical actions; but in some instances the effect cannot be referred to these actions, but may be referred to the organic changes which occur in the roots during vegetation.

3rd. That with the petals of flowers slight currents were obtained; and,

4th. In fruits and tubers powerful currents may be occasionally obtained; but these effects are evidently secondary results, due to the reaction of the different vegetable juices upon each other.

4. "Notice of some Additions to the Hepaticæ of the neighbourhood of Edinburgh," by John Lowe, Esq.

5. "Record of Localities for Rare Plants," by Prof. Balfour.

6. "Continuation of Account of some of the Contents of the Museum at the Botanic Garden," by Prof. Balfour.

7. "List of the Fibrous Plants of India," communicated by Prof. Balfour.

MISCELLANEOUS.

On the probable Origin of the Organized Beings now living in the Azores, Madeira, and the Canaries. By M. OSWALD HEER. In a letter to M. A. DECANDOLLE.

IN your Geography of Plants you have adopted the opinion of Edward Forbes, that in the miocene period the European continent extended to the Azores and Canaries, and supported it by fresh proofs*. In fact, the predominant European character of these islands, which occurs in their insects as well as in their flora, proves that they were anciently joined to the continent. Nevertheless we must not forget that, as compared with Europe, these islands are very different from those of the Mediterranean. They are distinguished in the first place by a much greater number of peculiar species, which constitute a third or a fifth of the plants; and in the second by some American types, which make their appearance in all these islands. These are not only certain American species which might have reached them accidentally by the agency of the winds and currents, or of man, but American genera which are represented by peculiar species. I will instance the genera *Clethra*, *Bystropogon*, and *Cedronella*, as also the unique pine of the Canaries (*Pinus canariensis*, Sm.), which belongs to the American forms with acicular ternate leaves. The relations of the Laurels is very remarkable in this respect; they form a great part of the forests of Madeira and the Canaries, dividing into four species and playing an important part. Two species (*Oreo-*

* DeCandolle, Géographie Botanique raisonnée, p. 1310.

daphne fœtens and *Persea indica*) are essentially American types; the third (*Phœbe Barbusana*, Webb) belongs to a genus which occurs in India and America; and the fourth (*Laurus canariensis*, Webb) corresponds with the European species. By the possession of these laurel forests the islands of the Atlantic differ greatly from the African continent, where they are entirely wanting, and approach America rather than Africa, notwithstanding the proximity of the latter.

These facts obtain great importance by the observation that the flora of the Atlantic islands has much resemblance to the Tertiary flora of Europe.

In my 'Flora Tertiaria Helvetiæ,' I have proved that a considerable number of plants of the Tertiary epoch corresponded with species peculiar to Madeira and the Canaries, in such a manner that there must be a relation between the two floras. On the other hand, our Tertiary flora indicates a great resemblance to the flora of the southern United States. Many perfectly characteristic genera, such as *Taxodium*, *Sequoia*, *Liquidambar*, *Sabal*, &c., were distributed over the whole of our tertiary country, and composed partly of species very closely allied to those which now grow in America; other genera belong equally to America and Europe (such as *Quercus*, *Corylus*, *Populus*, *Acer*, &c.), and occur in the European Tertiary epoch, composed of species corresponding with the American forms.

We find similar cases amongst the terrestrial mollusca and insects, although this is not so positive as with regard to plants.

These remarkable circumstances are explicable, if we suppose that during the Tertiary epoch a terrestrial formation united the continents of Europe and America, and that this surface was extended by some projection to the Atlantic islands. A glance at the map of the depths of the ocean by Maury, shows that the bottom of the Atlantic forms a longitudinal valley, of which the deepest parts are between the twentieth and fortieth degrees of north latitude, nearly at an equal distance from Europe and Africa, but that on the two sides of this deep valley there is a vast *maritime plateau*, which includes the Atlantic islands, as well as the whole space between the European continent, Newfoundland, and Acadia. Beyond this space another long valley, but of less depth, takes its rise, in a direction from south to north-east between Madeira and the Azores; it loses itself close to the coast of Oporto.

If we may attribute any importance to these very general data, we must admit that during the miocene period the maritime plateau above indicated was solid ground.

This country, this ancient Atlantis, would have had the same plants as central miocene Europe, of which the remains are found in the mollasse of Switzerland in such astonishing profusion, that I shall be able to give descriptions and figures of about six hundred species in my 'Flora Tertiaria.' On the coast of this country the marine shells presented a great conformity in America and Europe; and this remarkable phænomenon is still reproduced, that Europe has more littoral than deep-sea species of shells and fishes in common with America; which proves that at one period a band of firm ground must have united these two parts of the world. The Atlantic islands had already risen towards the south coasts of this continent at the diluvian period. That this country was at the bottom of the sea during the miocene epoch, is shown by the fossil shells of Porto Santo and St. Vincent in Madeira and those of the Azores; but that it had emerged at the diluvian period is proved by the terrestrial mollusca of Caniçal, and the fossil plants of St. Jorge in Madeira*.

The islands formed at this epoch would have received their vegetation from the Atlantis in the diluvian period, and consequently at an epoch when this continent had entered upon a new phase of development. If we suppose, that then, by a subsequent depression of the soil, the connexion with America was destroyed, and subsequently that which existed with Europe, we shall obtain the elements for the explanation of the existing flora of these islands. We there find the remains of the flora of the ancient Atlantis, and in consequence many types of the Tertiary flora are retained there whilst they have disappeared in Europe. These remains, with a certain number of other species, form the peculiar plants of these isles, corresponding in part with the American species because they have issued from the same centre of formation. But it is with Europe that these islands have the most species in common, probably because their connexion with this continent lasted longer.

At the diluvian period the flora of central Europe was displaced by great changes of climate (extension of glaciers, &c.); and as by the depression of the Atlantis the connexion with America was destroyed, the new European vegetation could not extend on that side, but only towards the east. It is thus that the characters of the new vegetation would be explained, particularly that of the lower countries, whilst the Alps and the north have undergone less change. This also is the reason of the great analogies which occur between the north of Europe, Asia, and America. I arrive therefore at the same conclusion with yourself as regards these latter countries, namely that the alpine vegetation is certainly the most ancient in our country, and that subsequently when the climate became warmer, after the glacial epoch, it rose from the low countries to the mountains and Alps.—*Bibliothèque Univ. de Genève*, April 1856, p. 327.

Note on Clausilia plicatula *and* C. Mortilleti. By J. Gwyn Jeffreys, Esq.

Mr. Benson, in the last Number of the 'Annals' (p. 75), states that I omitted *Clausilia plicatula* in my "Notes on the Swiss Mollusca," as well as two other so-called species of *Clausilia*; all of which he had found in Switzerland. My reason for omitting *C. plicatula* was explained in the preface to my "Notes," in which I said I was induced to think that a notice of "some *hitherto unrecorded* localities" which occurred to me might be interesting, and that I adopted Charpentier's Catalogue as my text-book. By referring to that catalogue it will be seen that Charpentier mentions *C. plicatula*

* See Heer, "Ueber die fossilen Pflanzen von San Jorge in Madeira." Zurich, 1855.

as "fort commune dans toute la Suisse occidentale." I found it at Belmont, les Rochers Naye, Lausanne, Devens, Blonay, and Montreux. For the same reason I omitted such common species as *Succinea amphibia*, *Helix arbustorum* and *nemoralis*, *Pupa avena*, *Clausilia parvula*, *Cyclostoma elegans*, and *Ancylus fluviatilis*.

C. plicatula is undoubtedly distinct from *C. Rolphii*; but whether *C. Mortilleti* is not a variety of *C. Rolphii* is another question. Judging from a comparison of specimens of *C. Mortilleti* kindly sent me by Mr. Prentice, with specimens of *C. Rolphii*, described and figured by the authors of the 'British Mollusca,' I am inclined to think they ought to be united. Mr. Hanley is of the same opinion. The differences pointed out by Mr. Benson are equally observable in varieties of *C. nigricans* and *C. bidens*. However, Mr. Benson has had great experience in the discrimination of species from varieties; and (as I remarked on a former occasion) naturalists may fairly differ on this point.—J. Gwyn Jeffreys.

1 Montagu Square, 11th July 1856.

LERNÆA BRANCHIALIS.

To the Editors of the Annals of Natural History.

Falmouth, June 28, 1856.

Gentlemen,—The "*Lernæa branchialis*," Linn., was procured this morning by Miss Vigurs from the gills of the *Gadus Æglefinus*. It measured one inch and seven-eighths in length. The head was ornamented with two transparent horns, about one-eighth of an inch long, slightly curved and sharp at the points. Neck long; body inflated, bent in the form of the letter S; filaments contracted, annulated, very much contorted, transparent. Colour of head, neck and body chocolate-brown.

I am, Gentlemen, yours truly,
W. P. Cocks.

On two new species of Birds from Santa Fé di Bogota. By Philip Lutley Sclater, M.A., F.Z.S.

Heterocnemis marginata, Sclater.

H. supra cinnamomeo-brunnea, pennis strictissime nigro marginatis: alis caudaque intus nigricantibus, externe brunnescentibus: subtus alba, gutturis et pectoris totius plumis stricte brunneo marginatis, quasi squamatis; his marginibus versus ventrem gradatim latioribus: ventre crissoque cinnamomeo-brunneis, nigro transversim vittatis: rostro nigro, mandibula inferiore basi alba; pedibus pallide brunneis.

Long. tota 3·0; alæ 2·2; caudæ 1·2; rostri a fronte ·5.

Mr. Strickland's name *Holocnemis*, proposed in 1844 for the *H. nævia* (figured in Cont. to Orn. 1849, pl. 18), has been previously applied to a genus of Coleoptera by Schilling, and I therefore propose to change it into *Heterocnemis*. A second species of the genus seems to be the bird figured in Buffon's Pl. Enl. 73, fig. 2, under the name of 'Le Bambla de Cayenne.'—(*Turdus bambla*, Bodd.—*Heterocnemis bambla*, mihi.)—The present bird is very closely allied to the latter. In the upper plumage it is very similar, being only of a more cinnamomeous tinge; but it may be distinguished by the want of the white markings on the wings, and the throat, breast and upper belly being white, each feather narrowly margined with brown. In *H. bambla* these parts are ash-brown, with obsolete transverse markings. Lesson's *Myrmothera troglodytes* (Desc. d. Mamm. et Ois. p. 301, no. 118) seems the same as *H. bambla*. This form is indeed very closely connected with some of the Wrens, and hardly to be separated from certain birds that are usually placed in the genus *Scytalopus*.

TODIROSTRUM GRACILIPES, Sclater.

T. supra olivaceum; alis caudaque nigricantibus, olivaceo anguste limbatis; pileo fuscescente; loris mentoque albidis; subtus flavum, lateribus olivascentibus; gutture et pectore longitudinaliter nigro striatis; tectricibus subalaribus sulphureis; rostro nigro; pedibus carneis; tarsis gracillimis.

Long. tota 3·8; alæ 2·0; caudæ 1·7.

This apparently new species is most nearly allied to *T. maculatum* (Desm.) and *T. striaticolle*, Lafr. (in both of which the neck is also striated), but has the whole throat yellow. The bill agrees in form with that of the former bird, but is rather shorter and narrower. The type specimen is in the British Museum.—*Proc. Zool. Soc.* July 24, 1855.

ON THE BRITISH DIASTYLIDÆ.

To the Editors of the Annals of Natural History.

8 Mulgrave Place, Plymouth, July 10, 1856.

GENTLEMEN,—It has recently been pointed out to me by Mr. Alder that I have unfortunately made use of two generic names in the paper on "the British *Diastylidæ*," lately published in the 'Annals,' that have been previously employed to designate other genera of animals. It is therefore desirable that the names *Halia* and *Venilia* should be changed, and I propose instead to use *Iphinoë* and *Cyrianassa* respectively. The names as applied will therefore be *Iphinoë trispinosa* and *Cyrianassa gracilis*.

Believe me, yours obediently,

C. SPENCE BATE.

Note on Helix Cantiana, *Mont.* By WM. LONSDALE, Esq., F.G.S.

"*Helix Cantiana* is abundant around Keynsham, Somerset. It was first found in the spring of 1825, alive and near the entrance to Dr. Fox's establishment, between Keynsham and Brislington; and more recently in lanes close to the town."

Description of a Fossil Cranium of the Musk-buffalo (Bubalus moschatus, *Owen*), *from the Gravel at Maidenhead, Berks.* By Prof. Owen, F.G.S.

This specimen was discovered by the Rev. Mr. Kingsley and Mr. J. Lubbock in a gravel-pit close to the engine-house at the Maidenhead station last summer, and is the first example of the subgenus *Bubalus* yet recognized as fossil in Britain. It consists of the cranial part of the skull, with the horn-cores, nearly perfect. The Professor, in describing this fossil, first offered his reasons for regarding the so-called "Musk-ox" as having been unnecessarily separated from the Buffaloes, and then gave an account of the few fossil skulls of the Musk-buffalo yet known, viz. those figured by Pallas, Ozeretskowsky, and Cuvier. A comparison was then made of the fossil remains with recent crania; and, although the skulls somewhat differ in a few points, especially in the relative curvatures of the horn-cores, yet the author was led to conclude that, as far as the materials for comparison at his command would serve, the differences between the fossil and recent Musk-buffaloes are not of specific value; that the *Bubalus moschatus* of the Arctic regions, with its now restricted range, is the slightly modified descendant of the old companion of the Mammoth and the Tichorhine Rhinoceros, which with them enjoyed a much wider range, both in latitude and longitude, over lands that now form three divisions or continents of the northern hemisphere; and that the circumstances which have brought about the probably gradual extinction of the northern Rhinoceros and Elephant have not yet effected that of the contemporary species of Arctic Buffalo.—*Proc. Geol. Soc.* Dec. 19, 1855.

A last word on Scissurella. By J. Gwyn Jeffreys, Esq., F.R.S.

To the Editors of the Annals of Natural History.

Gentlemen,—I had not intended at first to notice the communication of Mr. Woodward in your last Number, entitled "On the Evils of Increasing Synonyms;" but, lest it may be assumed that I admit his statements, I must request you to insert these few remarks.

The real question at issue, and the only one which in any way concerns naturalists or the cause of science, is whether *Schismope* is synonymous with *Scissurella*, or whether they constitute distinct genera. Now, although Mr. Woodward modestly states that he has shown they are synonymous and that the fact admitted of no reply, I cannot help reminding your readers that Dr. Gray (who is undeniably a much better authority than either Mr. Woodward or myself) has expressed a contrary opinion, and that the respective characters of those genera were taken from species which differ from each other in form, organization, and habit. I have now before me 130 specimens of *Scissurella crispata* of different ages and sizes, all of which exhibit the open slit.

As regards myself personally, I must repeat my regret that Mr.

Woodward has thought proper to mistake and pervert what passed between us, as it has nothing whatever to do with the present controversy.

It is true that he asked me for specimens of the *Schismope*, and that I referred him to Mr. Damon, who had all my collection of Mediterranean shells, on his repaying me (by previous agreement) the expenses I was at in dredging. But it is *not* true, that when I took him specimens (which I had a day or two before picked out of some sand), he put such an impertinent question to me as he suggests my remembering.

It was on this occasion that we examined together under a microscope *these* specimens (and not the specimens given to him by Mr. Damon), and that he noticed the peculiar structure of the closed slit. *After* we had consulted Philippi, and Sowerby's 'Genera' (and *not* "at that time," as Mr. Woodward would have me say), I went to the British Museum Library and referred to Sowerby's translation in the Zoological Journal of D'Orbigny's Memoir. The result of this reference I gave in a former paper.

When I took Mr. Woodward the specimens, I certainly understood him to say that he was unacquainted with any other species of *Scissurella* than *S. crispata*. It was some time afterwards that he showed me Mr. M'Andrew's specimen of *S. angulata*, Lovén (a true *Scissurella* and closely allied to *S. crispata*, but of a much larger size); and I certainly never saw D'Orbigny's specimen of *S. Bertheloti in company with* Mr. Woodward, nor heard him say anything about a New Zealand *Scissurella*. We examined together a collection of *fossil* shells (containing *Pleurotomaria* and *Trochotoma*) in quite another part of the Museum; and this he seems to have mistaken for the D'Orbignyan collection.

This explanation, however, cannot interest your readers; and I will not trespass any more on their patience.

I am, Gentlemen, yours obediently,
J. Gwyn Jeffreys.

1 Montagu Square, 11th July 1856.

New Mode of Cleaning Diatomaceous Deposits. By Prof. J. W. Bailey.

Having found the following method of cleaning diatomaceous deposits more speedy and efficacious than any other I have tried, I recommend it to all those who may have occasion to prepare specimens of the *siliceous* organisms in soundings, guano, mud, &c. Dissolve out the lime compounds, if present, by means of nitric or hydrochloric acid, wash and filter. Then put the moist contents of the filter into a porcelain capsule with enough strong *sulphuric acid* to make of the whole a fluid mass. Heat the capsule over a spirit-lamp until the organic matters are all charred, and continue the heat until strong acid fumes are evolved. Keep the capsule hot, and add, in minute portions at a time, finely powdered *chlorate of potassa*. If the acid is hot enough to give off fumes, the chlorate will be immediately decomposed without the accumulation of explosive gases, and it will exert so powerful an oxidizing action, that in a few moments a carbonaceous material as black as ink will become perfectly clean and colourless. Nothing now will remain to be done but to wash off the acid, which is best done by the addition of water and repeated decantations. I also would advise that the materials thus cleaned should not be dried, but should be kept in bottles with a little alcohol, which prevents their felting together, and does not allow the growth of the byssoid plants which often develope in water.

It is necessary to caution those not familiar with chemistry against using the chlorate of potassa with sulphuric acid in any other way than above directed, as violent and dangerous explosions might result. The process as above given is perfectly safe and very effective. —*Silliman's Journal*, January 1856, p. 145.

New method of Disintegrating masses of Fossil Diatomaceæ. By Prof. J. W. Bailey.

Many masses of fossil Diatomaceæ are so strongly coherent, that they cannot be diffused in water (for the purpose of mounting in balsam) without a degree of mechanical violence which reduces to fragments many of the most beautiful and interesting forms. This is particularly the case with some specimens from the "infusorial deposits" of California. Some of these I endeavoured to break up, by boiling in water and in acids, and also by repeated freezing and thawing when moistened, but without good results in either case. At last it occurred to me that the adherence might be due to a slight portion of a siliceous cement, which the cautious use of an alkaline solution might remove without destroying any but the most minute shells of the Diatoms. As the case appeared a desperate one, a "heroic remedy" was applied, which was to boil small lumps of the diatomaceous mass in a strong solution of caustic potassa or soda. This proved to be perfectly efficacious, as the masses under this treatment rapidly split up along the planes of lamination, and then crumbled to mud, which being immediately poured into a large quantity of water, ceased to be acted upon by the alkali, and gave, when thoroughly washed, not only all the large shells of the Diatoms in a state of unhoped-for perfection, but also furnished abundance of the minute forms. Having obtained by this method highly satisfactory results from specimens from many localities, I can confidently recommend it as an addition to our modes of research.

The following directions will enable any one to apply the process. Put small lumps of the mass to be examined into a test tube, with enough of a solution of caustic potassa or soda to cover them; then boil over a spirit-lamp for a few seconds, or a few minutes, as the case may require. If the solution is sufficiently strong, the masses will rapidly crumble to mud, which must be poured *at once* into a large quantity of water, which after subsidence is removed by decantation. If the mass resists the action of the alkaline liquor a still stronger solution should be tried, as while some specimens break up instantly in a weak solution of alkali, others require that it should be of the consistence of a dense syrup. The mud also should be poured off as fast as it forms, so as to remain as short a time as possible in the caustic ley.

The only specimens which I have found not to give good results by the method above described, are those from Tampa Bay, Florida, and the infusorial marls from Barbadoes. In the masses from Tampa the lapidification is so complete, that the alkali destroys the shells before the lumps break up; and in the case of the Barbadoes marls the cementing material is calcareous, and requires a dilute acid for its removal. In applying the above process one caution is necessary, which is to thoroughly wash the shells with *water*, and not with acids, as the latter will cause the deposit of a portion of the dissolved silica and materially injure the beauty of the specimens. When the washings are no longer alkaline, the specimens may be thoroughly cleansed by acids, or by the chlorate process described above.— —*Silliman's Journal,* May 1856, p. 356.

METEOROLOGICAL OBSERVATIONS FOR JUNE 1856.

Chiswick.—June 1. Hazy: cloudy. 2, 3. Very fine. 4. Very fine: cloudy: lightning at night. 5—7. Very fine. 8. Dull and cloudy. 9, 10, Very fine. 11. Cloudless. 12. Very fine: rain at night. 13. Rain. 14. Showery and boisterous. 15. Very fine: cloudy: clear and fine. 16. Very fine. 17. Showery. 18. Very fine: cloudy: rain. 19. Rain. 20. Showery. 21. Very fine: cloudy: rain. 22. Cloudy and fine. 23. Overcast. 24. Very fine: uniformly overcast. 25. Very fine. 26. Sultry. 27. Cloudless and hot. 28. Uniformly overcast: sultry: cold at night: range of temperature 45°. 29, 30. Clear and dry air.

Mean temperature of the month	58°·65
Mean temperature of June 1855	57 ·98
Mean temperature of June for the last thirty years	60 ·31
Average amount of rain in June	1·880 inch.

Boston.—June 1. Cloudy: rain A.M. and P.M. 2—6. Fine. 7. Cloudy. 8—11. Fine. 12. Cloudy: rain P.M. 13, 14. Cloudy: rain A.M. and P.M. 15. Cloudy. 16. Fine. 17. Rain A.M. 18. Cloudy. 19. Cloudy: rain A.M. 20. Cloudy. 21. Fine: rain P.M. 22. Cloudy: rain A.M. and P.M. 23, 24. Cloudy. 25. Fine. 26. Cloudy: thermometer 86° P.M. 27. Fine: thunder P.M. 28. Cloudy. 29. Fine. 30. Rain A.M. and P.M.

Sandwick Manse, Orkney.—June 1. Cloudy A.M.: drizzle P.M. 2. Drizzle A.M.: bright P.M. 3. Cloudy A.M. and P.M. 4. Cloudy A.M.: drops P.M. 5. Bright A.M.: cloudy P.M. 6. Cloudy A.M. and P.M. 7. Rain A.M.: bright P.M. 8. Clear A.M. and P.M. 9. Cloudy A.M.: drops, clear P.M. 10. Clear A.M.: showers P.M. 11. Rain A.M. and P.M. 12, 13. Bright A.M.: clear, fine P.M. 14. Cloudy A.M.: sleet-showers P.M. 15. Clear A.M.: cloudy P.M. 16. Showers A.M.: cloudy P.M. 17. Showers A.M. and P.M. 18. Bright A.M.: showers P.M. 19. Rain A.M.: bright P.M. 20. Cloudy A.M.: bright P.M. 21. Rain A.M.: bright P.M. 22. Bright A.M. and P.M. 23. Clear A.M.: cloudy P.M. 24. Fog A.M.: drizzle P.M. 25. Hazy A.M.: damp P.M. 26. Drops A.M.: rain, clear P.M. 27. Bright A.M.: damp P.M. 28. Damp A.M.: showers P.M. 29, 30. Clear A.M.: cloudy P.M.

Mean temperature of June for previous twenty-nine years ...	52°·76
Mean temperature of this month	51 ·47
Mean temperature of June 1855	52 ·23
Average quantity of rain in June for previous sixteen years ...	2·24 inches.

Meteorological Observations made by Mr. Thompson *at the Garden of the Horticultural Society at* Chiswick, *near London;*
by Mr. Veall, *at* Boston; *and by the* Rev. C. Clouston, *at Sandwick Manse,* Orkney.

Days of Month.	Barometer.					Thermometer.					Wind.			Rain.		
	Chiswick.		Boston.	Orkney, Sandwick.		Chiswick.		Boston.	Orkney, Sandwick.		Chiswick.	Boston.	Orkney, Sandwick.	Chiswick.	Boston.	Orkney, Sandwick.
1856. June.	Max.	Min.	8¾ a.m.	9¼ a.m.	8½ p.m.	Max.	Min.	8¾ a.m.	9¼ a.m.	8½ p.m.	1 p.m.					
1.	29·738	29·690	29·25	29·88	29·79	56	33	49·5	53	53	w.	n.	e.	....	·12	·06
● 2.	29·891	29·798	29·49	29·62	29·60	73	36	55	49	49	sw.	w.	nw.	....	·24	·10
3.	30·017	29·957	29·53	29·64	29·75	77	39	60	52	51	sw.	sw.	calm	....	....	·02
4.	30·108	30·046	29·54	29·77	29·86	75	45	59	55½	48½	w.	w.	w.	....	....	....
5.	30·143	30·103	29·61	30·02	30·13	63	33	57	51	49½	ne.	nw.	wnw.	....	....	·12
6.	30·253	30·189	29·75	30·16	30·10	66	46	57	55½	52	n.	nw.	sse.	....	....	....
7.	30·282	30·218	29·78	29·88	29·87	73	45	63	56½	48	sw.	w.	wnw.	....	....	·35
8.	30·203	30·178	29·63	29·98	29·94	72	52	64	53½	51	sw.	wsw.	s.	....	....	....
9.	30·128	30·062	29·54	29·82	29·81	75	49	65	55	48½	sw.	wsw.	ssw.	....	....	·01
☽ 10.	30·083	30·064	29·58	29·72	29·76	76	37	59	52	50	ne.	w.	ssw.	....	....	·09
11.	30·066	30·004	29·56	29·48	29·44	76	39	65	53½	50	s.	sw.	wnw.	....	....	·43
12.	29·920	29·854	29·37	29·54	29·61	66	55	67	53	50	sw.	ssw.	w.	·12	·09	·04
13.	29·777	29·525	29·32	29·66	29·67	64	54	63	53½	53	sw.	sw.	sse.	·24	·18	....
14.	29·779	29·568	29·00	29·55	29·53	65	37	57	51½	47	sw.	sw.	n.	·04	....	·11
15.	30·102	29·909	29·45	29·70	29·67	75	35	58	49	52	nw.	sw.	ssw.	....	·03	·01
16.	30·143	30·022	29·64	29·62	29·51	74	44	57	54½	52	sw.	sw.	s.	....	....	·09
17.	29·921	29·850	29·34	29·34	29·54	74	42	58	52	48	sw.	s.	w.	·04	....	·07
○ 18.	29·905	29·785	29·44	29·69	29·67	75	45	62·5	51	47½	w.	w.	ese.	·12	·04	·03
19.	29·623	29·493	29·18	29·67	29·74	62	49	63·5	48½	47	s.	s.	ne.	·08	....	·10
20.	29·941	29·533	29·06	29·78	29·78	67	40	57	52	48	sw.	w.	sse.	·16	·02	·02
21.	30·053	29·982	29·57	29·62	29·62	68	54	57·5	54	49	sw.	w.	calm	·08	·07	·26
22.	29·968	29·938	29·40	29·75	29·97	68	50	65	54	47½	nw.	w.	nne.	....	....	....
23.	30·225	30·093	29·66	30·10	29·98	69	42	55·5	53	49	ne.	n.	sse.	....	·13	·06
24.	30·190	30·148	29·68	29·78	29·81	68	55	62·5	54	53	w.	w.	w.	....	....	·22
☾ 25.	30·178	30·159	29·63	29·80	29·89	82	50	67	58	53	w.	w.	w.	....	....	....
26.	30·211	30·162	29·66	29·98	29·90	88	56	72·5	55½	57	nw.	nw.	sw.	....	....	·09
27.	30·144	30·030	29·55	29·86	29·95	86	57	76	53½	51	sw.	nw.	w.	....	....	·03
28.	30·162	30·038	29·54	29·89	29·93	82	37	67	52	48½	n.	nw.	wnw.	....	....	·05
29.	30·256	30·189	29·76	30·10	30·10	77	42	56	51	48	sw.	sw.	e.	....	....	....
30.	30·114	29·997	29·55	30·15	30·11	80	49	58·5	51½	49	nw.	w.	n.	....	·08	....
Mean.	30·050	29·952	29·50	29·785	29·801	72·40	44·90	61·1	52·93	50·00				0·88	1·00	2·36

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SECOND SERIES.]

No. 105. SEPTEMBER 1856.

XVIII.—*Attempts at a Natural Arrangement of Birds.* By ALFRED R. WALLACE.

IF we examine the varied form and structure of Birds with a view to their natural arrangement, we see as it were intuitively, that certain well-marked groups exist, which can be distinctly separated from the class, can be easily defined, and will contain species which are more nearly related to each other than to any other birds. Such are the Swimmers and Waders, which together may be called Water Birds, and of the propriety of the separation of which from the whole of the Land birds there has never been a difference of opinion among naturalists. Again, among land birds the Accipitres or Raptores of naturalists, containing the Hawks, Vultures, and Owls, form a well-marked group, all the members of which are undeniably related among themselves, but are separated as it were by a chasm from all other birds; for we consider the supposed affinity of the Owls with the Goat-suckers to be quite incorrect; those birds resembling each other only in a few unimportant particulars, while in all essential points of structure they widely differ. A third group which can also be readily distinguished and separated from the rest, is that of the Rasores or Gallinaceæ. The Pigeons are generally included in this order; but in that case a definition of Gallinaceæ becomes impossible, as so many of their most marked peculiarities do not exist in the Columbæ. It is however extraordinary, that though the Pigeons possess more characters which connect them with Perching birds than with Rasores, yet it is more easy to conceive their connexion by intermediate links with the latter than with the former; for it has never yet been pointed out what particular family or genus of Perching birds makes the least approach to a Pigeon. We therefore conceive that the

Columbæ should form a distinct order, and should be considered as an abnormal and passerine development of Rasores, representing the Perchers, but having no direct affinity with them.

Having thus eliminated a considerable number of generally large-sized birds, we have still remaining by far the larger portion, forming the Passeres, Insessores, or Perching birds. Out of about 7000 known birds, upwards of 5000 are Perchers. It is to this great group, or rather to a limited portion of it, that we intend to devote the present paper.

The Passerine order comprises at once the most perfect, the most beautiful, and the most familiar of birds. The feathered inhabitants of our fields, gardens, hedge-rows and houses belong to it. They cheer us with their song, and delight us with their varied colours. Their activity and elegant motions are constant sources of pleasure to every lover of nature. They are the birds with which from our infancy and boyhood we are most familiar, and we therefore involuntarily derive from them that ideal or typical form of animal life with which we connect the general term, Bird. And thus doing, who can doubt but that we are correct? The lightness, activity, elegant forms, brilliant colour and harmonious voice by which birds as a whole are peculiarly distinguished from all other animals, find in this group their fullest expression and most complete development. Here too the greatest variety of forms and habits is found, which are all connected together by such insensible gradations, that to discover in every case their true affinities has ever been and still remains one of the most difficult, and at the same time most interesting problems the naturalist has to solve.

The writer of this paper has enjoyed the great privilege of observing the habits of many tropical birds in a state of nature in S. America, and is at present doing so in the Indian Islands. Every naturalist knows how important this is towards a proper appreciation of the affinities of Birds, to which their habits are generally a sure guide, or at all events of much value in conjunction with other structural characters. Without pretending to any great knowledge of anatomy, he believes that no intelligent person can be in the constant habit of skinning birds without obtaining much information on very important parts of their internal structure. Even mere external characters, such as the texture and arrangement of the feathers, the form and structure of the tarsi, the form of the nostrils and of the tongue, can be examined far better in a recently killed bird than in a dried or mounted specimen. In the process of skinning we also ascertain the thickness and tenacity of the skin, the solidity of the bones, the form and strength of the skull, and the texture and contents of the stomach, which characters are perhaps, for the determination of affinities, of as much importance as any which can be pointed out. Observations of this nature have been applied by him to an arrangement of the Passeres; not as a perfect scheme, but as a starting-point to guide future inquiries. One portion of this arrangement, with the families included in which he is best acquainted, he now wishes to submit to the judgment of ornithologists.

The method illustrated at the commencement of this paper, of marking off certain groups from the general mass, has been satisfactory, because the portions so severed have been not only capable of definition, but have contained only species which have agreed in all essential points of their structure and œconomy. They have therefore met with general acceptance, and in all the different systems of ornithologists these groups have scarcely suffered any variation. But in attempting to carry out this system in a further division of the Passeres, no such satisfactory and generally accepted results have been produced. No syste matist has been satisfied with the arrangements of his predecessors, and, after an endless variety of divisions and subdivisions, we are as far off from any generally accepted system of arrangement as ever.

The reason of this we conceive to be, that we have to deal with a mass of species in which the series is so nearly complete, that there are no more of those great chasms separating considerable portions from each other, and that the affinities are so intricate and minutely varied, and so cut up as it were by minor gaps between genera and families, that any attempt to form great and well-marked subdivisions must fail, for the simple reason that such are not marked out by nature. In such a case an *arrangement* may be possible, but a *classification* may not be so. We must therefore give up altogether the principle of *division*, and employ that of *agglutination* or juxtaposition. We shall best explain our meaning by pointing out the errors we conceive to have been produced by the former method in most modern classifications.

The system of Cuvier, as modified by Vigors, Swainson, and G. R. Gray, may be fairly taken as that most generally in use, at least in this country. The tribes of the Conirostres, Dentirostres, Fissirostres, Tenuirostres, and Scansores, are said to be the natural divisions of the Passeres, the main difference of opinion being as to whether the Scansores should or should not form a separate order, a question we believe to be of no importance whatever. These divisions being accepted, every bird is forced into one of them, and the result has been the most incongruous and unnatural combinations. For instance, in the Tenuirostres are combined the Humming Birds and the Sun Birds (*Nectarinia*), families which in a natural arrangement would have, in our opinion, the mass of the other Passeres intervening between them. In the case of these two families, a mere outward resemblance appears to have been universally mistaken for an affinity. A similarity in size, in the prevalence of metallic colours, and in the slenderness of a very variable bill, has been taken to overbalance the most important structural differences. The universal characteristics of the Hummers are, excessively long wings and as excessively small feet, with more or less united toes. They take their food exclusively on the wing. Every motion is made upon the wing. The feet are solely used as means of support, never for locomotion. The Sun Birds and their allies, the *Cærebidæ* of America, have on the other hand long legs and toes, the hinder toe especially being very long and powerful; they are therefore as capable of hopping and perching as any of the most highly developed Passeres. Their wings, too, are short and round, quite incapable of any powerful flight, and their tail almost invariably short and even. Much stress has been laid upon the similar form and structure of the tongue. But the extensile tubular tongue only exists in some genera (*Anthreptes, Arachnothera*), while in others it is short, flat, and not extensible (*Dicæum, Cinnyris, Cærebidæ*). There is therefore no general agreement of structure to unite these groups, except the solitary and trivial one of an elongate and slender bill.

On similar principles, we believe the Conirostres and Dentirostres to be equally untenable and unnatural. They are professedly founded on one character only, and not on general structure; and it is therefore not to be wondered at, that in their attempts to pay some little regard to natural affinities, while forcing the genera and families into these divisions, no two naturalists should be able to arrive at the same results. The association of the Hornbills with the Crows, the separation of the Larks from the Wagtails, and the necessity for putting Dentirostral birds (Tanagers and Jays) in the Conirostral tribe, are some of the inconsistent results of the system.

The remaining groups, the Scansores and the Fissirostres, we believe to be much more natural, and in fact to be the only ones which can be distinctly separated from the Passeres, of which they form an abnormal development. It is to the arrangement of these two groups that we more particularly address ourselves.

The Fissirostres are those passerine birds whose feet are adapted solely for a state of rest,—all motion being performed by the wings. With very rare exceptions, they never move the shortest distance by means of their feet,—a character which distinguishes them at once from all other Passeres, which either hop, climb, or walk almost incessantly. Such a peculiar œconomy must evidently depend upon corresponding peculiarities of organization; and it is a remarkable proof of how little importance is the form of the bill alone as an index of affinity, that in this highly natural group we find every form of bill,—conical, toothed, hooked, serrated, spear-shaped, curved, and flat. The external characters which distinguish these birds are, very short and weak legs, long, or at all events powerful wings, and a wide gape. Their characteristic habit is to sit motionless, watching for their prey, to dart after it and seize it on the wing, and to return to their original position to swallow it. The groups which possess these peculiarities in the greatest perfection are the Trogons and the Kingfishers, with which we shall commence our inquiry into the extent of the tribe. We must observe at starting, that many continental ornithologists still place the Trogons among the Climbers, because they have their toes placed two and two, whereas those of the Kingfishers are arranged as in the majority of birds. But this is a point of detail which does not in the least affect the habits, for the toes are in both cases connected together at their basis so as to form a broad sole, giving a firm support to the bird without grasping. In both the leg is equally short and weak, and in both all the habits dependent on the feet are precisely similar. Of how very little importance this change in the position of the toes is, unaccompanied by a change in their form, motion, or mode of connexion with each other, we may judge from the fact of there being species of Kingfishers and of Woodpeckers with only three toes, and which yet have no perceptible difference of habits from the rest of the family. It would be as reasonable (and as unnatural) to withdraw these birds from their respective families and form of them a new three-toed family, as to separate the Kingfishers from the Trogons for the reasons assigned. As an instance how totally unable the Trogons are to use their feet for anything like climbing, we may mention that the Trogons of South America feed principally on fruit, which one would think they would get by climbing or walking after if they could. But no; they take their station on a bare branch, about the middle of the tree, and having fixed their attention on some particular tempting fruit, they dart at it, seize it dexterously on the wing, and return to their original seat. Often, while waiting under a fruit-tree for Chatterers or Pigeons, have we received the first intimation of the presence of a Trogon by the *whir-r-r* of its wings as it darted after a fruit. It is curious that this habit seems confined to the Trogons of America. In the East I have never yet observed it, and in the numerous specimens I have opened nothing has been found but insects. The African Trogons also appear to be wholly insectivorous.

Somewhat intermediate between the Trogons and Kingfishers are the Bee-eaters (*Meropidæ*) and the Jacamars (*Galbulidæ*).

The last possess the metallic plumage of the American Trogons, and habits almost identical, while the bill is an approach to that of a Kingfisher. The Motmots (*Prionitidæ*) are also closely related to the Trogons, and may be considered as an offshoot of them, or of the Bee-eaters, parallel to the Jacamars. The habits of all these birds, and of the small Eastern Kingfishers of the genus *Ceyx*, are almost identical, and we think there can be no reasonable doubt of the very close affinity of these five families. The Rollers (*Coraciadæ*) are the next group whose affinities we have to consider. These birds have for a long time been strangely misplaced among the strong-legged Crows and Grackles, whereas the short legs (with the toes united in some genera), wide gape, insect food captured on the wing, the nest in holes of trees or in the earth, and the colour and form of the eggs, all bring them close to the Bee-eaters, Motmots, and Kingfishers, the two former of which appear to be their most direct affinities. The structure of the skeleton, according to the best observers, confirms this result, which may therefore be considered as well established. We now arrive at the *Capitonidæ*, or Puff Birds of S. America, which, like the Trogons, have been often placed among the climbing birds, from having their toes placed two and two. They are, however, true sedentary birds, with habits exactly analogous to those of the Jacamars, Bee-eaters, and Trogons. Some, like the *Tamatias*, frequent the gloomiest and thickest parts of the forest, where they sit motionless on some low branch, and thence take short flights after insects. Others, like *Monasa* and *Chelidoptera*, frequent more open situations, sitting on bare branches often of dead trees, and take longer flights, which in *Chelidoptera* almost vie with those of Swallows for ease and rapidity. The last-mentioned genera make their nests in holes in sloping ground on the banks of streams,—a habit exceedingly general among Fissirostral birds, but we believe quite unknown among the Scansores. Their nearest affinities seem to be with the *Meropidæ* and *Trogonidæ*, though their large heads and heavy bodies would show some approximation to the Kingfishers.

We now arrive at some birds which have always been associated with the present group, of which, in fact, they appear to be the highest development, but which are nevertheless widely separated from the families we have hitherto been considering. They are the Swallows and Goatsuckers. In these the power of capturing insects on the wing has reached its maximum. The gape is enormously wide, the feet generally very short, and the wings long and powerful. Even between the two there is, however, a considerable hiatus; but no one has ever doubted that they are more nearly allied to each other than to any other birds. The question then remains, to which family of the Fissirostres are either of them allied? Where is the link that connects them? The Swallows appear to us to be farthest removed from any of the birds hitherto placed in the tribe. Their small size, powerful flight, and compact plumage, added to their strongly grasping feet, seem to shut out any direct affinity with them. It is, then, in the *Caprimulgidæ* that we must look to discover the affinity we are in search of; and we believe that the only group to which we can approach them is the *Trogonidæ*. The average size, the excessively thin skin, the mass of downy plumage, the general form, the nature of the food, and, in many species, the mode of capture, all point to an affinity in this direction. The different structure of the feet is the most important character on the opposite side of the question; but as this equally exists in such an undeniably closely allied family as the *Prionitidæ*, it need not be considered an insurmountable obstacle. There is, no doubt, still a very wide chasm to be passed over; but it will be still wider if we compare them with any other family of the Fissirostres, with which their anatomical structure, as well as the general considerations before alluded to, compel us to place them. We consider, then, the Swallows and Goatsuckers to exhibit the greatest development of the Fissirostral form; or, if the term is preferred, to be the typical groups. And, as a consequence of this position, they can neither of them serve as the connecting links or transition to any other tribe or order of birds; for if the Fissirostral character is what serves to distinguish this tribe from all others, it must certainly follow that those birds which have this character in its highest development must be most distinctly separated from all the species of any other group. We have here another reason for believing that the resemblance of the Goatsuckers to the Owls is one of externals, and not of essentials,—of analogy, but not of affinity.

We have now briefly passed in review all the families which possess the characters of Fissirostral birds in a plain and obvious degree, and which, without the greatest violation of their natural affinities, cannot be placed elsewhere in the system; but there are several others which have been associated with these by many naturalists, some of them we believe erroneously. And, first, the *Eurylaimidæ*, or Broadbills of the Eastern Archipelago, have been, and still are, generally placed among the Fissirostres. They have, however, in our opinion, no right whatever to this situation, being true Passeres, allied to the *Cotingas* and *Querulas* of S. America. The *Eurylaimus Javanicus* and the *Cymbirhynchus macrorhynchus* feed in the same manner as ordinary perching birds, hopping about the branches of trees, and picking off the fruit, which forms their principal subsistence. Their legs are of a moderate length, their toes strong, and the hind toe large and powerful, *which is never the case in true Fissirostres*. It is this peculiar conformation of the feet which affects the whole character and habits of these birds, which is not the case with the trivial circumstance of the toes being partially united. They have, moreover, none of the Fissirostral habits, nor any modification of them, as they do not capture insects on the wing, those which we have found in their stomachs being always ants and small Coleoptera, picked off the bark and leaves of the trees. To what erroneous results a dependence on such isolated characters as more or less united toes will lead, is seen by the Manakins and *Rupicolæ* of S. America being also often considered as Fissirostres on the same grounds as the *Eurylaimi*. Those birds are, however, purely frugivorous, are excessively active on their feet, have strong skins, firmly-set plumage (as have also the *Eurylaimi*), and, in fact, not one single natural character which can remove them from the great mass of Perching birds. The beautiful *Calyptomena viridis* has also all the habits of the Chatterers, and cannot be separated from them without a great violation of natural affinities.

The little Todies of the W. Indies have also been usually classed as Fissirostres; but their moderately long and slender legs, short rounded wings, and their excessive activity on their feet, are so totally opposed to the characters of every other member of that group, that we think them far more naturally associated with such Flycatchers as *Todirostrum* and *Megalophus*. From the description of Mr. Gosse, in his 'Birds of Jamaica,' it appears that they are most active little birds, hopping, perching, and flying after insects in every possible place and position: how totally opposed is this to the general character of the Fissirostres, which are sedentary and motionless, except when upon the wing! We cannot allow the one character of their nidification in holes on the banks of streams to counterbalance such a total diversity in structure and habits. It is, besides, impossible to point out any one group of Fissirostres to which they can be said to make any approach, whereas they have the greatest possible resemblance to the genera of Flycatchers above mentioned. We must therefore unhesitatingly decide, that the Todies are not to enter among the Fissirostres.

In place, however, of these two families which we reject, we introduce two others which have not generally found a place here. From an examination of the structure of the feet and toes, and from a consideration of their habits, we are led to conclude that the Hornbills are Fissirostral birds, though of a very abnormal form. Their very short legs, and united toes with a broad flat sole, are exactly similar to those of the Kingfishers. They have powerful wings, but their heavy bodies oblige them to use much exertion in flight, which is not therefore very rapid, though often extended to considerable distances. They are (in the Indian Archipelago at least) entirely frugivorous; and it is curious to observe how their structure modifies their mode of feeding. They are far too heavy to dart after the fruit in the manner of the Trogons; they cannot even fly quickly from branch to branch, picking a fruit here and a fruit there; neither have they strength or agility enough to venture on the more slender branches with the Pigeons and Barbets, but they alight heavily on a branch of considerable thickness, and then, looking cautiously round them, pick off any fruits that may be within their reach, and jerk them down their throat by a motion similar to that used by the Toucans, and which has been erroneously described as throwing the fruit up in the air before swallowing it. When they have gathered all within their reach, they move sideways along the branch by short jumps, or rather a kind of shuffle, and the smaller species even hop across to other branches, when they again gather what is within their reach. When in this way they have progressed as far as the bough will safely carry them, they take a flight to another part of the tree, where they pursue the same course. It thus happens that they soon exhaust all the fruit within their reach; and long after they have left a tree, the Barbets and *Eurylaimi* find abundance of food on the slender branches and extreme twigs. We see, therefore, that their very short legs and syndactyle feet remove them completely from the vicinity of the Toucans, in which the legs are actively employed in moving about after their food. Their wings, too, are as powerful as those of the Toucans are weak, and it is only the great weight of their bodies that prevents them from being capable of rapid and extensive flight. As it is, their strength of wing is shown by the great force with which they beat the air, producing a sound, in the larger species, which can be distinctly heard a mile off, and is even louder than that made by the flight of the great Muscovy Duck. They are still farther removed from the Crows, with which they have also been very generally associated, solely because they are *Conirostres*, or conic-beaked!—another instance of the extremely erroneous results which are arrived at by a dependence on a single character, and especially on one which so little influences the habits of a bird as the external form of its bill.

The preceding deductions from the habits of these birds had been made before I became aware that Mr. Eyton had arrived at similar results from anatomical considerations alone; and I had great pleasure in finding that there was such solid support for the opinion which I had formed, entirely from my own observations. The only question that remains then is, to what family of the Fissirostres do they most nearly approach? A careful consideration leads us to fix upon the Kingfishers. They are among the largest birds in the group, they have the largest bills, and, in the structure of the feet, the two are almost identical. The Hornbills of Africa are said to feed principally on reptiles, as do the King-Hunters (*Dacelo*) of Australia. We look upon Hornbills, therefore, as one of the abnormal developments of Fissirostral birds, of which they are the largest, the least elegant, and the least gifted with facilities for locomotion and for obtaining their food; and that their nearest affinities lie in the direction of the Kingfishers.

The remaining family, which, according to our views, belongs to the Fissirostral tribe, is that of the *Trochilidæ*, or Humming Birds, hitherto always placed in the Tenuirostres, which we have before adduced some reasons for believing to be an altogether artificial group. In this innovation we are not aware of having any support; yet we think it possible to show good reasons for it. What is it that characterizes the Fissirostral group but minimized feet and maximized wings, always connected with some modification of structure, adapted to give facilities for seizing the food with the mouth? and all these the Hummers possess in a remarkable degree. In the ease and flexibility of their motions on the wing they surpass even the Swallows. Their little feet exactly resemble those of some of the Swifts (*Dendrochelidon*), and the long, variously-curved bill and extensile tongue give them the same facilities for obtaining their food as do the short bill and wide gape in the other. They are, too (we believe), like the Swallows, purely insectivorous; for in every specimen we have examined the stomach was full of insects, principally minute flower-frequenting Coleoptera. No doubt they do partake occasionally of the nectar, or the pollen of the flowers they frequent, but as a delicacy rather than as solid food. The firmness and solidity of their muscle, the thickness of their skin, and the immense muscular exertion which they constantly make, can doubtless be supported only by animal food, which the very small space occupied by their stomach and intestines also shows to be the case. But a stronger proof of this assertion is, that there are many species which never frequent flowers! All the species of the genus *Phaëthornis* which we met with on the Amazon were found only in the lower parts of the forest, among the shrubs and palms which rise only a few feet from the ground. Here we have often seen them searching the leaves for insects, supporting themselves almost motionless in the air, their body erect and their bill pointed upwards, and passing rapidly over the under surface of each leaf in succession. They would often dart suddenly out into an open space, and remain motionless a few feet from my face, and then fly off again to repeat their search for their favourite food. At the various trees in flower about which I have observed and shot Hummers, I have never seen a species of *Phaëthornis*, whereas I used daily to meet with them in the gloomy jungle, where not a flower exists; and yet, from never being able to see them at a greater distance than three or four yards, they were the most difficult of all to obtain, without blowing them to pieces. Many species also hunt for insects in the air, exactly like true Fissirostral birds. I have often observed them in the evening, on the banks of streams, coming out of the jungle just as the Goatsuckers were beginning to appear, and darting about after the mosquitos and other minute insects, returning after each short circuit to the edge of the forest, where they remained balanced in the air for a moment and then darted off again. At other times they will sit on the topmost twig of a dead tree, and making short circuits in the air, return to it, exactly in the same manner as do the Jacamars and Puff Birds.

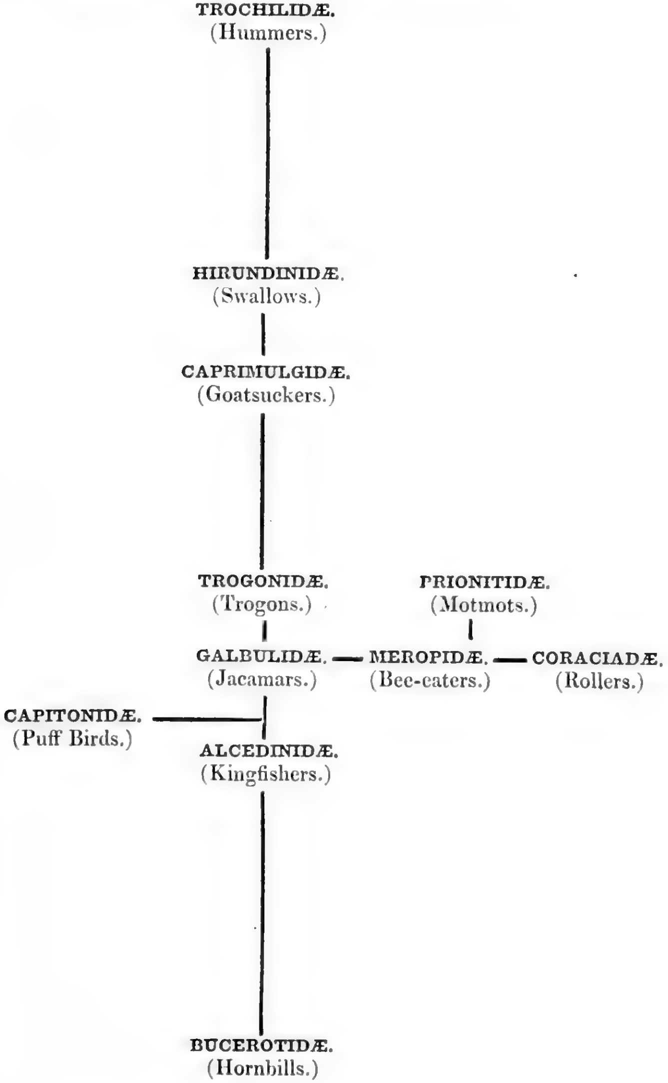
There is also another interesting fact to be mentioned. I had brought me a nest containing two little Hummers, apparently very recently hatched. I tried to feed them, and gave them, first, according to established rule, syrup made of honey and water, and also of molasses; but the poor little creatures did not at all like it, though they opened their mouths as if ravenously hungry. They were nearly choked by the liquid, and tried all they could to spit it out, which they generally succeeded in doing. Finding all my efforts to suit their taste in vain, I resolved to try if they liked insects better, and caught some minute flies which were very abundant. On dropping one of these into their mouths, they immediately closed their beak and by a great muscular effort of the throat swallowed it, and opened their mouths again for another. In this way they would each take fifteen or twenty little flies one after the other before they were satisfied. I thus kept them alive three or four days, and could I have bestowed sufficient time and constant attention upon them, there is no doubt they would have lived much longer. At all events the experiment satisfied me that the young Hummers are fed by their parents with insects, and not with honey.

I also observed that the beak of these little birds was very short, triangular, and very broad at the base,—in fact exactly the beak of a Swallow slightly lengthened. We see therefore in the Humming Birds an extreme and peculiar development of the Hirundine form of the Fissirostres. The wings of the Swallow, already among the longest in the whole class of Birds, are still further lengthened. The feet, already so short, are still further reduced. The plumage, which in the Swallow has become more compact and appressed than in any other of the Fissirostres, has these qualities still further developed. The skin, which in the tribe generally is thin and tender, is in the Swallows comparatively thick and strong, and in the Hummers is perhaps stronger in proportion to their size than in any other birds. The bill is that of a Swallow lengthened out to contain the long and extensile tongue; and the vital force and energy which enables the Swallows to enjoy such long-continued and rapid motion, seems here to have reached a point beyond which further development is scarcely possible. How then can we refuse them a place among those birds of which they possess the distinctive characters in the most eminent degree, while at the same time we keep together birds as different from each other as the Kingfisher from the Swallow, because they possess those characters?

But it will be objected that the structure of the tongue is so different and peculiar, and agrees so well with that of the Sun Birds. But we have already mentioned, and again repeat, that in closely allied genera of Sun Birds the tongue is totally different, and that therefore it is not a character to outweigh the whole structure and habits of a group of birds: moreover, in other groups the same difference in the tongue is not held to be sufficient to separate birds otherwise allied. The Cuckoos and the Toucans have ever been placed near each other, yet how different their tongues! while the Woodpeckers, still farther differing from them, are notwithstanding placed in the same tribe of Climbing birds. We might also expect, that when the structure of a bird had become so peculiarly modified as to bring it to seek the same food in the same places as another bird of quite a different type of structure, we should find each of them gifted with the same peculiarly modified organ adapted to such habits; and we therefore find that the Sun Birds and the Hummers, though with a widely different general structure, yet have a similarly constructed tongue which they both use in extracting minute insects from flowers and leaves. An exactly analogous instance exists in the *Picidæ* and *Dendrocolaptidæ*, two families as different in general structure as the *Trochilidæ* and *Nectarinidæ*, but which yet have one striking similarity in the rigid tail, which enables them both to rest vertically against a tree while extracting insects from the bark. We contend that these cases are strictly analogous, and that there is no more real affinity in the one case than in the other. The character which is most opposed to this view of their affinities is their nidification; but we think this is not only not an insuperable obstacle to their being thus placed, but one that we might to some degree have anticipated. In some of the Swallows we have already seen one deviation from the general character of the tribe in the carefully constructed nest of clay. In the Goatsuckers we have another, the Podargus of Australia forming a nest of sticks and grass on the branches of a tree. We should therefore expect that birds so peculiarly and highly organized as the Hummers, so aërial in their habits, and so intimately associated with flowers and foliage, would have a modified and characteristic form of nidification.

We have now completed a very brief and imperfect review of those families which we conceive can be separated from the mass of Passeres to form the tribe of the Fissirostres, and in the accompanying diagram we have endeavoured to represent at one glance their various affinities.

Diagram of the Affinities of the Fissirostres.



It is intended that the distances between the several names should show to some extent the relative amount of affinity existing between them; and the connecting lines show in what direction the affinities are supposed to lie. By referring to the diagram it will be seen that there are seven families placed close together, forming a central mass. Beyond the Trogons at some distance come the Goatsuckers and Swallows, while at the greatest possible distance from each other are the Hornbills and the Hummers, the former having a distant affinity to the Kingfishers, the latter to the Swallows.

We may here mention that it is an article of our zoological faith, that all gaps between species, genera, or larger groups are the result of the extinction of species during former epochs of the world's history, and we believe this view will enable us more justly to appreciate the correctness of our arrangement. For instance, let us suppose that the gaps shown in this diagram have been all filled up by genera and families forming a natural transition from one of our groups to the other, and we shall be able to judge whether our arrangement will agree with such a supposition. Thus, if the space between the Kingfishers and Hornbills has been filled up by a natural succession of families, we can see that the change must have been to heavier, larger, and larger-billed birds, and we see such a change begun already from the Jacamars to the Kingfishers. So from the Goatsuckers to the Swallows the change is to smaller, stronger-winged, thicker-skinned, and brighter-coloured birds,—exactly the kind of change which continued on will lead us to the Hummers. On the same principles we may conclude, that as the change from the Jacamars to the Rollers is to stronger-legged birds which do not feed solely on the wing but also on the ground, so the same change continued on would lead us to true Passeres in which the peculiar Fissirostral characters altogether disappear. The *Coraciadæ*, therefore, are either an extreme Passerine form of the tribe, or else form a transition by direct affinity to the Passeres.

The method of representing affinities here adopted we believe to be of the highest value. It is founded on the method suggested by the late Mr. Strickland, and which we believe Dr. Lindley has been the first naturalist to adopt, namely that of placing to the right and left of every family or other group the names of those to which it is most nearly allied. But this alone conveys no idea to the mind, especially in an extensive group, till represented by a diagram, the most convenient way to construct which we have found to be as follows. Suppose you have a family of a dozen genera which you wish to arrange; first write down the names of the genera in any order, and right and left of them those to which you believe them to be allied most closely.

Then take a dozen pieces of paper or card cut out with a gun-wadding punch, and on each write a name of a genus. Place them on a table and arrange them according to your list. This will not always be so easy a matter as it appears at first sight, for you will most likely find that you have set down some conflicting affinities, or that you have mistaken some mere analogies for affinities. When you have them in tolerable order, the next thing is to get the distances between them to bear some proportion to the closeness or remoteness of the affinities, and lastly, bring the whole into symmetry by placing what appears to be the main line of affinities in a straight line, and bringing the others into branches right or left from it. When this is done, the positions can be copied on a sheet of paper and kept for reference as a trial-arrangement, which is to be tested by every new fact that is procured, and by any additional knowledge that may be gained on the structure or habits of any of the species. The advantage claimed for this particular form of diagram is that it can be printed with ordinary type, whereas any circles or figures to represent the groups require woodcuts or lithographs. It is much to be wished that in every systematic work each tribe and family should be illustrated by some such diagram, without which it is often impossible to tell whether two families follow each other because the author thinks them allied, or merely because the exigencies of a consecutive series compel him so to place them. Thus, Bonaparte places in his 'Conspectus,' the *Trochilidæ* between the *Cypselidæ* and the *Phytotomidæ*. By making them follow the Swifts he would seem to take the same view of their affinities as is here done, but by placing immediately after them the *Phytotomidæ*, one is at a loss to understand by what principles he has been guided. An explanatory diagram, or even the plan of denoting the affinities as adopted by Dr. Lindley, would remove such doubts, and render a work of such great labour and research as the one referred to less likely to be misunderstood.

On the Affinities and Limits of the Scansorial Birds.

However much systematists have differed as to what families should enter into or be excluded from the Scansores or Climbers, considered as a natural group of Birds, there are four families which have formed part of it in every system. These are the Woodpeckers (*Picidæ*), the Parrots (*Psittacidæ*), the Cuckoos (*Cuculidæ*), and the Toucans (*Rhamphastidæ*). We may therefore take these as a basis, to inquire in what respects the Scansores differ from the true Passeres and from the Fissirostres, and to deduce their natural characters. Having done this, we may inquire further if any and what other groups can be naturally associated with them.

The first thing that strikes us on comparing these birds with each other is, that we could hardly pick four families from the whole class which should have more diversified forms of bill. The resemblance and affinity between them must therefore exist in other parts of their body, and we find it in their wings and feet. The former are generally short, rounded, and very weak, quite incapable of rapid or long-continued flight, while the latter are remarkably large, powerful, and peculiarly formed. They may be said therefore to be the very reverse of the Fissirostres, whose grand features are large wings and small feet, while in the Scansores the small wings and large feet are equally characteristic. But it is the peculiar structure quite as much as the size of the feet to which we must pay attention. The toes are always exceedingly long, and the outer toe is either turned completely backwards or nearly at right angles to the others. This toe is often the longest of all, while the true hind toe is always small, and sometimes altogether wanting. It is this peculiar structure that altogether separates this group from all the short-winged and strong-footed Passeres, whether they are walkers, perchers, or climbers.

The habits that result from this form of foot and wing are, as might be expected, to a great extent characteristic, and will serve us as a valuable guide in those cases of anomalous form and structure where the position of a genus or family might be otherwise doubtful. These birds then are truly arboreal, rarely descending voluntarily to the ground. They use their wings only for passing from tree to tree, and, whether frugivorous or insectivorous, they obtain their food in or upon trees. Their motions along the trunk or branches, or among the thick foliage, are either true climbing, or a succession of rapid hops producing an appearance of climbing. The Woodpecker runs up the vertical trunk, and assisted by a peculiarly modified tail and a powerful wedge-shaped bill, seeks his food beneath the bark. The Parrot climbs, assisted by his hooked bill, after the fruit, which alone he feeds on. The insect food of the Cuckoos is sought for upon the leaves and smaller branches, and they progress among these so rapidly, that they have been constantly mistaken by us for squirrels or other small arboreal animals. The Toucans again hop actively about the tops of lofty trees, devouring an immense quantity of fruit.

Now, though these four families have evidently more connexion with each other than with any other birds, yet they present so many important points of difference, as to show that they are in reality very distant from each other, and that an immense variety of forms must have intervened to have filled up the chasms, and formed a complete series presenting a gradual transition from one to the other. The differences in the form of the bill have already been alluded to, but those of the tongue are perhaps still more extraordinary; the fleshy tongue of the Parrot, the barbed extensile spear of the Woodpecker, the short horny tongue of the Cuckoo, and the long and slender feathered tongue of the Toucan, would seem rather to belong to birds most remote from each other, than to those for whom we can find no nearer allies. We should be inclined to consider therefore that they form widely distant portions of a vast group, once perhaps as extensive and varied as the whole of the existing Passeres.

Notwithstanding the difference of their food, it is evident that the Cuckoos and the Toucans approach more closely to each other than to the others. Their legs are longer, and they consequently hop, which the other two never do. Their bills are similar in form, their plumage is in both much more loose than either in the Parrots or the Woodpeckers, which again, in these peculiarities in which they agree, to some extent approach each other. We would place therefore the Parrots and the Woodpeckers at one extreme of the group, and also considerably removed from each other, while the Toucans and Cuckoos, rather nearer together, should be placed at the other extreme.

The Barbets (*Bucconidæ* of Lesson and Bonaparte, *Capitoninæ* of G. R. Gray) have also been always included amongst the Climbers, but their place has been so often varied and their affinities so much misunderstood that they require a separate consideration, especially as in the systems of Swainson and Gray they have been considered as a subfamily of *Picidæ*, and have therefore not appeared among the families of the Scansores. The only ground for placing them with the Woodpeckers appears to have been that some African species do cling against and peck at trees something in the manner of those birds. Their whole structure however is totally opposed to their being thus placed. In their feet, wings, and the form of the whole body they much more nearly resemble the Toucans. The texture of their feathers, their broad, angular and weak skulls also resemble them, and are strikingly dissimilar to those of the Woodpeckers. From my own observations too, I can assert that, in the habits both of the South American and of the Eastern species, they resemble the Toucans more closely than any other birds; and Le Vaillant makes the same observation with regard to the African species. Besides, the grand characteristic of the Woodpeckers, the barbed and extensile tongue, which exists equally in the *Yunx* and *Picumnus*, is totally absent in the Barbets, while their bill is of quite a different type of form, much more nearly approximating to that of the Cuckoos. In their habits too they are equally distinct: they hop and cling, but never climb, and they live almost exclusively on soft fruits. We must therefore consider them as a distinct family, and place them in the vicinity of the Toucans and Cuckoos.

We will now proceed to the consideration of those groups, about the propriety of including which in the Scansorial tribe considerable difference of opinion has existed. These are the Turacos (*Musophagidæ*), the isolated genus *Opisthocomus*, and the *Certhiadæ* including the *Dendrocolaptidæ*. These last have, we believe, only been so placed by Messrs. Vigors and Swainson, but as their classification claims to be pre-eminently "The Natural System," and as it has still some advocates, it deserves to be carefully examined. What are the characters then by which the *Dendrocolaptidæ* are supposed to be united to the *Picidæ*? They appear to be these: both are true Climbers, both have a rigid tail which assists them in maintaining an erect position, and both feed on insects which they obtain upon the trunks and branches of trees. On the other hand, they present many and important differences. The long, slender, curved bill and short, horny, non-extensile tongue of the Creepers are very far removed from the strong straight bill and extensile barbed tongue of the Woodpeckers. But this, it may be said, is of no importance, as a similar difference exists in the other families admitted into the Scansores. This is true; but then those birds agree in having the same form of feet, which is of far more importance in this case than it may at first sight appear, for we shall be able to show not only that the Creeper's foot is very different from the Climber's, but that *it is further removed from it than is that of any other of the Passeres.*

The characteristic form of foot in the *Certhiadæ* and *Dendrocolaptidæ* is to have the toes placed normally, three forward and one backward, and to have the forward toes all connected together at their bases, particularly the outer toe, which is generally longer than the inner, and often connected to the middle toe as far as the second joint. The result of this conformation is, that the forward toes do not spread much laterally, but form one line of support opposed to the hind toe. This hind toe also is remarkably long and powerful, and armed with an equally powerful claw. This peculiar structure has been gradually arrived at, through the most nearly allied families of Passeres. Passing from the Wagtails and Larks through the *Anabatidæ* to the *Certhiadæ*, *Sittidæ*, and *Dendrocolaptidæ*, we find the outer toe gradually more and more united to the middle one, and the hind toe becoming gradually larger and more developed; so that we are justified in asserting that we see here that peculiar modification of the normal ($\frac{3}{1}$-toed) foot which is adapted for climbing. In the Woodpeckers, however, we find the outer toe always turned completely backwards, and therefore quite free from the middle toe. The true hind toe is also invariably small and weak, and of so little importance that in several species of Woodpeckers it is altogether wanting, without at all diminishing the bird's powers of climbing. If we compare this foot with that of the other Scansores, we shall find that it is an extreme modification of the Scansorial form, adapted for true climbing. The toes are all more powerful, the claws much stronger, the outer toe longer, and the hind toe smaller. If therefore the structure of foot in the Cuckoos and Turacos, where the outer toe can be placed either forward or backward and the hind toe remains moderately developed, is (as is universally allowed) the link between the $\frac{2}{2}$-toed and $\frac{3}{1}$-toed form, then it follows that of all $\frac{2}{2}$-toed feet the Woodpecker's is most removed from the $\frac{3}{1}$-toed, and of all $\frac{3}{1}$-toed feet the Creeper's is the furthest removed from the $\frac{2}{2}$-toed;—and thence as a further deduction it follows, that the feet of the Creepers and Woodpeckers are the furthest possible removed from each other. When, in addition to this remarkable result, we consider that the structure of the climbing tail is totally dissimilar in the two cases, we shall see that there exist no grounds whatever for establishing an affinity between the two families, and that the Creepers must not only be separated from the Scansores, but in a natural arrangement will be placed at a very considerable distance from them.

The *Musophagidæ*, containing the Turacos and Plantain-eaters, have been placed among the Scansores by the continental ornithologists (Temminck and Vieillot), while in England they have been considered to be Conirostres by Swainson and Gray. We believe the former are correct; for these birds have the short, rounded and weak wings of the Cuckoos and Toucans, and consequently very imperfect flight, while their legs are very strong, the outer toe long and versatile, but rather less so than in the Cuckoos, and the hind toe, as in all Scansores, short. Their habits are described as being almost exactly those of the Toucans and Barbets, their plumage is of a similar texture, while the short crest at the back of the head is similar to that of the Woodpeckers. Some species are said to be able to cling to vertical trunks. Their internal structure and the form of the sternum appear to correspond exactly to this view of their affinities, which is still further confirmed by their nidification, like that of all other Scansores, in hollow trees, so that they may be well placed in the wide interval between the Cuckoos and Toucans on the one side, and the Woodpeckers and Parrots on the other, but rather nearer to the former than the latter. If, on the other hand, we place this group among the Conirostres, we can give no such satisfactory account of its structural affinities. Swainson places it between the *Fringillidæ* and the *Buceridæ*. The former have all well-formed Passerine feet, the hind toe always well developed, and the outer toe never so long as the middle one; they have generally powerful wings, and are of such a uniformly small size as not even to give them an appearance of affinity with the Turacos and *Musophagidæ*. The Hornbills are if possible still further removed, as our previous account of their habits and the structure of their feet will at once show. We cannot believe that so very acute and observant a naturalist as Mr. Swainson could have been led to propound these as natural affinities, had he not been blinded by his belief in the universal existence in nature of a numerical and circular arrangement, which, without disproving it in any particular cases, we believe can be shown to be absolutely untenable on two general grounds. 1st. Geological investigations prove that the animals now existing on the earth are probably not one-tenth, perhaps not one-hundredth, of those which have existed; for all before the Tertiary epoch were of different species and mostly of different genera, and thousands of other genera, families, and whole orders must have existed of which we are absolutely in ignorance. If therefore this regular system were true of the whole, it must be quite imperceptible in the mere fragment we have an acquaintance with. Instead of complete circles being the rule, they should scarcely ever exist; in fact, the gaps left in the system by its authors do not leave room enough for all the forms that must have become extinct. 2ndly. This system absolutely places limits to the variety and extent of creation; for it is said that every group can only contain five subgroups, and the number of gradations of groups is fixed. For instance, in a family there can be only five subfamilies, in each of which there can be only five true genera, and again in each genus five subgenera. In the *Psittacidæ* therefore there can be but twenty-five generic forms, and when those are all known, not only is it declared to be impossible to discover a new one, but it is also asserted that no others can possibly ever have existed and become extinct. This is the logical deduction from any system of definite numbers in natural history, and it is one that should convince every person of the false basis on which all such systems rest.

Having determined the position of the Turacos, we shall next have to consider that remarkable bird, the *Opisthocomus cristatus*. This has been and still is placed among the Gallinaceæ by most continental authors. Mr. G. R. Gray, however, places it near the

Turacos, and Mr. Swainson in the family of the Cuckoos. We believe it should be placed between the two, or rather as a lateral branch from the Turacos. This bird is very abundant on the banks of the Amazon, where we have often observed and shot it. It frequents low bushes on the river's edge, where it feeds on leaves, principally those of a gigantic Arum. It never goes on the ground. This circumstance, combined with the fact of its having no gizzard, would at once decide that it is not Gallinaceous. Our own impression at the time, from its general appearance, flight, and habits, was, that it was a gigantic Cuckoo. Its long crest remarkably resembles that of the genus *Diplopterus*, several species of which occur in the same district, and they both have the habit of throwing it up when alarmed in exactly the same manner. In its bill and general form it approaches the Turacos more nearly than any other bird. The only difficulty is in the feet, which, though similar in form, have not the versatile outer toe of those birds. This however seems of less importance, because a genus of *Musophagidæ* (*Schizorhis*) has also all the toes directed forwards. The short wings, weak heavy flight, strong legs, long toes, and the character of the plumage, added to the resemblances already pointed out, certainly justify us in believing this to be the true position for this singular bird, while its peculiar food and internal structure show that it is to some extent isolated, and cannot be referred to any known family.

We have now only one more group to introduce into our Scansores, but it is one of extreme interest, as tending in some degree to fill up the wide chasm which separates the *Psittacidæ* from all other birds. This we believe is done by the *Coliidæ*, a small group of birds peculiar to Africa, and which have been generally classed as Finches, from their small size and thick beaks. The particulars which Le Vaillant gives of their habits are however exceedingly curious, and show a resemblance to the Parrots which no other birds exhibit. They live entirely on fruits, never touching either seeds or insects. They never perch or jump. They walk with the whole tarsus applied to the ground, creeping as it were upon their belly. They are very fleshy, and weigh twice as much as another bird of apparently the same size, for their feathers are so short and so close-laid upon their body, that they are really much larger than they appear. They have also very weak wings, and can fly a very short distance. They climb up to the top of a tree or bush to fly to another, and in doing so, lose elevation so as generally to arrive at the foot of it. They climb one foot after the other, and *help themselves on with their beaks.*

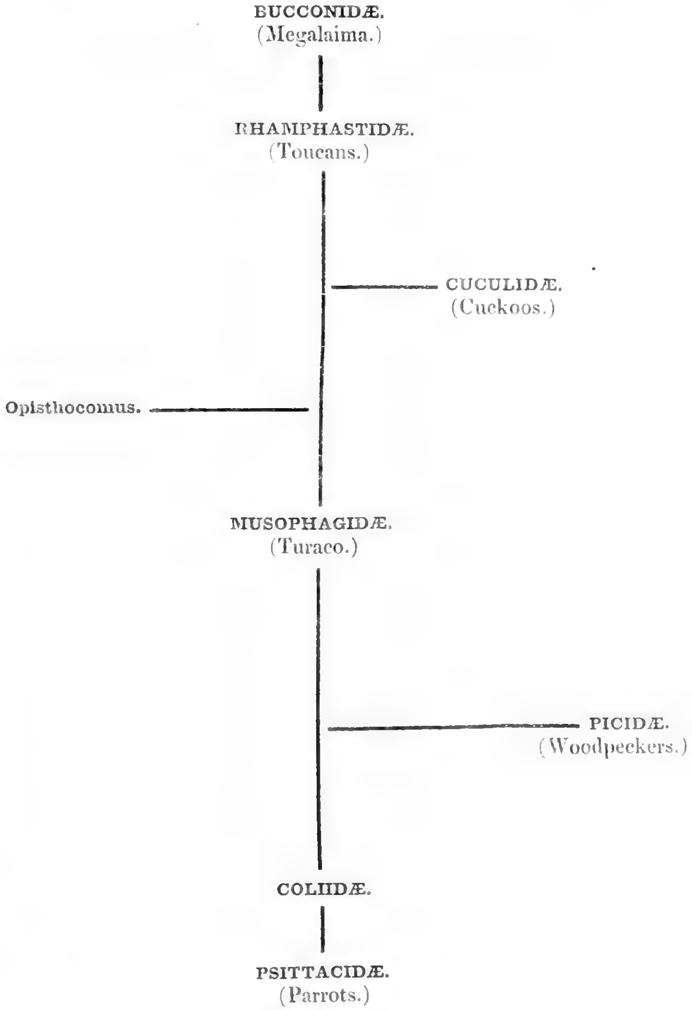
Now, almost the whole of this description will apply to some of the Parrot tribe and to no other birds. Their bill is an approach to that of the Parrot; the upper mandible being thick, much curved, and acutely pointed, while the lower is much smaller and nearly straight,—a form quite different from that of the Finches. The feet are very peculiar, the hind toe being small and capable of being turned forward. The tongue is described as cartilaginous and flat,—one step from the ordinary horny-tipped tongue to the fleshy one of the *Psittacidæ*. We consider therefore the *Coliidæ* to be more nearly allied to the Parrots than any other birds, and to be an isolated link serving to connect them with the other Scansores in the direction of the *Musophagidæ*.

In the accompanying diagram we have endeavoured to lay down the families of Scansorial birds, so as to represent their respective affinities; but the very imperfect and fragmentary state in which according to our views the group exists, prevents our arriving at a very satisfactory result.

We may here remark, that we can never hope to arrive at the true direction and amount of the affinities of the several families of birds, owing to our complete ignorance of the extinct forms. It is probable that in very few cases is there a direct affinity between two groups, each being more or less distantly related to some common extinct group, so that we should represent their connexion more accurately by making our central line a blank, for the extinct portion of the group, and placing our families right and left, at different distances from it. We should thus see the reason why we so rarely find one family or genus exactly intermediate between two others. For instance, though the Cuckoos are by their feet intermediate between the Turacos and Toucans, yet their different plumage and their insect food show that they are more properly a lateral branch from some common central group now extinct.

Having thus determined the extent of the two groups which can be separated from the Passerine birds, there remains an extensive series of species which we believe constitute one great group of equal value with those we have already defined. This group may be called the normal or typical Passeres, and consists of about thirty-five families, containing between three and four thousand species, or at least half of the known birds. These we believe are too intimately connected with each other to allow of their being separated into a few great divisions without violating many of their natural relations. They have all normal or $\frac{3}{1}$-toed feet, which are never so short or weak as to be unadapted for progression. The bill is always moderate in size and form, and in the few cases where it is peculiarly modified, as in some species of *Dendrocolaptes*, other species in the same family possess the normal form. There is also a remarkable moderation in size; for though the species are so numerous, there are none either so large or so small as are to be found in the two abnormal groups. There is also a much greater uniformity in texture of plumage

Diagram of the Affinities of the Scansores.



and in form, as well as in habits, which binds the whole into one compact and natural group. It is also a most important point to consider that there are no isolated families,—none but have numerous points of connexion and transition with others; and to such an extent is this the case, that there is scarcely an extensive family group about the limits of which ornithologists can agree. The Thrushes, Warblers, Flycatchers, Chatterers, Tanagers, Finches, Shrikes, Bush-Shrikes, and many others are in this condition, and offer a striking contrast to the families of the Fissirostres and Scansores, about the limits of every one of which there is scarcely any doubt or disagreement whatever. Here then we have three groups, one of which, though very much more extensive than the others, offers less variation in the form and size of the species, and in the modifications of their principal organs. Correct principles of classification would surely oblige us to consider the three groups of only equal rank.

But all the families which compose this group are so intimately connected with each other, that the limits of a great many of them cannot be determined, and there is no family of any extent which does not gradually blend into others. How then can we hope to form two or three primary divisions which shall be sufficiently well marked out to command general acceptance? without some probability of which, the mere multiplication of systems of classification is a nuisance.

We conceive therefore that the efforts of ornithologists should be directed to the study of the different families individually, in order to determine their extent and to point out their true affinities with other families. When this has been done for all, we may be able to arrange the whole group so as to present to the eye a view of the relations of the several parts, and then, and then only, shall we be able to determine whether any and what subdivisions can be established.

There is one other point on which it is necessary to say a few words before concluding this paper. It is on the connexion of the three groups we have here endeavoured to establish with each other. The subject is a most difficult one, and we have been able to come to no satisfactory conclusion upon it. We are inclined however to imagine, that the Puff Birds and Barbets, as exhibiting the least development of the peculiar characters of their respective tribes, may show the line of connexion between the Fissirostres and Scansores, while the Rollers may connect the former with the normal Passeres somewhere near the *Eurylaimidæ*. But a minute and careful examination of the families in question is requisite to decide so nice a point, on which too the greatest light may be thrown by anatomical observations. It is to be hoped that some ornithologist will be found to investigate it fully.

XIX.—*Recent Discoveries in Vegetable Embryogeny.* By Arthur Henfrey, F.R.S., Professor of Botany in King's College, London.

The subject of the development of the embryo of flowering plants being one of those upon which I have constituted myself a reporter, from time to time, for the pages of the 'Annals,' I find it necessary again to demand a small space, for the purpose of making known some important events which have lately occurred in the history of the question, and at the same time of putting in a distinct claim to priority in the publication of one of the most important of the latest discoveries.

It is well known to all readers of this Journal who are interested in the present subject, that I have always been an advocate for, and defender of, the opinion first put forth by Amici, that the embryo originates as a distinct cell in the embryo-sac, and is merely fertilized by the pollen-tube. Several physiologists (whose papers will be found referred to in my 'Report' published in the 'Annals' in 1852*) have argued on the same side; one of them however, Tulasne, declaring his inability to find the germinal vesicle in the embryo-sac *before* fertilization, although he distinctly asserts that it originates quite independently of the end of the pollen-tube. On the other hand, Schleiden has continued to defend his original views, and has been ardently supported by his pupil Schacht, and more lately by Deecke.

The events of the last few months have quite changed the aspect of the discussion; not only has Schleiden given his adherence to the opinion that the germinal vesicle pre-exists in the embryo-sac, but Schacht also now states that he was in error, and that the embryo is a product of a body originating in the embryo-sac, and is merely fertilized by the pollen-tube.

The merit of convincing Schleiden is due to another of his own pupils, Dr. Radlkofer, of Munich, who published at the beginning of this year some excellent observations on *Euphrasia Odontites*, and certain other plants†; and was empowered to make known therein Schleiden's acknowledgement of the accuracy of his representations. The memoir of Dr. Radlkofer did not add any new fact of importance to our knowledge, but was of much value, not only from its bearing the approval of Schleiden, but from its setting in their true light the phænomena which Schacht and Deecke had recently urged as subversive of Amici's views. Dr. Radlkofer's observations were made during

* Ann. Nat. Hist. Ser. 2. vol. ix. p. 441, &c.

† Die Befruchtung der Phanerogamen, von L. Radlkofer, M. & Ph.D. Leipzig, 1856.

last year, but did not reach me until late in the spring of this year, and were therefore overlooked in the brief summary of late researches contained in my last publication. This publication, a paper read before the Linnæan Society of London, March 4th, 1856, and reported in the 'Annals' of May following, contained the facts supporting, and the more definite assertion of, the opinion which I had propounded in the article "Ovule" (page 482) in the 'Micrographic Dictionary,' in the autumn of 1855, that the germinal vesicles (or corpuscles) exist in the embryo-sac before fecundation, *not as complete cells*, but as *corpuscles of protoplasm which acquire their cellulose coat after the fertilization by the agency of the pollen-tube.*

Entertaining this view, it was with no little satisfaction that I last week received a new paper, by Schacht (published in the Reports of the Berlin Academy for May 22nd of this year), on the "Process of Fertilization in *Gladiolus segetum*," in which he completely abandons the opinion so long and so warmly urged by him, of the origin of the embryo from the end of the pollen-tube, and not only admits the pre-existence of the embryonal corpuscles, but, in ignorance of my recently promulgated statements, describes the phænomena nearly in the same manner as I have done in *Santalum*, more particularly as regards the formation of the cellulose coat around the protoplasmic embryonal corpuscle, as a consequence of the fertilization. This corroboration of my views may be given in his own words: "In the unfertilized embryo-sac of *Gladiolus segetum* lie two germ-corpuscles, closely adherent to the micropyle-canal, the upper part of the corpuscles consisting of a bundle of delicate filaments, the lower of a mass of protoplasm. At the epoch of flowering these corpuscles are not surrounded by a firm membrane; their points project *freely* out of the embryo-sac. On the third or fourth day after the application of the pollen, the pollen-tube arrives at the germ-corpuscles and becomes intimately connected with them, and a firm membrane is developed around the latter as the first product of this conjunction. The end of the pollen-tube swells, becomes thickened, and loses its granular contents. *Both* corpuscles are ordinarily fertilized by *one* pollen-tube, but only *one* of them becomes further developed, a nucleus appearing in its plasma-mass, and soon after this a horizontal septum. The first cell of the rudimentary germ produced in this way grows gradually up into the embryo, while the upper half of the original germinal corpuscle becomes the suspensor, which appears firmly connected with the wall of the embryo-sac. Not uncommonly two or three pollen-tubes descend, without producing any essential alterations; the pollen-tube sometimes branches in the micropyle, and, though very rarely indeed, the fertilized germ-corpuscle may also branch in the embryo-sac. Hence the pollen-tube exerts a *fertilizing* influence, and does not, as I formerly assumed, directly produce the germ, for the first cell of the germ does *not* originate in its interior; on the contrary, its influence causes a granular protoplasmic mass existing in the embryo-sac before fertilization to produce that cell from which both the embryo and its suspensor proceed. Those filaments (*fertilization-filaments*), of which the apices of the germinal corpuscles consist, and which I always found destitute of any power of motion, are quite essential to the act of fertilization, but they do not appear to take any direct part in the formation of the first cell of the germ." (Pp. 11, 12.)

As to these 'filaments' I cannot say anything at present; they occur in the situation of the 'coagula' which I have described and figured in my memoir, and Schacht's drawings are not very unlike what I have seen, except that I did not detect any filamentous structure; and moreover, I do not think they project freely from the embryo-sac, although I have described them as occupying the absolute summit and exhibiting a kind of notch between them.

I must not conclude this brief notice without offering my testimony to the value of Tulasne's recent researches on this subject*. Although he has missed the most essential point, his observations are of exceeding value as contributions to our knowledge of the history of the embryo-sac and the earlier stages of growth of embryos.

London, July 30th, 1856.

XX.—*On* Edwardsia carnea, *a new British Zoophyte.* By Philip H. Gosse, F.R.S.

[With a Plate.]

Sp. Char. Mouth conical; tentacles above twenty-four, in three rows; epidermis subpolygonal, coriaceous, rough, brown; anterior column and posterior bulb pellucid, carneous, marked with white.

Description.—Length $\frac{3}{8}$ths of an inch, of which the anterior column is $\frac{1}{6}$th of an inch; diameter of body $\frac{1}{16}$th; expanse of tentacles $\frac{1}{10}$th of an inch.

Body enclosed in a tubular epidermis, from which the anterior and posterior extremities protrude at will (Pl. IX. fig. 1). This

* Ann. des Sc. Nat., Botanique, 4me Sér. iv. p. 65.

epidermis is thick and coriaceous, roughened externally, the projections having a slight tendency to longitudinal arrangement, imparting a subpolygonal form to the body, which however is very indistinct: its colour is yellowish-brown, tinged in parts with rufous, and slightly translucent, so that the scarlet hue of the stomach shines through it, when the animal is contracted.

Anterior column cylindrical or slightly barrel-shaped; fluted; pellucid, almost colourless; each fluting defined by a slender white line, and marked with an oblong-linear spot of opake cream-white near its base: stomach visible through the integuments like a thick scarlet axis.

Oral disk small; a star of cream-white rays on a translucent ground, surrounded by twenty-eight short, subfusiform, pointed, pellucid, carneous tentacles: mouth scarlet, on a low conical papilla. Tentacles slightly ringed with alternate bands of subopake and pellucid carnation; they are arranged in three indistinct circles, those of the innermost circle thickest, graduating outwards.

Posterior extremity, when extruded, a somewhat inflated bladder, membranous, delicately pellucid, carneous, with the pale septa distinctly visible. The extremity is imperforate; it does not form a defined sucking-disk, but its surface is capable of adhering with considerable force to extraneous bodies (as a plate of glass for example), on pressure, thus forming a temporary disk. When this bulb is extruded, the epidermis is forced upward, and lies in great tucks or folds around the body, like a loose stocking (see fig. 4). At other times it is quite covered by the epidermis, which then appears continuous and imperforate (see fig. 3).

In the specimen described, the anterior column was attached to the epidermis, not at the extremity of the latter, but a little within its periphery, which, when the column was protruded, rose in irregular, overlapping, and somewhat everted points around its base (see figs. 2 & 3). In the process of contraction, the retiring column carried with it the epidermis, causing this to invert itself to a considerable extent. After a time, however (a week or more), I observed that the column, in retreating, ceased to invert the epidermis, simply descending into it as into a tube, the everted points of which remained exactly as they were when the animal was protruded. Hence I presume that there is no organic connexion between what is called the epidermis and the animal, but that the former is a cutaneous secretion thrown off, and inhabited as a tube; like the investiture of *Edwardsia vestita*. In this case the attachment of the mouth of the tube to the column observed before, was probably a voluntary and temporary adhesion produced by the suctorial property of the general surface; a property which we have seen to exist in all parts of the posterior bulb.

This pretty and interesting, though minute, Actinoid was found at Torquay in July by Miss Pinchard, an accomplished student of our marine natural history. This lady kindly forwarded it to me in its own native nidus,—an old *Saxicava's* burrow in the limestone rock, out of which its fore-parts projected (see fig. 2). Though removed from its burrow for the purpose of examination, it has lived several weeks in one of my small aquaria, expanding at intervals (somewhat charily), and frequently adhering to the glass by its posterior bulb.

EXPLANATION OF PLATE IX.

Fig. 1. *Edwardsia carnea*: natural size.
Fig. 2. *Ibid.* (magnified), in the act of protruding.
Fig. 3. *Ibid.* (magnified); the anterior column protruded and expanded.
Fig. 4. *Ibid.* (magnified); the posterior bulb protruded.

XXI.—*Notes on the Freshwater Infusoria of the Island of Bombay.* No. 1. *Organization.* By H. J. Carter, Esq., Assistant Surgeon H.C.S., Bombay.

[Concluded from p. 132.]

Nucleus.—By this term we shall understand, for the most part, an organ situated in the outer portion of the sarcode, which, when well marked, presents under the microscope the appearance of a full moon (to use a familiar simile), with similar slight cloudinesses (figs. 1 *d*, 2 *e*, 3 *d*). It is discoid in shape, of a faint yellow colour, and fixed to one side of a transparent capsule, which, being generally more or less large than the nucleus itself, causes the latter to appear as if surrounded by a narrow pellucid ring. In this state it is invariably present in *Amœba*, *Actinophrys*, *Spongilla*, *Astasia* (fig. 45 *b*), and *Euglena* (figs. 16 *a*, &c.), though difficult at first to recognise; particularly in the two latter families, where the pellucid space or capsule, at the bottom of which it is situated, is often the only visible sign of its presence. In *Difflugia proteiformis* it cannot of course be seen, from the thickly incrusted state of the test; but in a smaller and less incrusted species, which might be called *D. tricuspis* (from the trefoil-form of the opening of the test) (fig. 80), as well as in *Euglypha*, its position is posterior, and evident, from the largeness of the capsule, though the nucleus itself is so faint that even in *Euglypha* it can only occasionally be distinguished; while in *Arcella vulgaris* (Ehr.) it is constantly double and opposite (fig. 79). In *Amœba Gleichenii* the nucleus itself occasionally presents a pellucid spot or punctum in its centre.

In *Vorticella* there is a long cylindrical organ, which appears analogous to, if not homologous with, the nucleus, and this, in a large *Epistylis* common here, and some other species of *Vorticella*, is wrapped once round the upper part of the buccal cavity, in the same manner as the ovary is wrapped round the visceral organs of *Salpa* among the Tunicata (fig. 74 *g*). Stein states that after *Vorticella microstoma* has become encysted, this organ divides up into embryos, which, when the parent integument bursts, come forth like "*Monas colpoda* or *Monas scintillans*"; and he "assumes" that these monads, after having become fixed and stalked, pass into young *Vorticellæ**;—an assumption which can hardly be doubted, though it may be some time before chance favours its demonstration.

In *Otostoma*, and many forms of Ehrenberg's Enterodelous class of animalcules, there is a similar organ, either of a circular, cylindrical, or fusiform, elongated shape (Annals, vol. xvii. pl. 9. fig. 6). In *Oxytricha* also there is something of the kind, and in *Himantophorus* (*Charon*, Ehr., mihi) it extends nearly all round the body, commencing from the posterior extremity, and terminating on the right side close to the vesicula.

The cylindrical organ in *Vorticella* not unfrequently presents a granular appearance, and the granules, which are minute, but uniform in size, appear to occupy the periphery; but whether they are inside or outside the wall of the cylinder, or in the substance of the wall itself, I have not been able to determine. Stein places them inside, in the form of a granular cylinder, and within this "nucleoli †,"—nucleated, discoid bodies, into which the nucleus becomes divided.

In the Rhizopodous cell which inhabits the protoplasm of the *Characeæ* ‡, it is at first uniformly clear and transparent, then semi-opake and subgranular, afterwards two or more distinct granules make their appearance, and finally it becomes wholly granular and much enlarged; or undergoes fissiparation and thus gives origin to more cells, like the cytoblast of the vegetable kingdom.

Use.—It is impossible, in the present state of our knowledge, to specify the uses of the nucleus. One point, however, is evident, that it appears very early in the development of the freshwater Rhizopoda, sponge-cell, &c.; and another, that it bears a close analogy to a similar organ in the vegetable cell, viz. the

* Ann. and Mag. Nat. Hist. vol. ix. p. 474 & 477.

† Die Infusionsthiere, &c. Taf. 4. fig. 24. 4to, Leipzig, 1854.

‡ Ann. and Mag. Nat. Hist. vol. xvii. p. 101, 1856.

cytoblast, which also is the primary organ of this cell; and therefore, perhaps, we might term it the presiding organ, or consider that such are its primary offices over the development and life of these cells respectively. If we trace it from the Rhizopoda into the vegetable kingdom, we shall find it occupying the very same position relatively in *Amœba* that it does in the cell of *Serpicula verticillata**. Thus, in some Amœbous cells which settled down from their spherical into the plane reptant forms, the following sequence from without inwards was distinctly seen: viz. 1st, the pellicula and diaphane; 2ndly, the molecular sarcode bearing the nucleus, and a layer of greenish granules *externally*; 3rdly, the aqueous fluid of the centre (figs. 1, 2);—and in the spine-cell of the leaf of *Serpicula*—1st, the cellulose cell-wall; 2ndly, the molecular protoplasm, in which are imbedded the green granules (viz. cells or organisms in which part of the protoplasm bears chlorophyll) and the cytoblast; 3rdly, the aqueous fluid of the centre (figs. 63, 64). The difference between cellulose and pellicula, and the absence of the vesicula, &c. are points which have so little to do with the analogy in question when the latter is followed up through *Astasia, Euglena, Navicula, Closterium,* &c. into *Œdogonium,* and *Nitella* to *Serpicula,* that very little doubt will, I think, then remain, of the offices of the nucleus in *Amœba* being similar to those of the nucleus of the plant-cell, whatever these may hereafter prove to be.—Here, again, I would return for a moment to the cause of sphericity in *Amœba,* and submit whether the cavity containing the distending fluid is that of the vesicula or the centre of the sarcode; since the aqueous cavity of the vegetable cell may then be analogous to the vesicula; for, as before stated, I have never been able to succeed in detecting the vesicula in *Amœba* when under a spherical form; although, the moment it becomes plane and polymorphic, this organ reappears, of its usual size, and endowed with its usual activity.

Much, however, as the nucleus may at first appear to be a presiding organ, there can be no doubt, from what will presently be stated, that its ultimate destination, in some organisms at least, is to pass into granules which become new beings.

Ovules.—This term will be applied to a number of discoid, or globular, nucleated cells, which appear together in the sarcode of some of the Infusoria. At an early stage in *Spongilla, Amœba, Euglypha, Astasia,* and *Euglena,* these bodies consist of a transparent capsule, lined with a faint yellow film of semi-transparent matter, which, subsequently becoming more opake and yellowish, also

* This aquatic plant is selected for comparison because the circulatory movement is well marked in the cells which occupy the body of the leaf, and the cytoblast and protoplasm in the spine-cells of the margin.

becomes more marginated or distinct, and assumes a nucleolar form. In *Spongilla* there is also a delicate, pellicular layer, which is endowed with a low power of movement (figs. 39 *h*, 40 *a*).

I first noticed these ovules in the seed-like bodies of *Spongilla*, where they are enclosed in transparent globular sacs*, each sac holding a greater or less number of ovules, which are discoid in form, of different sizes, and accompanied by a great number of active molecular granules (figs. 37, 38); and during the past year I have frequently seen such in *Amœba Gleichenii*, where they have been equally numerous, have borne the same characters, and have been accompanied by a number of active molecular granules, as in the transparent globular cells of the capsules of *Spongilla* (fig. 5.) They occur also in *Euglypha alveolata*†, congregated round the hyaline capsule of the *nucleus*, from four to fifty in number, and mostly of the same size, but always globular, and accompanied also, as in *Spongilla*, by molecular granules (fig. 26). Such ovules may also be seen similarly situated in *Difflugia tricuspis* (H. J. C.) and in *Arcellina dentata* (Ehr.); enclosed in the latter in an ovoid capsule, which nearly fills the test. In *Actinophrys*, also, they appear to have been seen by M. Nicolet, as will be mentioned hereafter.

Astasia and *Euglena* constantly become filled with discoid cells of a similar kind, but in those of the former I have seldom been able to distinguish the capsule from the internal contents, on account of their smallness and the incessant motion of the animalcule (fig. 46). In *Euglena*, however, they are very evident, and it is worthy of remark that each partakes of the form of the *Euglena* to which it belongs (figs. 50, 58). Thus in *E. acus* it is long and cylindrical; in *E. viridis* oblong, compressed (fig. 59); in *Crumenula texta* and *Phacus* circular, compressed, &c.

In *Spongilla* and *Amœba* these ovules follow the motions of the sarcode, in which they appear to be loosely imbedded; they also undergo partial transposition in *Astasia* and *Euglena*, but in *Euglypha* and *Difflugia* are chiefly located round the globular hyaline capsule of the nucleus, at the posterior part of the body (fig. 28),—a position which it is well to remember; for although apparently unconnected in all, with the nucleus and its capsule, and diffused generally throughout the sarcode in *Spongilla*, *Amœba*, *Astasia*, and *Euglena*, yet in *Euglypha* and *Difflugia*, which we shall hereafter find the best for typical

* Ann. and Mag. Nat. Hist. vol. iv. p. 87, 1849. Of the formation of the seed-like body, I need not say more here, than that it consists of a capsuled aggregation of ovule-bearing sponge-cells; while *Amœba* presents the same appearance, when pregnant with ovules, as one of these cells, and becomes capsuled singly.

† Dujardin, Hist. Nat. des Zoophytes, Atlas, tab. 2. fig. 9.

reference, they are undoubtedly developed in the neighbourhood of the nucleus, and therefore confined at first to a particular part of the body.

In many of Ehrenberg's enterodelous Infusoria it is not uncommon to see a number of defined globular bodies, of nearly equal size, and of a faint, opake, yellow colour, which closely resemble ovules,—*ex. gr. Amphileptus fasciola* (Ehr.), *Himantophorus Charon* (Ehr.), &c.; nor is it improbable that many of his Trachelina, which come near *Planaria*, possess ovules similar to those which are found in the latter; but, from being so much mixed up with the spherical cells, pass equally unnoticed while in, as well as when out of the body, under such circumstances. M. J. Haime, however, has distinctly seen instances in which these bodies have been ejected from Infusoria, and have passed into locomotive animalcules under his eye. Thus he states that in *Plœsconia* they form a group of from forty to fifty in the middle of the body, are round, issue one by one, remain tranquil some time, then develope two filaments, one in front, the other behind, and move about rapidly. In an "undescribed" species of *Dileptus* they are whitish, and form a wreath, extending almost throughout the whole length of the body, become yellow towards the anal extremity, where they pass out with the remains of the food, soon develope two opposite filaments, and move about rapidly. In *Paramecium aurelia*, M. Haime states that an ovary appears some hours before death, about the middle of the body, which becomes filled with about sixty little nuclei; these increase in size, burst the ovisac, and thus pass into the body of the parent, from which they finally escape by an opening in the tegumentary covering, formed by the diffluence of the latter, and the ovisac follows them *.

Spermatozoids.—This term is provisionally applied to granules which are originally developed from the nucleus in *Amœba, Euglypha*, and *Spongilla* (?). In *Amœba* the process appears to commence by an increase of size in the capsule of the nucleus, which becomes more or less globular; at the same time the nucleus itself becomes uniformly granular; the latter then increases in size, so as to occupy a third of the interior of the animalcule, and then undergoes, apparently, duplicative subdivision, for the mass is sometimes seen to present a *single* groove, which passes through the centre, and ultimately becomes divided up into several segments. These segments assume a circular compressed or globular form, and continue entire until the granules or spermatozoids of which they are composed become fully developed, when the latter acquire the power of locomotion, and

* Ann. des Sc. Nat. Zool. t. xix. p. 131, foot-note, 1853.

thus separate from each other; meanwhile the original capsule of the nucleus for the most part disappears (figs. 10–15). In this way, some individuals out of a group of *Amœba radiosa*, bearing such granules, were seen moving about, even when so reduced that hardly anything but their cell-wall, and the one or two spherical segments of the granulated nucleus that remained in its interior, were left; upon being delivered of which it may be presumed that they became effete or died (fig. 14). Sometimes these segments are evidently held together by a soft mucous cell, which, being polymorphic, assumes the form of *Actinophrys*, and thus exhibits a locomotive power (fig. 16); while at others the cell becomes firm, transparent, and spherical, and the granules do not leave it until they become endowed with locomotion (fig. 15). When the latter is the case, the spermatozoids may be seen, if fully developed, to be bounding about their respective capsules, while the capsules themselves are still rolled on in the sarcode of the *Amœba* under progression. At other times the whole mass of spermatozoids, all separated, and having left their capsules, may be seen to fill the body of the *Amœba*, whilst still under active polymorphism and locomotion. Lastly, the parent sometimes dies in this state, and then the mass of spermatozoids may be seen to undergo gradual disintegration, as the granules, by twos and threes, or more, disentangle themselves from the sarcode, and bound off into their new element. These granules or spermatozoids in *Euglypha* average about $\frac{1}{10000}$ to $\frac{1}{12000}$ of an inch in diameter; about four of them would make the diameter of the largest ovules, which are, again, somewhat less than human blood-globules.

In *Euglypha alveolata* a similar development takes place round the anterior part of the capsule of the nucleus (fig. 29); but from the concealed position of the latter, I have not been able to see it distinctly originate in the nucleus, as in *Amœba*. The segments here have always been compressed, probably from the soft polymorphic state of the mucous cell which encloses them admitting of their assuming a plane or reptant actinophorous form (fig. 31); and in this way they are carried out of the *Euglypha*, which, like *Amœba*, perishing on their development, and passing into decomposition, thus allows them to quit the parent cavity; at other times they separate close to the hyaline capsule of the nucleus, and finally swarm about in the test generally (fig. 29). Although this development, as well as that of the ovules, takes place more profusely in different individuals than in the same one, yet it is by no means uncommon to see, in a group of ovule-bearing *Euglyphæ alveolatæ*, individuals with both developments in them at once (fig. 30); and with no gradation in the size of the ovules to indicate that they originated in the granules, or *vice versâ*,—the two developments thus appearing distinct: and this seems to be confirmed by what takes place in a larger variety of this species of *Euglypha*, where there is a test something like that of the parent developed in the interior, and within this a spherical capsule, provided with a straight tube, which extends to the pointed end of the test in which it is immediately enclosed (fig. 32). At this time the animal has entirely disappeared, and the contents of the spherical capsule, having undergone segmentation, assume the form of circular masses of granules, like those developed from the nucleus in *E. alveolata*; after which the granules separate, and pass out of the straight tube, which is slightly patulous at its free extremity (fig. 33). Other tests of the same variety may be seen more or less filled with ovules, as before described.

Lastly, in *Spongilla*, there are always many cells to be found in that part of the mass where the seed-like bodies are being developed, partly filled with similar granules, loose or in a circumscribed group; but I have not yet been able to determine whether this development is nucleolar, or ovular at an early stage. It is certainly most like the granular development of the nucleus in *Euglypha* and *Amœba*.

In *Astasia*, irregular globular botryoidal masses, dividing up into spherical cells, colourless and translucent, or of a faint, opake, yellow tint, present themselves so frequently (and generally inversely developed with the ovules, as in the Rhizopoda), that I cannot help thinking that they are also developments from the nucleus (figs. 47, 48); but from not having seen them present that evident granular aspect which characterizes this development in the Rhizopoda, I have not been able to determine satisfactorily whether they are parts of the latter, or that kind of division of the sarcode into green spherical cells which sometimes takes place in *Euglena*.

In *Euglena*, also, I have described a development of the nucleus, partly under the idea that it might be a parasitic rhizopodous development; but now it appears to me to be a simple enlargement, granulation and segmental development of this body into polymorphic, reptant, mucous cells, filled with spermatozoid granules, as in the Rhizopoda*.

Finally: from what organs, in the freshwater Rhizopoda, *Astasia* and *Euglena*, are the ovules and the spermatozoid granules developed?

Of the origin of the latter from the nucleus there appears to me to be no doubt; for independently of the changes taking place in it which have been mentioned, I have never been able

* Ann. & Mag. Nat. Hist. vol. xvii. p. 115, 1856.

to see the nucleus and its capsule in their original form when the spermatozoid mass has been present, though I have occasionally, in *Amœba*, and almost always in *Euglypha*, seen the empty globular capsule in connexion with the latter. In *Amœba*, before the spheroidal divisions of the nucleus have separated from each other, they frequently appear in the form of a botryoidal mass, projecting from one part of the capsule.

But, as regards the ovules, although they are also unquestionably developed around the globular capsule of the nucleus in *Euglypha*, yet the fact of their being developed throughout the greater part of the sarcode which lines the cell of *Euglena*, and the same in *Astasia*, which is closely allied to *Amœba*, while in the latter they appear also to be developed from the sarcode generally, seems to indicate that they are developments of some part or parts of the sarcode—perhaps of some of the moleculæ. That the two developments, viz. that of the ovules and spermatozoid granules, present themselves together in *Euglypha*, has already been stated, and the fact of the ovules in *Euglena* first becoming developed outside the capsule of the nucleus, and the granular development of this body following it, shows that the ovules are not developed from the nucleus. The capsule, therefore, in *Euglypha*, under these circumstances, as well as when there are ovules alone present, is often seen minus the nucleus; and the same in *Amœba Gleichenii*, where it may be observed rolling about with the ovules when the latter have, for the most part, reached their largest size (fig. 5). In these instances, too, the granules of the nucleus, if the latter has undergone this transformation, may be dispersed among the general mass, as the nucleus on such occasions has, if not absent, appeared faintly marked, probably from having become effete or atrophied,—the ovules and spermatozoids appearing to be inversely developed; and in *Astasia* and *Euglena*, the former to be destroyed on the development of the latter.

Nicolet has stated that in *Actinophrys* the generative organs consist of a central spherical membrane, enclosing little globules, which are the rudiments of "eggs," surrounded by a "gelatinous granular layer," the granules of which appear to be the reproductive organs*. But this simple statement, though bearing the semblance of fact, is too meagre, without illustrations, to be of any use. If his "spherical membrane" be the same as our capsule of the nucleus, after the latter has become globular, then certainly the ovules are not contained in it in *Euglypha*. Stein also figures the nucleus of his *Actinophrys oculata* in accordance with Nicolet's observations, viz. with a granulated

* Comptes Rendus, vol. xvi. p. 115, 1848.

nucleus, fixed in a spherical capsule, surrounded by a zone of granular plasma (?) (fig. 95)*. This, as will be seen hereafter, is very like the state of the nucleus in the rhizopodous cell of the protoplasm of the Characeæ, when the former is undergoing reproduction.

With reference to the organs of generation in the other Infusoria, I can state no more than that although there is a fusiform nucleus in *Otostoma*, I have also constantly seen a bunch of string-like filaments floating about its interior, which appeared to be attached near the buccal cavity; and although I could make out nothing more, I could at the same time only liken these to the generative apparatus in the *Planaria* mentioned, which floats round the buccal cavity and upper part of the membranous stomach in a similar manner.

Impregnation.—In *Amœba* and in *Actinophrys* a union of two individuals is not uncommon, and many have noticed this in the latter. It has occurred to me, also, to see it in a species of *Amœba*, which, from its circular form, and the prolongations only taking place from one point of the circumference, appeared thus to present an anterior extremity, by which several pairs of the group were united (Plate V. fig. 17); and on one occasion two separated under my eye, when an attenuated prolongation of one seemed to be drawn out through a thick prolonged portion of the other (fig. 18). More convincingly and frequently, however, this union was observed in a group of *Euglypha*, where the anterior extremity of the body is distinct (figs. 34, 36). Here the protruded parts, after having been united for some time, began to separate by constriction at the point of contact, which, soon diminishing to a mere mucous thread, became smaller and smaller, and more elongated, as the two individuals, retreating from each other, withdrew themselves into the bottom of their test respectively, from which they appear on such occasions never again to emerge. Lastly, in a group of *Euglena deses*, several couples appeared united by the tails, not only to one another, but fixed to the watch-glass at this point, where they continued until each sank down, close to the other or separate, into capsuled forms filled with ovules,—a state which appeared so much the more to be the result of impregnation, from the number of couples thus united presenting every stage of ovigerous development in their interior, from mere molecular sarcode to repletion with full-formed ovules (figs. 49, 52). It is not an uncommon thing to see, among a group of *Euglenæ agiles* (H. J. C.), individuals chasing each other, becoming united head to head, head and tail, or tail to tail, and then separating with difficulty by a

* *Op. cit.* tab. 5. figs. 25–28.

whirling motion, as if the bond of union were a mucous thread, which could be only twisted off in this manner. Two *Euglenæ virides* may also sometimes be seen united by the intertwisting of their filaments only, just like the congress of two snails.

All these unions appear very much like so many acts of conjugation; but when we find *Euglypha* as well as *Arcella* united, not only in pairs, but triply and quadruply, in this way, and the same with *Euglena viridis*, the connexion of these phænomena with reproduction, as Claparède has stated *, becomes "exceedingly doubtful;" particularly as we have seen the spermatozoid granules developed from the nucleus and among the ovules; and this granular spermatozoid development, if it be one, does not take place until after conjugation. At the same time, in one group of *Euglyphæ*, nothing but spermatozoids were developed, while in another hardly anything but ovules appeared; and it was only here and there that both were found together; again, in the larger variety of *Euglypha*, the granules were developed in a distinct apparatus, and the ovules in the same manner as in *E. alveolata*, viz. in the posterior part of the body, outside the capsule of the nucleus.

Lastly, we come to the question whether or not these granules are spermatozoids? That the ovules in *Spongilla* pass into polymorphic cells, I proved by experiment some years since†; and lately, I have repeated similar experiments, with the same results. Moreover, I have seen the ovule of *Euglypha* in every stage, from its first appearance in the test to the time when it has acquired the power of putting forth rhizopodous prolongations (fig. 31), after which the tests of very small *Euglyphæ* presented themselves in the same basin, which did not appear before the parents had died off and left their ovules to shift for themselves. Hence this is one mode of propagation among the Rhizopoda, whatever the granules which we have provisionally called spermatozoids may be. Then, also, it has often occurred to me to see circular groups of spermatozoids undergoing disintegration or dehiscence in the test of *Euglypha*, while ovules were present, and granules like the former swarming round the latter at the same time; as well as granules of the same kind in *Amœba Gleichenii*, where the ovules have been far advanced in development. In *Spongilla* also similar granules abound in the transparent globular sacs of the capsules which contain the ovules (figs. 37, 38); and when the latter are set free by forcibly bursting the former, these little granules crowd round the large ovules so markedly that I made this observation several years since‡, when I little

* Ann. & Mag. Nat. Hist. vol. xv. p. 286, 1855.
† Idem, *loc. cit.*
‡ Idem, *loc. cit.*

thought that there was any reason for thinking them organs of impregnation. Lately, however, I have observed, that full half the larger ovules of the seed-like body, under this condition, have one of these granules in different degrees of connexion with them, from simple approximation to almost undistinguishable incorporation (fig. 39 *a'–e*) ; also that when the internal contents granulate on the third or fourth day after they have been set free, the prominence caused by the appended granule does not disappear until the whole ovule has passed into a polymorphic cell (*h, l*) ; that is, that after this, no capsule or anything else remains behind, to indicate that the granule and its capsule, with this prominence, have not wholly become transformed into the new sponge-cell. This granule, however, is not entirely confined to the larger ovules, where it is for the most part affixed to the margin, but is also presented here and there by many of the small ones. In the larger ovules it bears, in size, the proportion of about one to eight, and the largest ovules average about $\frac{1}{3000}$th of an inch in diameter. About twelve hours after the ovules and granules have been set free in the manner mentioned, into distilled water, in a watch-glass, they, as well as the granules, exhibit a great deal of motion, which lasts up to the end of the first day, when they become quiet again; and this motion, though least in the largest ovules and most in the smallest granules, is generally from one side to the other in all, like that of a zoospore which is attached to the glass by one of its cilia, or of a monad, which possesses a polymorphic coat attached to some body, and a moving single cilium. Some of the granules, however, every now and then appear to break away from this attachment, and then present a single (?) ciliary appendage, which ceases to be visible again the moment they become fixed. All the ovules, both those with which a granule is connected, and those without, appear to undergo a like granulation of their internal contents, and pass into new sponge-cells (*i, k, l*), which for a day or two remain polymorphic and reptant, and then assume a spherical actinophorous form; while there is also a development of single (?) ciliated monads, closely resembling those which are found in the fully-developed sponge (*m*). In their reptant state, also, the former present the vesicula and frequently a single cilium.

Under what circumstances we are to view the incorporation of this granule with the sponge-ovule, I am ignorant*. Certain it

* It is just possible that these granules may be buds like those which appear on the so-called "ferment-cells" (fig. 44), but the latter grow into new cells as large as the old ones before they are detached, if even this takes place then, which is not the case with the granule attached to the sponge-ovule. Again, the ferment-cells are chiefly seen in pairs, from the bud in many having increased to nearly the size of the parent, while the sponge-

is, that one of these granules, which at first hardly appears to differ from the ovule itself, except in size and the addition, perhaps, of a single cilium, may frequently be seen to exhibit movements about a large ovule indicative of a desire to become incorporated with it; and frequently, also, it seems to succeed in fixing itself permanently to its circumference, before the eye; while occasionally a monociliated granule may be seen to be appended to one of the sponge-cells thus newly developed, in the same manner that the "zoosperm" attaches itself to similar cells in the old sponge (fig. 43).

In the absence, then, of direct evidence respecting the ultimate destination of these bodies, we must infer that they are germs, which grow into new individuals (perhaps like microgonidia*), or that they are impregnating agents, which enter into the ovules, and thus render them capable of further development, or both. Analogy, in connexion with the facts mentioned, seems to favour the latter view; for when we observe the development of the ovules, and these spheroidal or discoid segments of the granulated nucleus, which are of about the same diameter as the ovules, occurring together in the same *Euglypha*; and one cell, viz. that of the ovule, remaining entire, while the contents of the other, viz. the spheroidal segment of the nucleus, has apparently divided up into a number of locomotive granules, —the process so far accords with what takes place in higher organic developments during the process of true generation that we become much induced to extend the analogy still further; and consider that the contents of some of the spermatozoid granules or smaller cells go into this larger one to complete it, in the families of Rhizopoda, &c. mentioned. The monociliated cells ("zoosperms" †) of *Spongilla* might, perhaps, by some be considered young sponge-cells, which lose their cilium on further development; for such is the course with the monads which are produced from the rhizopodous cells of the protoplasm of the

ovules do not appear in this state. It is only when the buds of the ferment-cells are very small, that there is any direct resemblance between them and the sponge-ovules presenting a similar condition. If the granule in connexion with the sponge-ovule be a bud, it must be detached from the parent when very young, for there are no intermediate stages as in the ferment-cell to show that it is in reality one.

Again, the oscillation of the granule round the sponge-ovule may be a physical attraction; this oscillation, however, does not present itself among the ferment-cells, while in the sponge-ovule it appears to end frequently in a permanent attachment of the granule to the ovule,—a condition that may be aided by the "external layer" or diaphane envelope of the latter.

* See Braun on the reproduction of *Hydrodictyon*. Ray Soc. Pub. Bot. and Phys. Mems. pp. 89 & 261.

† Ann. and Mag. Nat. Hist. vol. xiv. p. 334.

Characeæ before they pass into *Amœbæ*; while the number of the former being as great in the first portion of sponge which issues from the capsule as in the older mass, if not more so, seems not only to support this view, but also that they do not all form part of the surface-layer of the canals in which cilia have been detected by Mr. Bowerbank, for at this period there are no canals present. The facts above mentioned, however, are opposed to this view; for there is a marked difference between the reptant sponge-cells produced from the ovules in the watch-glass, and the monociliated ones developed from the granules, both in size and appearance (*l*, *m*); and although the cilium subsequently seen in the former may have pre-existed in the ovule, still, both being polymorphic, rhizopodous cells, and, therefore, when united undistinguishable individually, the cilium might belong to either, *i. e.* to the sponge-cell or to the incorporated granule,—the latter of which may frequently be verified when examining a piece of *Spongilla* torn to pieces, under the microscope (fig. 43). Whether or not, however, both possess a cilium at first, the sponge-cell loses it afterwards, whatever may happen to that of the supposed zoosperm, which may not become incorporated with one; and this may be the case with the monads which are produced from the rhizopodous cell of the Characeæ,—there may be two kinds.

Should it be hereafter proved that the granules of the nucleus thus become impregnating agents, then this mode of generation may perhaps be extended through *Euglena* to *Navicula*, *Closterium*, *Spirogyra*, *Œdogonium*, and *Cladophora*; for in none of these Algæ has anything approaching to a process of generation been detected beyond conjugation and the formation of the spore; while, indeed, in *Spirogyra mirabile* (Hass.), *Œdogonium*, and *Cladophora*, the spore is formed without conjugation.—Might not the granulation of the nucleus, &c. go on in the spore?

In *Cladophora* the gonimic substance consists of nucleated cells, each containing a portion of green chlorophyll-bearing protoplasm, and these are arranged in the way of a pavement on the inner side of the cell; hence we must consider *Cladophora* a composite Alga, which would then form the first step to the cell of *Nitella*, in which the green chlorophyll-bearing cells would correspond to the same kind of organisms in the cell of *Cladophora*; but as the form of *Nitella* is more complicated, so it requires distinct organs of reproduction for its general development. That the conjectured mode of generation mentioned in the freshwater Rhizopoda may be the same as in the lower Algæ, and that the addition of other and distinct organs for this purpose in the higher developments is a necessary sequence of their complication, are observations merely put forth for what they may prove worth. At the same time, it appears evident that each organ must have its proper cell, and this cell its proper mode of impregnative reproduction, just as much as the most complicated beings of which it forms a part; while the granulating of the nucleus of a cell to furnish fertilizing germs for the process of generation, when a simple division of it only is required for common reproduction, is perhaps not the least untenable view that may be held on the subject.

In *Physactis saccata*, Kg., the spherical, terminal cell of the snake-like filaments is filled or lined with a homogeneous, translucent substance, in one part of the circumference of which is a nucleus, and this part is invariably next the last granuliferous cell of the filament (fig. 70 *b*), which with the four or five following ones unite together to form the elongated club-shaped sporangium (fig. 71). When the sporangium is completed, the spherical cell is seen to be united to it by a kind of neck, but the nucleus and its homogeneous contents have disappeared, that is, have passed into the sporangium (fig. 71 *a*). While here and there may be seen spherical cells unattached to (probably separated from) their filaments, some of which have a granular substance growing out in a linear form from the *nucleus* (figs. 72, 73). Hence then, as we have the *nucleus* of the spherical cell applied to the terminal cell of the granuliferous chain, a tubular prolongation connecting it with the sporangium, the disappearance of the nucleus and other contents of the spherical cell after the formation of the sporangium, together with a granular growth from the *nucleus* of this cell when the sporangium is in process of formation, I think it may fairly be inferred, that the chief part which the spherical cell adds to the sporangium is this granular growth from its *nucleus*.

Development of the Ovule.—In *Spongilla* and *Euglypha*, this appears to take place by the passing of the transparent, faint-yellow film, which lines the interior of the capsule, into an opake, yellowish, granuliferous membrane; synchronously with which it becomes more marginated towards the capsule, and presents, in the centre, a pellucid area, in the middle of which, again, is a minute granule or body, which appears to be the rudiment of the nucleus (fig. 59). Frequently, also, another layer, as before stated, is seen in the ovules of *Spongilla* external to the capsular one, and this appears to be endowed with locomotive power, as it generally presents a parabolical shape, extended out from one side of the ovule (fig. 40 *a*); after which the ovule in each becomes transformed, apparently wholly, into a polymorphic, reptant Rhizopod (fig. 39 *i*, *k*). The same process, modified, appears to take place in the ovules of *Euglena*. Thus in *E. viridis*, where they are of an oblong shape (and therefore unmistakeable, if nothing but a legion of this species pregnant with ovules be present), they are found like the ovules of *Spongilla*, viz. scattered over the sides of the vessel, and evidently have, in like manner, the power of locomotion in addition to that which both also possess of turning upon their long axis when otherwise stationary. This, perhaps, may be partly effected by the external membrane just mentioned. The pellucid central area in the oblong ovules of *E. viridis* corresponds with the oblong shape of the capsule (fig. 59); but beyond this, and the central granule, I have not been able to follow their development out of the parent; though, from the number of young *E. virides* which present themselves under the circumstances mentioned, it may reasonably be inferred that they come from the ovules. The young *Euglenæ*, however, being so rapid in their movements when once the cilium is formed, it can hardly be expected that, except under a state of incarceration, their development can be followed so satisfactorily as that of the slow-moving Rhizopod. Instances do occur, however, where the ovules gain the cilium within the cell, and there bound about, when fully developed, like the zoospores of Algæ within their spore-capsules. In this way I have seen them moving rapidly within the effete transparent capsuled body of *E. viridis* and in *Crumenula texta*, where the spiral fibre layer is so strongly developed as to retain the form of the *Euglena* for a long time after all the soft parts have perished. On these occasions the embryos are perfectly colourless, with the exception of a central point, which reflects a red tint; and on one occasion, while watching a litter in rapid motion within the capsuled body of *E. viridis,* the capsule gave way, and they came out one after another just as zoospores escape from the spore-capsule; but from their incessant and vigorous movement I was unable to follow them long enough to make out anything more about them. Kölliker also noticed in *Euglena* "four to six embryos in one individual, and entirely filling it, which at last, furnished with their red points and cilia, broke through their parent, leaving it an empty case*." The same kind of development of the ovule probably takes place in all the Rhizopoda as in *Spongilla,* and in *Astasia* as in *Euglena*. I have seen young *Astasiæ* in the effete body of an old one, but could not say that the latter was the parent.

To Stein's original and valuable observations on the development of embryos, arising from the division of the nucleus in *Vorticellæ,* I have already alluded; and also to M. Jules Haime's statements regarding the ovules which he saw in the bodies of

* Quart. Journ. Microscop. Sc. vol. i. p. 31, 1853.

Plæsconia, *Dileptus*, and *Paramecium aurelia*. Neither, however, appears to have seen ovules in either of these Infusoria sufficiently distinct to describe their composition in detail.

Lastly, I would advert here to the rhizopodous forms which *Vorticella* occasionally appears to assume when under gemmiparous reproduction. Stein has described it in *Acineta*, and I have since observed it in a Rhizopod undistinguishable from *Amœba Gleichenii*; I have also seen *Vorticellæ* developed *singly* from *Acineta*; and am now compelled to return to the conclusion which I doubted formerly, viz. that the rhizopodous development which takes place in *Euglena* is a similar passage of the nucleus, and perhaps certain other contents of this Infusorium, into a rhizopodous form*. It appears to be as general in the family of *Euglena* as in that of *Vorticella*; and although these two organisms at first look very different, yet not only is their metamorphosis into rhizopodous forms similar, but the sudden contractile movement at intervals of a species of *Glenodinium* (Ehr., very nearly the same as *G. tabulatum*) is so like that of *Vorticella*, and *Glenodinium* is so closely allied to *Euglena*, that we cannot help seeing in this act alone a feature which links together *Euglena* and *Vorticella*,—if not also, with other points of resemblance, the biphorous Tunicata or Salpidæ.

Hence then, as *Vorticella* may pass into *Acineta* or *Amœba*, and *Euglena* also into a rhizopodous cell, and the former may in its metamorphosis produce young *Vorticellæ*, so perhaps *Euglenæ* may produce young *Euglenæ* after a similar manner.

How, then, are we to regard this granulating development of the nucleus? We have seen that it occurs in *Euglypha*, where also there is a distinct development of ovules. Are we to regard it as the flowering of a diœcious male plant, or as the budding of a monœcious or bisexual flowering one,—as the impregnating element, or as a reproductive gemmiparous one? We can hardly consider it budding or gemmiparous, because it is a development of the nucleus itself, which allies it more to fissiparous or duplicative subdivision; and if this cannot be determined, perhaps it

* This was the original view I took of it. I then conceived it to be a foreign development, like the rhizopodous cell of the Characeæ, for it took place in several *Crumenulæ*, which had respectively been enwrapped for a short time in rhizopodous cells, when I thought the germs of the new development might have been introduced into them. Still I wavered in my opinion, as may be seen in the latter part of my description of this (Ann. and Mag. Nat. Hist. vol. xvii. p. 115), and since then I have returned to the old view, which is that above expressed; for independently of other evidence in favour of it, *Euglena* would be an exception to what now seems to be a general occurrence in organisms closely allied to it, that is, if we considered this granular metamorphosis of the nucleus into polymorphic, rhizopodous bodies, a foreign development.

had better be called "granulation." Gemmæ grow out from the surface, and do not appear to contain any portion of the nucleus (*ex. gr. Vorticellæ*)*; neither could I discover an elongated nucleus, as Stein has figured, in the *Amœbæ* and *Acinetæ* which I saw developing young *Vorticellæ*, the former in plurality (one to three), and the latter singly; if present in the amœbous form, it was circular, and if in the *Acinetæ*, undistinguishable from the general "granulation."

Again,—Where are these transformations to end? Into what kind of rhizopods do the *sheathed Vorticellæ* pass? How many of the freshwater Rhizopoda are alternating forms of *Vorticellæ*? How many actinophorous Rhizopods those of *Euglenæ*? How many more Infusoria pass into amœbous forms? &c. are questions originating in Stein's important discovery, which not only indicate the necessity of further investigation, but a considerable approaching change in the classification of Infusoria.

It is desirable, also, that I should add here what little more I have been able to collect respecting the development of the Monads in the rhizopodous cell, which dwells and multiplies in the protoplasm of the Characeæ †. This, it will be remembered, I conjectured to be by segmentation of parts of the diaphane and sarcode; but before making any further observations on the subject here, I will again premise a brief description of this cell. It is distinctly a Rhizopod, like *Amœba*, or the sponge-cell, but of greater tenuity, and without, so far as my observation extends, a vesicula; that is, I have not been able to recognize this organ in it, though on dying it presents vacuoles. The nucleus, as before stated, is clear at first, then becomes cloudy, and presents one or more defined granules, afterwards semi-granular and opake, and then uniformly granular throughout, when it appears to multiply by fissiparation in the parent cell, and thus to give rise to several daughter-cells, after the manner of a vegetable cytoblast; or to grow into an elongated granular body, of whose ultimate development, while within the living internode of the Characeæ, I am ignorant (fig. 93). But when the internode of *Nitella* (*ex. gr.*) is about to die, and this rhizopod seizes upon the green disks of the periphery and other nutritious matters of the interior, now deprived of the vitality which kept them together and thus exposed to the rapacity of the ascendant parasite, the nucleus undergoes various changes, which arrests of development at different stages, among the myriads which are

* A similar process takes place in the roots of *Chara*, where the new nuclei for the new buds come into existence in the protoplasm surrounding the old nucleus, but at some little distance from it, after which the old nucleus perishes.

† Ann. and Mag. Nat. Hist. vols. xvi. p. 10, & xvii. p. 115.

presented to view, seem to elucidate. Thus the nucleus with its capsule, now surrounded by the nutritive contents enclosed within the sarcode, enlarges and passes from its discoid form (elliptical in the large *Nitella*) into a globular one*: meanwhile the former becomes distinctly and uniformly granular; the granules enlarge and become refractive; they assume, *en masse*, a spheroidal form enclosed within a cell of their own, and thus become distinct from the capsule; at the same time one or more refractive (oil?) globules, or a nucleus, may sometimes be seen in the latter. While this is going on, a zone of colourless plasma (?) forms all round the capsule of the nucleus, which thus becomes separated from contact with the now hardened cell-wall or pellicula, as well as from the diaphane and sarcode (fig. 94). The next stage is the bursting of the proper cell, and passage of the granules of the nucleus into its capsule, and from thence into the soft plasmic zone which surrounds it. After this, the plasma assumes a mulberry shape, and divides up into monads, which feed upon the enclosed nutritive matters, and are at length seen in the position of the sarcode and diaphane, now circumscribed by a transparent delicate membrane, the second pellicular cyst†. That the refractive granules of the nucleus, and portions of the enclosed nutritive contents, which are coloured brown by the dead chlorophyll, get into the bodies of the monads, cannot be doubted, as such matters are seen in them, and could come from no other source. Frequently, however, cells may be seen, apparently under an arrest of development, in which the plasmic zone has assumed a subtuberculated or mulberry form, and the granules of the nucleus are still in their globular cell within the capsule; hence it may be inferred that the segmentation of the plasma commences before the granules of the nucleus get into it (fig. 96). Again, in a more advanced but still arrested stage, the capsule of the nucleus is seen to be empty, and its bright granules, in the little pouches or mulberry-shaped excrescences of the plasma, now reduced to a mere membrane by arrest of development (figs. 97, 98). From which it may also be inferred that each pouch, which represents a monad, receives one or more of the granules of the nucleus. Does the tuberculated or mulberry

* I must infer this, because the nuclei in the large species of *Nitella*, as well as in *Chara verticillata*, are all elliptical.

† Is this degenerated pellicula and diaphane, or a new cyst, composed of the former only? I am now inclined to the latter theory, here as well as in *Otostoma* (Ann. and Mag. Nat. Hist. vol. xvi. p. 108 & xvii. p. 118 respectively), and that in *Otostoma* the ciliated coat is divided up for the new litter, while in the rhizopodous cell of the Characeæ the diaphane and secreting organ of the pellicular cysts become effete and pass into dissolution. (See the discussion on this point *ante*, pp. 117, 118.)

surface of the plasmic zone, thus under an arrest of development, indicate that it has taken this shape from consisting originally of a number of ovules enclosed within a globular membrane; and if so, is the passage of the granules of the nucleus into them to be considered an act of impregnation? If they were ovules, then one would think that there would be no occasion to lay up extraneous nutrition for them, more than in *Euglypha*, *Spongilla*, &c., the ovules of which, after the parent perishes, remain for a certain time in the effete body, and ultimately undergo a kind of incubation generally after they have left the cavity in which they were developed. Again, though very much like the granulating of the nucleus in *Euglypha* and *Amœba*, where the bodies which are thus evolved singly or in groups generally become endowed with active locomotive power before they leave the parent; yet in these instances no plasmic zone around the nucleus preparatory to this has been observed*. In the present stage of our knowledge, therefore, we are not able to say whether this be a gemmiparous or a generative process; whether monads developed in this way are merely multiplied zoosperms of this organism, or the mixed product of a genuine generative process; whether there be, in addition, an ovular development, as in *Euglypha*, &c.; or whether the monads thus developed soon perish, or become new cells. Certainly in *Spongilla* there are two kinds of developments, viz. the so-called zoospores or monads, and the transformation of the ovules directly into the sponge-cell: both are polymorphic, and at first have each (?) a single cilium; but one being much smaller than the other, they may perhaps be regarded respectively as macrogonidia and microgonidia, as Braun has suggested for the zoospores of *Hydrodictyon*†. From whence, then, come the so-called zoospores in the latter—from the granules or the nucleus?

Lastly, there are two organs in those *Euglenæ* (mihi, which for no just reason Dujardin has separated from this family), viz. *Phacus* (Ehr.) and *Crumenula texta* (Duj.), that I should notice here, though I am perfectly ignorant of their use. These are the so-called "red spot," which in *Crumenula texta*, where it is comparatively very large, rests in the form of a small obtuse cone upon the vesicula; and the glairy capsuled body, which always exists in the centre of *Phacus*, and in the long lip of *Crumenula texta*, &c.;—in some *Euglenæ* there is an undefined yellowish body here.

Of what use the "red spot" or body may be, I am ignorant; but it is very common to see matter like that of which

* *Actinophrys oculata* (Stein), however, presents a nucleus and plasmic zone of this kind. (See p. 228.)

† Ray Soc. Pub. Bot. and Phys. Mems. *loc. cit.*

it is composed multiplied throughout the body of *Euglena*, both in an amorphous and molecular form, or, when nothing but the ovules remain in the colourless, transparent, fibrous cells of the two species mentioned, to see little granules of it moving with a more than Brownonian motion among the ovules. Ehrenberg regarded it as the rudiment of a visual organ; and perhaps he is right, for there seems to be very little difference between the pigment of the skin of a Negro and the pigment of the choroid membrane of his eye, while the latter is confined to the eye alone in white-skinned people. Again, in some of the Rotifera, it is not uncommon to see the material of which the red pigment of the eye is composed, more or less dispersed in a molecular form, though it is generally confronted by a bluish refractive matter, corresponding perhaps to the vitreous humour and lens. Also, in the so-called blind *Planaria*, there are organs like eyes with flat corneæ, but no pigment; and when the animal is about to divide into two across the stomach, the first indication appears to be an inversion of the integument which is to form the future eye, and at the same time a covering of it with cuticle, which thus supplies the cornea. Finally, then, as we find in the Albino eyes capable of seeing without the presence of pigment; the eye formed by an induplication of the skin; the pigment dispersed over the body, as well as in the eye, in the Negro, while it is confined to the eye in the white races,—we are led to the conclusion that the red body in the family of *Euglena*, though not necessarily indicating sight, may nevertheless mark the point where something of this nature exists in this, as well as in other Infusoria of the kind, although, as in *Astasia*, it is not similarly marked, any more than in many animals wherein a visual organ is present without this accompaniment.

In a small species of *Euglena*, which dwells in the brackish water of the main-drain of Bombay, and which, after having been placed in fresh water, assumes the still, Protococcus form, multiplying itself by fissiparation and internal segmentation of the sarcode, after the manner of vegetable cells, and occasionally in linear arrangement, like the filamentous Algæ,—the red body is as often omitted as repeated in each cell; while in the active state, previous to *longitudinal* deduplication, the red body always becomes dual, one on each side the vesicula. But in transverse fission it is frequently absent in the lower half, and only remains in the longitudinal divisions of the *anterior* one (fig. 62 *a–d*). It is interesting, too, to observe that this body is present in the gonidia of *Ulothrix zonata*, one of the filamentous Algæ, and that it also is confined to the first cell in fissiparation, which so far corresponds with *Euglena*, that when the latter assumes a fixed or algoid form, by capsulation, the peduncle of the pellicula is extended from the anterior, ciliated extremity. This also is the part which developes the root-like prolongations in *Œdogonium*; and probably the gonidia of *Ulothrix* grow after the same manner; in which case the red body would remain in the inferior half, and not be repeated, as in *Euglena*, when the latter fissiparates, in the still form, transversely.

With reference to the single, glairy, capsuled body which exists in the centre of *Phacus*, and in the large lip of *Crumenula texta*, also dually in *Euglena geniculata* (Duj., *spirogyra*, Ehr.), one on each side the nucleus (figs. 53 *a*, 87 *a*, 88 *a*), I can state nothing further than that in the two first it consists of a discoid transparent capsule, which at an early stage appears to be filled with a refractive, oily-looking matter; that it is fixed in a particular position, and remains there apparently unaltered, with the exception of becoming nucleated, until every part of the animalcule has perished, and nothing is left but the spiral-fibre coat, and perhaps a few ovules. In *Euglena geniculata* it is bacilliform, and contains a correspondingly-shaped nucleus; and although I can state nothing respecting its uses, I cannot fail to see that it has an interesting analogy, particularly in the latter instance, with two similar organs, which are commonly seen in the *Naviculæ*, and which in *N. fulva*, *ex. gr.* are situated in a variable position, between the nucleus and the extremities on either side (fig. 89. In this species they make their appearance as little specks, generally previous to the development of the oil-globules, &c., and, enlarging rapidly, assume a globular form, consisting of a transparent capsule, enclosing a glairy, refractive, oily-looking fluid. As the starch and oil-globules are developed and subside, these glairy globules become distinctly nucleated, sometimes irregular in form, or pedicled to the endochrome-bearing protoplasm, and, like their apparent analogues in *Crumenula*, &c., remain in the frustule when everything else has become decomposed, or has passed into minute brown-red granules (sporules ?), when they present a central, glairy, circular nucleus, surrounded by a double globular capsule, neither of which, like the globule in *Crumenula*, takes any colouring from a solution of iodine. I need not here go further into the description of this organ in *Navicula*: suffice it to say, that it also appears constantly in a large species of *Amphiphora* common in the brackish water of the main-drain of Bombay, where it assumes the form, when fully developed, of an elliptical body, terminated at each end by a compressed, truncated, or obtuse elongation, like a barrel, and is always attached to the circumference of a vesicle (fig. 90 *a*, *a*). I should not have written so much about this organ here, but as it is not (as, I think, is generally supposed) a common oil-globule, and we know so little of the organology of the *Diatomeæ*, while its occurrence in *Navicula* seems to add to the other points of alliance which exist between the *Diatomeæ* and *Euglenæ*, its mention may not prove useless or uninteresting to those who are engaged in these studies. Perhaps for the present we had better call it the "glair-cell."

Here I should not omit to add, that the resting-spore or macrogonidium (Braun) of *Œdogonium* developes a number of capsules like the ovules of *Euglenæ*; and that though they occasionally exhibit, under the action of iodine, a blue tint, indicative of their amylaceous nature, yet when fresh and newly formed, they only take the brown-yellow one invariably presented by the ovules of *Euglena* under the same circumstances. Similar colourless capsules may also be seen moving about cells of *Œdogonium* whose contents have left their walls, and appear to have partially progressed towards that of the spore, without having had strength to assume the globular form; and these very much resemble the ovules of *Crumenula* when moving by the aid of a cilium within the effete transparent cell. All must allow, from what I have stated respecting the cell-contents of *Œdogonium flavescens* (Kg.), viz. that under favourable conditions, when the cell is broken, they can leave it bodily, form into a spore, and swim about by aid of their cilia, and that the germs of *Œdogonium* can pierce the sheath of *Oscillatoria princeps* (Kg.), and germinate between its cells, that these are phænomena of a kind much more common in the animal than in the vegetable kingdom.

In conclusion, I have only to remark, that the reader is requested to view all speculative suggestions in this summary of my "Notes" as mere cursory observations, introduced for the purpose of calling attention to subjects which are deemed worthy of consideration; the study of this part of organic creation being so much in its infancy, and so intricate, that hardly anything but that which has received ocular demonstration should be taken for *fact*.

P.S.—The following is a good illustration of what I have just stated. Since writing the above, I have seen numbers of "pores" in the investing membrane of *Spongilla*, open, remain so, and close; admit currents of water, as proved by the presence of particles of carmine; which particles were found to have been taken into the bodies of the sponge-cells and so-called "zoosperms," and afterwards thrown off again as the refuse of food by *Amœba*. This last fact establishes the animality of *Spongilla*. The "pores," at times, appear to be generally closed; hence the error of my having supposed this with a single vent to be the typical form of the investing membrane of *Spongilla*, and the consequent inference, that it was thus supported by endosmosis. I shall have to recur to these facts more particularly hereafter.

Bombay, 10th June 1856.

EXPLANATION OF PLATES V., VI., VII.

Plate V.

Fig. 1. Amœbous cell under spherical distension, about to become planiform, from the brackish water in the marshes of the island of Bombay; 1-400th of an inch in diameter: (*a*) pellicula and diaphane; (*b*) sarcode and granules; (*c*) space unoccupied by sarcode; (*d*) nucleus in its capsule.

Fig. 2. Section of ditto through the nucleus, showing the same parts marked with the same letters: (*c*) nucleus; (*d*) central cavity now distended by water.

Fig. 3. *Amœba quadrilineata*, H. J. C. (n. sp.?), under reptation: (*a*) diaphane; (*b*) moleculæ of sarcode; (*c*) vesicula; (*d*) nucleus and capsule; (*e*) digestive globule containing a fragment of *Oscillatoria*.

Fig. 4. *Amœba Roeselii* (?), Duj.: (*a*) "granules;" (*b*) vesicula; (*c*) nucleus.

Fig. 5. *Amœba Gleichenii* (?), Duj.: (*a*) discoid ovules of different sizes, the largest 1-2800th of an inch in diameter; (*b*) one more magnified showing the capsule; (*c*) "granules;" (*d*) portions of food; (*e*) capsule of nucleus empty; (*f*) vesicula. Animal about 1-400th of an inch in diameter when spherical.

Figs. 6–8. Ditto, becoming capsuled. 6. First stage, all extraneous matter thrown off, peduncle formed, but pellicula still admitting of (*b*) expansions; (*a*) ovules and granules. 7. Capsule too much hardened to admit of expansions of the diaphane. 8. Capsule formed, rough, yellow, about 1-300th of an inch in long diameter.

Fig. 9. *Euglena* (*viridis*, mihi), Ehr., encapsuled, capsule rough, of a yellowish-brown colour: (*a*) red-body next the peduncle.

Figs. 10–16. *Amœba radiosa* (?), Duj., showing nucleus in different stages of "granulation." 10. (*a*) nucleus enlarged, granular. 11. Nucleus still more enlarged, (12) presenting first sulcus of duplicative (?) subdivision. 13. Same process ending in the production of a mass of spherical, delicate, transparent, granuliferous cells. 14. Parent nearly effete with only two of the spherical cells remaining, the granules of which have become large, free, separated from each other and endowed with rapid locomotive power. 15. One of these cells more magnified. 16. Plane or actinophorous form of ditto previous to hardening of the pellicula and development of the granules.

Fig. 17. Ditto in conjunction.

Fig. 18. Ditto, another pair, just after separation.

Fig. 19. Actinophorous form of a species of *Palmellea* (?), Kg., like *Glœocapsa granosa*, Kg., but with cells, separate and solitary.

Fig. 20. Nucleus of *Amœba* under "granulation," presenting the second sulcus of duplicative subdivision.

Figs. 21–23. Different forms of botryoidal granuliferous cell-development of the nucleus in *Amœbæ*.

Fig. 24. *Amœba Roeselii* (?), Duj., presenting a nucleus undergoing botryoidal development: (*a*) mammilliform projection of vesicula preparatory to discharging its contents.

Fig. 25. *Euglypha alveolata*, Duj.: (*a*) sarcode, granules, and moleculæ; (*b*) nucleus and capsule (the former very seldom visible except in young individuals); (*c*) particles of food; (*d*) supernumerary scales; (*d'*) form of scale. Average length of full-grown test 1-400th of an inch.

Fig. 26. Ditto, with body transformed into an ovisac filled with ovules. Ovule about 1-4000th of an inch in diameter.

Fig. 27. Ditto, presenting a development of delicate granuliferous cells like those of *Amœba radiosa.* Cells about 1-4000th of an inch in diameter: (*a*) capsule of nucleus which generally remains entire.

Fig. 28. Ditto, showing that the ovules are developed outside the capsule of the nucleus: (*a*) opercular closure of the test accompanying these developments.

Fig. 29. Ditto, showing a separation and development of the granules into moveable bodies (spermatozoids?) *within* the test: (*a*) group of cells entire on their passage outwards. This and the last figure also show the development of the ovules and granuliferous cells in the neighbourhood of the nucleus and its capsule, and the latter apparently growing out of the nucleus.

Fig. 30. Ditto, showing ovules and granuliferous cells developed in the same test, and together: (*a*) supernumerary scales.

Fig. 31. Ovule of *Euglypha alveolata* more magnified: (*a*) showing capsule and nuclear portion; (*b*) ditto with pellucid area and central granule; (*c*) bearing granules. Do these granules indicate an approaching development of the sarcode, or are they adventitious? They do not appear in the early state of the ovule, but generally before it has left the test, wherein granules like those developed from the granuliferous cells are frequently seen oscillating round them. (*d*) development of external layer or diaphane, now giving the ovule a rhizopodous form. 31'. Granuliferous cell more magnified; in this state it progresses under a plane, actinophorous form, or the granules become large, separate, and exhibit much activity within the test.

Fig. 32. *Euglypha alveolata* (large variety?), 1-300th of an inch in length, showing a special apparatus for the development of the granuliferous cells: (*a*) animal (?) transformed into a secondary test; (*b*) cyst containing granuliferous cells; (*c*) tube for their liberation when they have become locomotive. The same is seen in the common or smaller variety.

Fig. 33. Ditto, ditto, with the granules separated and endowed with active locomotive power: (*b*) shows the structure of the test of *E. alveolata.*

Fig. 34. *Euglypha alveolata* in conjunction; the granules of each passing freely backwards and forwards into each other's tests, as if the two bodies had been two drops of water thus united. The union however is only apparent, as we see in the separation of *Arcella vulgaris*, which also exhibits a similar conjunction both still and under reptation.

Fig. 35. Ditto, ditto, separating: (*a*) the bond of union reduced to a mere thread.

Fig. 36. Ditto, separation of the fleshy substance completed, tests still united: (*a*) nucleus in its capsule.

Plate VI.

Fig. 37. Globular sac of seed-like body of *Spongilla*, partly filled with ovules and granules, of different sizes.

Fig. 38. Portion of contents of ditto more magnified: (*a*) largest ovule of the group presenting the type of the whole, viz. that of a nearly colourless cell within a transparent capsule; (*b*) granules; (*c*) ditto in connexion with ovules; (*d*) ovules without a granule. Largest ovules 1-3000th to 1-2000th of an inch in diameter.

Fig. 39. Series of ovules of *Spongilla* to show the different degrees of approximation of the granule. 39 *a'–c*. Where the granule is adherent to the margin; (*f*) marginal view of ditto; (*d*) when adherent to the flat surface of the disk; (*g*) marginal view of ditto; (*e*) two granules in connexion with one ovule; (*h*) development of the ovule in connexion with a granule which appears to open into the cavity of the capsule, within which the granular sarcode is making its appearance; (*i*) next stage of development, in which the ovule has become slowly polymorphic and presents a vesicula; (*k*) when the polymorphism is more active; (*l*) ditto, presenting a cilium; (*m*) granule (?) transformed into a monad precisely like the "zoosperm." All these developments take place in three to five days after the ovules have been pressed out of the seed-like body into distilled water in a watch-glass.

Fig. 40. Ovule of *Spongilla* in progress of development to show the presence of the external layer or diaphane extending from it in a parabolic form. (It may here be asked, "what becomes of the 'capsule' which is originally so well defined?" This line of demarcation between the diaphane and sarcode disappears as soon as the ovule becomes polymorphic.)

Fig. 41. Ovi-bearing sponge-cell, still polymorphic, from the seed-like body at an early period, viz. before the capsule is formed. Spherical form 1-700th of an inch in diameter.

Fig. 42. Form of a sponge-cell which exists in a layer around the young uncapsuled seed-like body, and probably constructs the capsule.

Fig. 43. Small sponge-cell with so-called "zoosperm" attached, from an old piece of *Spongilla*.

Fig. 44. Group of so-called "ferment-cells" from the juice (*vulg.* "toddy") of *Cocos nucifera*, under fermentation; to contrast with the apparent budding development of the ovule of *Spongilla*: (*a*) vacuoles which abound in all these cells. Largest, circular cells 1-2000th of an inch in diameter.

Fig. 45. *Astasia limpida*, Duj., previous to the formation of ovules: (*a*) molecular sarcode; (*b*) nucleus; (*c*) vesicula; (*d*) buccal tube or proboscis; (*e*) position of anal orifice (?). Length about 1-438th of an inch.

Fig. 46. Ditto, filled with discoid ovules, of which few are ever found so large as the largest of *Spongilla*; they are generally about 1-6000th of an inch in diameter: (*a*) more magnified view of ovule showing its capsuled character.

Fig. 47. Ditto, containing spherical granuliferous cells like those of *Amœba* and *Euglypha*. Ovules atrophied as in *Crumenula texta* under similar (?) circumstances (see Annals, vol. xvii. pl. 9. figs. 11–13): (*a*) granuliferous cell more magnified.

Fig. 48. Ditto, with a botryoidal development (of the nucleus?) of similar cells: (*a*) bunch more magnified.

Fig. 49. *Euglena viridis* in conjunction previous to the formation of ovules: (*a*) position of nucleus and capsule; (*b*) vesicula; (*c*) red body; (*d*) molecular sarcode. Length of largest individuals 1-200th of an inch.

Fig. 50. *Euglena viridis*, after the formation of ovules; individuals still adhering to each other and to the watch-glass in which this was observed.

Fig. 51. Ditto, subsiding into spherical encystment.

Fig. 52. Ditto, encysted. (Although one of each of these pairs is left blank, both individuals were alike in nature.)

Fig. 53. *Crumenula texta*, Duj., showing sarcode and its granules, nucleus, vesicula, red body, and (*a*) glair-cell; (*b*) glair-cell more magnified to show its nucleated character. Length of animalcule about 1-560th of an inch. (For a figure of the same filled with ovules or "embryonic cells," see *loc. cit.*) Ovules about 1-2300th of an inch in diameter.

Fig. 56. Ditto, effete, containing ovules endowed with locomotive power; probably from the development of a cilium, which in this instance I could not see for want of a microscope of higher power. (*b, b*) red grains, round, composed of material like that of the red body; (*c, d, e*) different phases of the ovule of this specimen more magnified.

Fig. 57. *Euglena viridis* (large specimen) encysted and filled with ovules.

Fig. 58. Internal, transparent, tough sac holding the ovules (probably a transformation of the parent): (*a*) portion of the contents of the sac to show that they consist of ovules of different sizes, and granules.

Fig. 59. Ovule more magnified to show its oblong or quadrilateral form in *Euglena viridis*: (*a*) capsule; (*b*) film of homogeneous matter lining its interior; (*c*) pellucid area with central granule. (This ovule has somewhat progressed in development.)

Fig. 60. Effete cell of *Crumenula texta*, showing that it possesses a skeleton cell composed of sigmoid fibres arranged spirally, so as to assume a conical form: (*a*) end view; (*b, c*) form of fibres; (*d*) portion of a broken cell. Is not this analogous to the spiral-fibre of the vegetable cell?

Fig. 61. Longitudinal deduplication of *Euglena viridis* during active life.

Fig. 62. *Euglena agilis*, H. J. C. (n. sp.?), from the brackish water of the marshes of Bombay: (*a, b, c*) *Protococcus* or still-form after having been kept in a watch-glass and supplied with fresh water; (*a*) transverse division showing that the red body is not developed in the lower half; (*c*) ditto quadruple, longitudinal division showing that the red body is equally multiplied; (*d*) linear development (probably by longitudinal division, as the red body is present in each cell). Animal 1-600th of an inch in length.

Fig. 63. *Serpicula verticillata*, Roxb. Spine-cell of leaf showing the protoplasmic cell or primordial utricle of Mohl. (*a*) nucleus; (*b*) green granules in the reticulate molecular protoplasm (the former corresponding to the "granules," and the latter to the molecular sarcode of the amœbous cell, figs. 1, 2) (?).

Fig. 64. Ditto, cell of body of leaf showing protoplasmic cell in rotatory motion, carrying round with it chlorophyll-bearing cellules (probably only an enlarged form of the green granules of the spine-cell, fig. 63), imbedded in the protoplasm promiscuously. These two figures are for comparison with the amœbous cell, figs. 1 & 2.

Fig. 65. *Paramecium aurelia*, Ehr.: (*a*) granules; (*b*) digestive globules containing food; (*c*) buccal cavity drawing in particles of food for the formation of the new digestive globule at its lower extremity. Length about 1-170th of an inch.

Fig. 66. Ditto; diagrammatic view under compression, showing (*a, a*) vesiculæ and the papillæ respectively through which their contents appear to be discharged; (*b*, *b*) radiating lines or vessels consisting of a concatenation of pyriform and fusiform sinuses. This state can be only partially seen, viz. when the vesiculæ are just receiving the contents of the sinuses; at this moment both may be observed to be slightly dilated together, but never to the extent represented in the diagram.

Fig. 67. *Paramecium aurelia*, Ehr.; sketch of, under compression, just preceding diffluence and death; showing the dilatation of the proximal sinuses only, and the passage of the rest into each other, so as to form continuous vascular channels.

Fig. 68. Ditto, not compressed; showing a lateral view of the vesiculæ *in situ*: (*a*, *a*) dilatation of the vesiculæ pressing inwards the proximal sinuses, which are thus shown to open into the inner part of the vesiculæ; (*b*) discharge of digestive globule through the anal aperture; (*c*) granules.

Fig. 69. Ditto, in transverse fissiparation, to show the quadrupling of the vesiculæ.

Fig. 70. Filament of *Physactis saccata*, Kg., with terminal spherical cell previous to the formation of the sporangium: (*a*) homogeneous contents of spherical cell; (*b*) nucleus of ditto.

Fig. 71. Ditto, after the formation of the sporangium: (*a*) spherical cell now empty and connected with the sporangium by a tubular prolongation.

Fig. 72. Spherical cell of *P. saccata* separated from the filament.

Fig. 73. Ditto, with a granular development extending from the *nucleus*.

Plate VII.

Fig. 74. *Epistylis Galea* (?), Ehr., showing (*a*) entrance of buccal cavity; (*b*, *b*, *b*) buccal cavity with constriction armed with cilia (?); (*c*, *c*) digestive globules in process of formation; (*d*, *d*) ditto formed and containing food; (*e*, *e*) small green zoospores taken in as food, and showing by their circulating throughout every part of the body that they are not confined to an intestinal canal; (*f*, *f*) vesicula opening into the buccal cavity just above the constriction; (*h*) arrow marking the position of the anal aperture; (*g*) cylindrical form of nucleus wrapped round the vesicula and buccal cavity like the ovary in *Salpa*; (*i*) closed individual.

Fig. 75. *Vorticella* —— ?, presenting a pouch-like extension of the buccal cavity in the position of the anal aperture and discharging orifice of the vesicula: (*a*) pouch; (*b*) vesicula; (*c*) another individual passing into the *Acineta* form.

Fig. 76. *V. microstoma*, showing the separation of the different organs under decomposition: (*a*) vesicula; (*b*) buccal cavity; (*c*) nucleus; (*d*) diffluent operculum.

Fig. 77. *V. convallaria* (?), Ehr., to show (*a*) granules, (*b*) nucleus.

Fig. 78. *V. microstoma*, to show the invisible state of the buccal cavity during the dilatation of the vesicula, and *vice versâ*: (*a*) with vesicula; (*c*) dilated; (*b*) disappearance of vesicula and reappearance of (*d*) buccal cavity; (*e*) nucleus.

Fig. 79. *Arcellina vulgaris*, Ehr., showing (*a*, *a*) duality of nucleus; (*b*, *b*, *b*) plurality of vesicula; (*c*) granules; (*d*) filiform attachments of animal to the test. Animal 1-200th of an inch in diameter.

Fig. 80. *Difflugia tricuspis*, H. J. C. (n. sp.?), showing (*a*) nucleus; (*b*) vesicula in plurality; (*c*) podal prolongations with greenish elongate "granules;" (*d*) tricuspid form of opening of test; (*e*) filiform attachments of animal to the test. Animal 1-320th of an inch long.

Fig. 81. *Amœba quadrilineata*, H. J. C., showing two lateral vesiculæ (*a, a*) about to discharge themselves independently of the large, apparently normal one (*b*). Animal about 1-350th of an inch in length.

Figs. 82, 83. *Chilodon cucullulus*, Ehr., two individuals to show linear continuation of circular sinuses in one (82), and the vesicula in its normal position: (*a*) nucleus; (*b*) dental apparatus; (*c*) vesicula; (*d*) lines of sinuses. 83. To show apparent absence of vesicula and irregular distribution of contracting sinuses. Animal: largest size seen 1-320th of an inch in length.

Fig. 84. *Spirostoma virens* (?), Ehr. Posterior extremity to show dropsical state of proximal sinuses and vesicula; the former thus presenting the appearance of an areolar structure round the latter.

Fig. 85. *Bursaria leucas* (?), Ehr.: (*a*) nucleus; (*b*) vesicula surrounded by six globular sinuses.

Fig. 86. *Himantophorus Charon*, Ehr.; vesicula of, surrounded by dilated proximal sinuses.

Fig. 87. *Euglena spirogyra*, Ehr., showing (*a*) posterior glair-cell with its broad surface upwards, and cylindrical nucleus; (*a'*) anterior glair-cell with its margin upwards; (*b*) "nucleus." Animal about 1-133rd of an inch in length.

Fig. 88. *Phacus pleuronectes*, Duj.: (*a*) glair-cell and its nucleus; (*b*) supposed position of "nucleus." Animal 1-500th of an inch long.

Fig. 89. *Navicula fulva*, Ehr., showing the form of its endochrome or organ bearing this colour: (*a, a*) glair-cells; (*b*) nucleus suspended by threads to the endochrome, like those of *Spirogyra*. Frustule 1-183rd of an inch long.

Fig. 90. *Amphiphora oblonga*, H. J. C. (n. sp.?), primary surface showing form of endochrome after division: (*a, a*) glair-cells; (*a'*) one more magnified. Largest specimen seen 1-75th of an inch in length.

Fig. 91. Ditto, lateral view; the margin is of course angular.

Fig. 92. Spherical cells or "biliary organisms:" (*a*) one from *Otostoma*, H. J. C., containing five or more cellulæ filled with a bile-coloured fluid; (*a'*) one from a binocular *Planaria*, showing (*b*) oil-globule, (*c*) bile-cellulæ, (*d*) lash of cilia; (*e*) another cell from the same *Planaria*, containing four daughter-cells, each of which is provided with a single bile-cellule; (*f*) ditto with a single large bile-cellule in the centre, and several small oil-globules; (*g*) spherical cell from *Brachionus Pala*, Ehr., presenting one large bile-cell filled with granules, also a lash of cilia; this bile-cell has much the appearance of a granulating nucleus.

Figs. 93–98. Rhizopodous cell inhabiting the protoplasm of the Characeæ, under different phases to show the early stages of the development of the monads. 93. The cell with single nucleus as it exists in the living protoplasm: (*a*) pellicula and diaphane; (*b*) nucleus in the capsule; (*c*) sarcode containing moleculæ and greenish "granules."

Fig. 94. Ditto after having taken in food (the green cellules of the internode at its death), which is represented by the dark shade: (*a*) old pellicula or external cell; (*a'*) secondary pellicular layer or internal cell; (*b*) food in the midst of the sarcode, which, with the diaphane, now perishes; (*c*) development of plasmic (?) zone round the capsule of the nucleus now become globular; (*d*) nucleus subdivided into spherical granules of refractive matter, still circumscribed by their proper membrane within the capsule; (*e*) nucleolus within this proper capsule which sometimes appears as a disk of protoplasm, at others as an oil-globule, and at others in a state of minute granulation.

Fig. 95. Nucleus of *Actinophrys oculata* after Stein (tab. 5. figs. 25-28. *op. cit.*), to compare with the nucleus and plasmic zone just described: (*a*) "Marksubstanz;" (*b*) "nucleus."

Fig. 96. Rhizopodous cell of Characeæ under arrest (?) of generative development: (*a*) plasmic zone reduced to a membranous (?) state and presenting a number of pouches on its surface; (*b*) granules still within the capsule of the nucleus.

Fig. 97. Ditto, with capsule of the nucleus empty, and its refractive granules in the pouches of the mulberry-shaped plasmic membrane.

Fig. 98. The mulberry-shaped plasmic membrane, &c. of the foregoing figure isolated.

XXII.—*Descriptions of one Indian and nine new Burmese* Helices; *and Notes on two Burmese* Cyclostomacea. By W. H. Benson, Esq.

1. *Helix pylaica,* n. s., nobis.

Testa obtecte perforata vel imperforata, depresso-conoidea, solidiuscula, nitente, superne radiato-costulata, subtus læviori, costulis evanescentibus, cornea, spira depressa, apice obtuso, sutura impressa; anfractibus $6\frac{1}{2}$ lente accrescentibus, angustis, ultimo antice vix descendente, subtus convexo, ad periomphalum excavato; apertura transversa, angusta, lunato-lineari dente unica elongata parietali, lamelliformi, alba, coarctata; peristomate incrassato, obtuso, edentulo, albo, intus strictiusculo, margine externo infra angulum periphærii sinuato.

Diam. major 9, minor 8, axis 5 mill.

Hab. ad Maulmain. Teste W. Theobald.

This and the following shells were collected by Mr. W. Theobald, jun. It presents a singular resemblance to the North American *H. hirsuta,* Say, in the form of the aperture and the structure of the parietal plait; but there is no disposition to form teeth on the basal callus as in that shell. It must be included in the division *Tridopsis* of Beck, of which *H. hirsuta* and the Burmese *H. infrendens,* Gould, form a part. A still nearer approach to the latter species will be found below in *H. capessens.*

2. *Helix artificiosa,* n. s., nobis.

Testa anguste umbilicata, orbiculata, discoidea, nitidiuscula, superne liris confertis sulcisque profundis spiralibus, costulisque confertis obliquis decussata, subtus liris remotioribus striisque radiatis ornata, pallide cornea, spira planulata, interdum omnino planata, apice vix elevato, obtuso, sutura profunda; anfractibus 6½ angustis, lente accrescentibus, ultimo superne subangulato, subtus convexiusculo; apertura sub-anguste lunata, obliqua; peristomate acuto, leviter sinuato, margine columellari brevissimo, basalique expansiusculo, dextro crenulato.

Diam. major 14, minor 12, axis 5 mill.

Hab. ad Phie Than vallis Tenasserim. Teste W. Theobald.

The sculpture of this discoid species is very elaborate, and strongly pronounced in proportion to the size of the shell, presenting a very beautiful appearance under the lens. The ends of the spiral liræ give a scalloped edge to the outer lip.

3. *Helix capessens*, n. s., nobis.

Testa imperforata, depresso-conoidea, superne radiatim costulato-striata, subtus læviori, rufo-cornea; spira subconoidea, apice obtusiusculo, sutura impressa; anfractibus 6½ convexiusculis, lente accrescentibus, ultimo acute carinato, antice leviter depresso, subtus convexiusculo, ad periomphalum excavato; apertura transversa, angusta, dentibus 3 basalibus æqualibus coarctata, margine recto, obtuso, vix sinuato.

Diam. major 9, minor 8, axis 4 mill.

Hab. ad Maulmain. Teste W. Theobald.

Nearly related to *H. infrendens*, Gould, which was found by Mr. Theobald at the Kangoon Caves on the Salween River, but easily distinguished by its more depressed form, keeled periphery, and the more regular dentition of the basal margin. The profile of the spire is less convex, and the last whorl is depressed in front below the level of the keel of the penultimate whorl, whereas in *H. infrendens* it ascends at the same part. *H. capessens* forms, with *H. pylaica*, a notable addition to the restricted section *Tridopsis*.

4. *Helix convallata*, n. s., nobis.

Testa vix perforata, convexo-depressa, tenui, nitidissima, radiato-striata, translucente, olivaceo-cornea; spira convexiuscula, apice prominulo obtuso, sutura profunde canaliculata; anfractibus 6 convexis, lente accrescentibus, prope suturam acute angulatis, ultimo rotundato, non descendente, subtus convexiusculo; apertura vix obliqua, lunata; peristomate acuto, superne prope suturam angulato, antrorsum leviter arcuato, margine columellari oblique descendente, expansiusculo.

Diam. major 14, minor 11½, axis vix 7 mill. Apert. lata 7, alt. 5 mill.

Hab. ad collem Therabuin vallis Tenasserim. Detexit W. Theobald.

Singular among the allies of *Helix vitrinoides* on account of the excavated canaliculate suture with a carinate margin.

5. *Helix Hariola*, n. s., nobis.

Testa perforata, subturbinata, tenui, oblique striatula, striis minutissimis confertissimis spiralibus sub lente ornata, non nitente, diaphana, purpureo-cornea, strigis opacis, albis, laciniatis, fascias duas latas efformantibus, picta; spira conoidea, apice obtuso, sutura impressa; anfractibus $4\frac{1}{2}$ convexiusculis, ultimo ad periphæriam obtuse angulato; apertura obliqua, late lunata; peristomate tenui, albido, margine dextro, basalique expanso, columellari laminam triangularem dilatatam, umbilicum subtegentem efformante.

Diam. major 15, minor 13, axis $10\frac{1}{2}$ mill. Apert. $6\frac{1}{2}$ mill. longa, 8 lata.

Hab. ad Thyet Myo, prope ripas Irawadi fluvii. Detexit W. Theobald.

The interspace between the opake bands forms a dark girdle below the angle, and the periomphalus is similarly coloured. The shell is more depressed in form and destitute of a keel, but singularly like the rare *H. Capitium*, Bens., in colouring. Since the discovery of the latter species by Capt. Boys, at the foot of the Rajmahal Range near Sikrigali, it has not been met with by any naturalist in that quarter; but an imperfect specimen of a very rare *Helix* met with by Mr. Theobald in the hills above Cuttack, 400 miles to the southward of its original habitat, proves to be a young *H. Capitium*.

6. *Helix bifoveata*, n. s., nobis.

Testa umbilicata, oblato-globosa, utrinque concava, oblique striata, minutissime granulata, luteo-fusca, translucente; spira profunde excavata, perspective umbiliciformi; anfractibus $4\frac{1}{2}$ angustis, convexis, recedentibus, ultimo prominente, superne compresso, globoso, cæteros occultante, subtus circa umbilicum mediocrem perspectivum compresse angulato; apertura verticali longissima utrinque testam superante, angustissime lunata, superne et infra subangulata; peristomate simplici, acuto, expansiusculo, marginibus remotis convergentibus, columellari brevi subverticali, leviter expanso.

Diam. major 10, minor 9, axis 6 mill. Long. apert. 7, lat. vix 2 mill.

Hab. ad collem Therabuin vallis Tenasserim raro. Detexit W. Theobald.

This is the most singular among the planorbular *Helices* which exhibit a concavity, and, as it were, an umbilicus on the spiral, as well as the basal face of the shell. The parietes of the true or basal umbilicus are more vertical than those of the spiral depression, and the excavation is deeper. The sculpture is peculiar, consisting of lines of granules crossing each other obliquely.

The published species most nearly related to *H. bifoveata* are *H. Omicron*, Pfr., *H. Shuttleworthi*, and *H. Calculus*.

7. *Helix pansa,* n. s., nobis.

Testa perforata, conoideo-depressa, confertim oblique striata, subtus nitida, radiatim striatula, translucente, fusco-cornea; spira convexo-conoidea, apice prominulo, glabro, nitido, sutura leviter impressa; anfractibus 6 lente accrescentibus, convexiusculis, ultimo ad periphæriam subcarinato, subtus convexiusculo; apertura obliqua, late lunata; peristomate recto acuto, margine columellari oblique descendente, superne breviter reflexo.

Diam. major 14, minor 13, axis $6\frac{1}{2}$ mill. Apert. 5 longa, 7 lata.

Hab. ad Akaouktoung prope ripas Irawadi fluminis. Detexit W. Theobald.

Allied to the Sikkim form, *Helix tugurium,* nobis.

8. *Helix Bolus,* n. s., nobis.

Testa subaperte perforata, globosa, tenui, oblique striatula, striis minutissimis confertissimis spiralibus, sub lente, sculpta, nitidula, translucente, pallide cornea, interdum fascia unica rufa supra periphæriam ornata; spira conoidea, apice obtusiusculo, sutura leviter impressa; anfractibus 5 convexiusculis, ultimo inflato; apertura vix obliqua, rotundato-lunari; peristomate tenui, expansiusculo, albido, margine columellari latiori, superne perforationem subtegente.

Diam. major 14, minor 12, axis $10\frac{1}{2}$ mill.
" " $15\frac{1}{2}$, " 14, " $11\frac{1}{2}$ "

Apert. majoris 9 mill. longa, 8 lata.

Hab. ad Prome. Detexit W. Theobald.

This shell varies in being more or less globose in the last whorl, some specimens presenting a subturbinate appearance. The band is indifferently present or absent in each variety.

9. *Helix textrina,* n. s., nobis.

Testa perforata, depressa, superne lineis radiatis et spiralibus rugose decussata, pallide rufescente, subtus læviori, lactea; spira planiuscula, apice obtuso, sutura leviter compressa; anfractibus $5\frac{1}{2}$ subplanulatis, sensim accrescentibus, ultimo supra periphæriam angulato; apertura late lunari; peristomate acuto, vix expansiusculo, margine columellari oblique descendente, superne brevissime reflexo.

Diam. major 29, minor 25, axis vix 13 mill. Apert. 15 mill. lata, 10 alta.

Hab. ad Thyet Myo. Detexit W. Theobald.

Allied to *H. labiata,* Pfeiffer, a Western Himalayan shell, but differing in its more depressed form, peculiar sculpture, like that of the upper part of *H. ligulata,* by its more widely lunate aperture, and by the absence of any true labiation. The colour may be more pronounced in fresher specimens.

The spire is more depressed and the apex less prominent than in *H. Theodori*, Phil.; the shell also is more solid, the aperture wider, and the columellar lip descends more horizontally.

10. *Helix Laidlayana*, n. s., nobis.

Testa constricte perforata, sinistrorsa, turbinato-depressa, tenui, oblique striata, striis confertissimis spiralibus decussata, nitidiuscula, translucente, albida, fascia 1 supera angusta, rufo-castanea, periphæriam tangente, interdum 1 supera lata, et altera infera remotiuscula ornata; periomphalo et pariete aperturali castaneis; spira depresse conoidea, apice obtusiusculo, sutura leviter impressa; anfractibus 5 sensim accrescentibus, ultimo ad periphæriam angulato, antice breviter descendente, subtus convexo; apertura valde obliqua, subquadrato-lunata; peristomate recto, acuto, margine columellari subrecte descendente, anguste reflexo, perforationem constrictam subtegente.

Diam. major 27, minor 23, axis 15 mill. Apert. 15 mill. lata, $13\frac{1}{2}$ alta.

Hab. in Provincia Bengalensi Bheerbhoom, ubi exemplum unicum junius detexit J. W. Laidlay; nuperrime in Provincia Orissæ, non procul ab urbe Cuttack, exempla majora non raro invenit W. Theobald.

Named after a former Secretary of the Asiatic Society of Calcutta, to whom I am indebted for a specimen found by him many years ago in the region of the late Santhal insurrection. The rediscovery of the shell in about 20° N. lat., as well as the detection of *H. Capitium* in the same quarter, shows that these species range through nearly 5 degrees of latitude. The colouring of *H. Laidlayana* has much resemblance to that of *H. quæsita*, Fér., but the shell has nearer relations to *H. interrupta*, nobis, and *H. trifasciata*, Müll. It differs from *H. interrupta* in colour, depressed form, greater number of whorls, contracted perforation, descent of the last whorl above the aperture, and in the disposition of the bands. When a single broad dark band is present in *interrupta*, it touches the angulate periphery. From *H. 3-fasciata* it differs in lustre, less depressed form, want of solidity, contracted perforation, more vertical columellar lip, and in the disposition of the bands, that which is above the periphery in *3-fasciata* never touching the angle. The colour of the periomphalus and parietes of the aperture is also peculiar.

Among the known Burmese *Helices*, *H. Achatina*, Gray (*anguina*, Gould), var. *β*, Pfr., was taken by Mr. Theobald at Maulmain, and at the Kangoon Caves on the Salween River. A small variety of *H. refuga*, Gould, occurred at Kwadouk, near Thyet Myo, on the Northern Frontier, and an interesting dextrorse variety at Phie Than in the Tenasserim Valley. A fragment of *H. Saturnia*, Gould, was also sent from that valley, where *H. retrorsa* and *anceps*, Gould, were found abundantly, and *H. Theodori*, Phil., very sparingly. A shell, apparently referable as a variety to the Darjiling *H. Castra*, nobis, was once met with at Pyä, between Maulmain and Tavoy. *Helix Merguiensis*, Ph., *H. gabata*, Gould, a small var. of *H. delibrata*, nobis (*procumbens*, Gould), and *H. honesta*, Gould, occurred both at Maulmain and in the valley of the Tenasserim River, where *H. resplendens*, Ph., was not rare. The widely spread *H. similaris*, Fér., is noted from Thyet Myo and Prome, on the river Irawadi, and a sharply-keeled variety of *H. rotatoria*, V. d. Busch, hitherto supposed to be peculiar to Java, inhabits the banks of the same river, lower down, at Akaouktoung. None of the *Helices*, described by Gould or others from the former dominions of the Burmese Empire, appear to have escaped the researches of Mr. Theobald, who has added largely to the list, several other species of *Helix* remaining to be described.

Rhaphaulus (*Anaulus* and *Megalomastoma*) *Chrysalis*, Pfr., from Maulmain, in a more perfect condition than the type specimen, shows a much longer tube running up the penultimate whorl than either *bombycinus* or *Lorraini*, Pfr., and its colour is a rich chestnut. A dead specimen of *Megalomastoma sectilabre*, Gould, from Yanglaw on the Tenasserim River, confirms an opinion communicated last year to Pfeiffer, and derived from Gould's and Mason's observations, and from a view of Pfeiffer's supposed specimen of *sectilabre* from Borneo, that, although allied to, it was quite distinct from my Bornean *M. Anostoma*, with which Pfeiffer had believed it to be identical. The channel in *M. Anostoma* (Annals, 1852, vol. x. p. 269–270) is on the inner lip, as in *M. altum*, Sow. In *sectilabre* it appears on the right lip, near the top of the aperture. The latter is a more solid shell, with the spire more slender and longer in proportion; the suture is distinctly marginate; the peristome is white (not coloured, as in *M. Anostoma*), and presents a contrast with the orange-chestnut interior of the aperture; the apex also is not pale or white, as in the Bornean species.

Cheltenham, 30th July 1856.

XXIII.—*On an Abnormality in the Flowers of* Salix Andersoniana. By John Lowe, Esq.*

In the year 1841, the Rev. J. E. Leefe communicated to this Society a paper, entitled "Remarks on some curious Metamor-

* Read to the Edinburgh Botanical Society, July 10th, 1856.

phoses of the Pistil of *Salix Caprea*." A short time since, I observed a corresponding set of changes occurring in the male flowers of *Salix Andersoniana*. These, as forming, with those of Mr. Leefe, a complete series of morphological changes, may not be unworthy the Society's notice. The changes observed by Mr. Leefe in *Salix Caprea* consist of a gradual conversion of the pistilline into staminal organs, each step in the process being clearly explained by the plate which is given with his paper in the 1st volume of the Society's 'Transactions.'

In the present specimens we have just the opposite, viz. the stamens becoming converted into ovaries, and this by every conceivable gradation.

The plant from which these were taken grows about half a mile below Cramond Bridge near Edinburgh; it is to all appearance strong and healthy, and in the majority of its flowers there was no observable alteration.

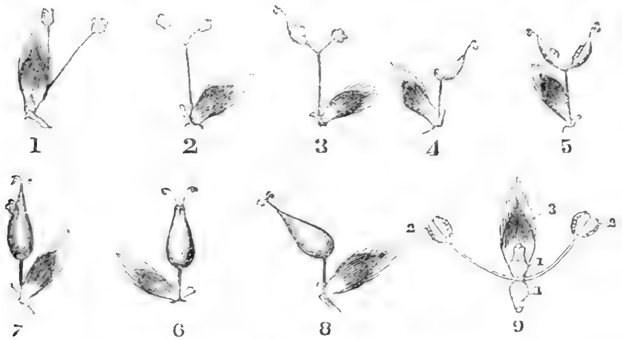


Fig. 1. is a floret whose filaments are partially united at the base; in other respects it is perfectly normal. The scales and glands in this as in the other florets present nothing unusual.

Fig. 2. The stamens still further united, giving the filament a forked appearance.

Fig. 3. represents one of the stamens of the last figure converted into an ovary which bears a pollen-mass on its inner edge; the other stamen is unaltered.

Fig. 4. A still more advanced condition. The ovary has no vestige of pollen-cells, but at the base is the remaining anther, sessile.

Fig. 5. shows each stamen converted into a carpel and bearing an antherine mass. The styles have each but one stigma.

Fig. 6. The two ovaries are here nearly united, but have a fissure superiorly in which are the remains of the anthers. The styles are distinct and monostigmatous.

Fig. 7. The fissure seen in last figure has disappeared by the

union of the styles; a pollen-mass still remains on the side of the united ovaries.

Fig. 8. A complete and well-formed ovary.

I ought to remark here that these figures are not intended to represent the progressive development of the ovary as shown by any individual floret, but simply the different stages which may be traced in a number of florets and which may be reasonably regarded as successive.

We may now consider the cause of these phænomena and the laws which govern formations of this nature.

The generally received opinion regarding the production of diœcious flowers is that each flower is rendered unisexual by the suppression of the other sexual whorl, and though this may be mainly true of many diœcious plants, it does not appear to express the whole truth with respect to diœcious Amentiferæ.

Dr. Braun in his 'Rejuvenescence of Nature,' states that both kinds of sexual organs are derived from the same leaf, or as he expresses it, "the same leaves appear in the male as stamens and in the female as carpels." In other words, the leaf which fails to produce a male will give rise to a female organ, and *vice versâ*. Hence, though it is perfectly correct to say, that there is an arrest of development when stamens are alone produced, it is otherwise with respect to female organs, since there is here not an arrest but an exaltation of development.

These specimens illustrate also the parts of the leaf which give origin to the different parts of the essential organs; thus, the anther gradually merging into the carpel shows that it is derived from the lamina of the leaf (the fact of the carpel being formed by the lamina of the leaf being ascertained by morphological changes in other plants). The pollen observed on the edge of the ovary in fig. 5, would encourage the idea that pollen is merely a gemmiferous condition of the lamina of the leaf. And, lastly, we may allude to the gland, which, although not presenting any peculiarity in the present specimens, I have nevertheless found in others assuming a very interesting form. I am not aware that the question has been mooted as to what is its real morphological value. It might be assumed to represent an abortive stamen, but that we find it present in those Salices which may be regarded as having their staminal whorl complete, *Salix pentandra* for instance. Moreover it is found to be placed opposite the interval in flowers which have only two stamens, thus having an alternate arrangement. I have little doubt, especially since meeting with the specimen shown in fig. 9, where there are two glands alternating with the stamens, that they represent the corolla. Regarding the scale as the calyx, we have thus the various whorls of the flower complete.

XXIV.—Cardium exiguum :—*its Siphons and its Byssus.* By Philip H. Gosse, F.R.S.

[With a Plate.]

A minute Cockle (*Cardium exiguum*), about one-fourth of an inch in diameter, and of a pure white hue, was dredged by me in Weymouth Bay, May 13th, 1855, and was deposited in one of my aquaria. For some time after I had domiciled it I saw no more of it, and supposed it was lost; but one day my attention was arrested while looking with my lens through the glass side, along the edge of the bottom-rubbish, by an object which I knew not what to make of. From the midst of the floccose matter a very minute bladder was projected, the motions of which were so vivacious as to cause me no little surprise and speculation as to what manner of thing it might be. After vainly trying to decipher it by mere gazing, I ventured carefully to clear away some of the rubbish on each side with a pin-point fastened to a stick; when I discovered my tiny friend, the Cockle. No trace, it is true, was now to be seen of the bladder, but after a few minutes I saw it again, and understood the mystery; not indeed all at once, but by degrees, and by repeated examinations. The facts I thus learned I will now record.

In the great spinous Cockles (*C. aculeatum*, &c.) the ejecting or anal siphon is formed closely like the receiving or oral one,—a simple orifice, surrounded by filiform tentacles. But in this pigmy species the anal orifice is crowned by a semi-elliptical sac, which at the instant of opening the valves for the renewing of respiration is projected *with a jerk*. This sac is composed of membrane of the most extreme delicacy, and of such transparency that it would be utterly invisible but for rows of minute opake-white dots that run down it longitudinally. It terminates in a circular aperture, whose width is about half that of the greatest diameter of the sac; but from the sensitiveness and contractility of the membrane, the form and dimensions of the orifice slightly vary. Its edges are not in the least thickened, and they are with the greatest difficulty detected, except by the termination of the macular lines just mentioned. In some circumstances it is protruded to a much greater extent than in others, forming a very elongated ellipse, and extending to the length of $\frac{1}{6}$th of an inch, or little less than the transverse diameter of the valves. I for a time thought it was projected by the evolution of its walls; but on more careful examination, I saw that the sides collapsed into a wrinkled thread when the jet ceased, and were instantly distended, with force, when it was renewed.

The movements of this organ, though not extensive, are indicative of great sensibility. It is continually contracting and dilating both laterally and longitudinally; bends quickly from side to side; twitches spasmodically; and occasionally contracts or constricts one part without altering the rest. The ejection of the effete water from it is continuous while the organ is protruded, and sufficiently forcible to make the current visible at the distance of upwards of an inch from the orifice. The *receiving* current however is intermittent. The siphon through which this latter passes is a short truncate column, the edge of which is set with about fifteen short incurved tentacles, separated from each other at their bases by more than their own diameters. This column, when withdrawn, first becomes oval, and then collapses; the sides coming into contact as the valves close over it.

I am not aware that any one has included the Cockles among the byssus-spinners. This little species however exercises the faculty freely. It crawls up the glass sides of my aquarium, or up a phial, six inches or more in a few hours, moving itself by several diverging threads of varying length; and frequently, when disturbed, hanging by one alone, after the others have been cast off. I watched the process of spinning, which did not differ from what I have observed in other byssiferous Conchifera. The tiny white foot was protruded, and pressed against the glass for a few seconds; during which a slit, with mobile fleshy lips, was opened in its upper edge, not reaching to the tip, but terminating at about two-thirds of its length from the base. When the foot was withdrawn, two threads were found attached to the glass by minute sucking buttons. All the time of the process I perceived that the terminal, ungrooved portion of the foot, which was pellucid, seemed to be permeated by a central canal through which a fluid was percolating. Such at least was the appearance.

EXPLANATION OF PLATE IX.

Fig. 5. represents *Cardium exiguum*, with the siphons extended; magnified 5 diameters.

BIBLIOGRAPHICAL NOTICES.

An Introduction to Entomology, or Elements of the Natural History of Insects. By William Kirby, M.A., F.R.S, F.L.S., and William Spence, F.R.S., F.L.S. Seventh Edition. Sm. 8vo. London, Longmans, 1856.

After the long period during which this work has occupied a high place in our entomological literature, almost all that remains for us to do is to announce to our readers the appearance of this "new and cheaper" edition of the 'Introduction to Entomology.' It comprises only the first two volumes of the original edition, containing what may be termed the popular portion of the book, and is in fact a reprint of the sixth edition of these two volumes, which were published separately some years since.

Considering the exceedingly low price at which this volume of upwards of six hundred pages is offered to the public, it is certainly very well got up, although we are sorry to see a good many misprints in its pages, which one would think might easily have been avoided in a work which has been so often printed. The entomologist perhaps may find these but trifling difficulties, but many of them will prove sad stumbling-blocks in the way of the ordinary reader. We should have been glad also to have seen a few alterations in the notes in some parts of the work, as for instance at page 155, where the reader is referred to Mr. Westwood's 'Introduction' for an "account of the facts hitherto recorded respecting" the *Strepsiptera*, although Mr. Westwood's book, having been published before the history of these singular insects was cleared up by the researches of Von Siebold and others, must necessarily give a very erroneous view of the present state of our knowledge of their mode of life.

An interesting appendix is formed by the addition to the volume of the account furnished by Mr. Spence to Mr. Freeman's Life of the Rev. W. Kirby, of the origin and progress of the 'Introduction to Entomology,' with particulars of the portions which are principally due to each author.

Ferny Combes: a Ramble after Ferns in the Glens and Valleys of Devonshire. By CHARLOTTE CHANTER. London, Reeve, 1856.

This is a pleasant little volume, written in a simple style, and commending itself alike to the tourist and valetudinarian, whom it would fain lead through some of the beauties of the 'far west,'—and whom it would seek to inoculate with that love of natural history which unfolds a new volume of hidden stores to the temporary sojourner 'midst Arcadian scenes, converting the barren moor, and bleak upland waste, into a paradise. Although its main object is, as indeed its title would imply, to point out localities for those species of our ferns which the authoress has detected in the fairy Combes of Devon, yet she distinctly disclaims any intention of entering the realms of science: "I write," says she, "for the votaries of health and pleasure, not for votaries of science. I write for those of less cultivated intellect, who, with an innate taste and love for all that is beautiful and divine in nature, too often wander in darkness where even a little knowledge would open to them worlds of light in the animal and vegetable kingdoms,—provided not only for use, but for endless interest and research into the works of their Creator." Her delineations of the country through which she conducts us are truthful and good,—clearly emanating from the pen of an observer, and bearing no evidence (as is too frequently the case in similar publications) that she has merely compiled from the works of others. The description (p. 17) of the inconveniences of a 'Devonshire lane' is marvellously correct; and to us, who have wandered, over and over again, through these 'arva beata,' prying into every nook and crevice between the limits of Lynton and Lundy, and have marked (to our cost) the sudden change which comes over the 'face of the deep' when the bold promontory of Hartland affords us no longer its friendly shelter on our passage to the 'isle of rats,' her remarks are painfully suggestive of the past: "Ah! how the coast and sea alter as you pass Hartland Point! No gentle wavelets ripple over the sand, but sturdy Atlantic billows, rolling in from the far west, come bounding over the stony strand, and leap high into the air as they strike against the projecting masses of rock." (p. 26.)

Her picture, too, of Clovelly is manifestly 'drawn from the life;' as is also that of the entrance into it, by the well-known "Hobby-drive,"—"a road terraced along the cliff, winding in and out through deep wooded glens and over trickling streams; whilst, below, the blue sea shines between the branches, and the waves make gentle moan upon a beach you cannot see" (p. 28). Clovelly is indeed a wonderful spot, and "any one," says our authoress, "who would venture down its street must leave his dignity behind him, and get down as best he can,—fortunate if he have not a hard tumble or two by the way." Another writer has aptly described it as "a small fishing-village built on the steep slope of a cliff, and looking almost as if the whole place had been wrecked from some large ship, and had cleverly contrived to scramble on shore, and clamber up the rocks just beyond high-water mark, but had never been able to reach the summit*."

In the concluding portion of her volume, Mrs. Chanter pilots us through the 'pixied haunts' of Dartmoor, and leads us into many a wild and unvisited retreat. From the top of Lustleigh Cleve she surveys, amidst craggy Tors, the teeming valleys beneath,—and taking up her harp, in all the warmth of a poetic imagination, exclaims: "It is a place in which one longs to linger and drink in all its charms. It is a place from which one cannot turn without a sigh of regret; a place that comes back in pleasant dreams of happy hours; a place one seems to have known somewhere, somehow,—long, long ago." (p. 67.)

The last chapter of this little book contains some directions on the cultivation of ferns, and the three or four preceding ones descriptions of the species of these plants, referred to in other parts of the work. These descriptions appear to be copied for the most part from Mr. Moore's works, and they are illustrated by some pretty good coloured figures.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

November 13, 1855.—Dr. Gray, F.R.S., in the Chair.

CHARACTERS OF SOME APPARENTLY NEW SPECIES OF BUCCONIDÆ. By PHILIP LUTLEY SCLATER, M.A., F.L.S.

1. BUCCO HYPERRHYNCHUS.

Tamatia hyperrhynchus, Bp. MS. et Consp. Vol. Zygodact. p. 13.

B. supra fulgenti-niger; fronte lata et superciliis anticis albis:

* June: a Book for the Country in Summer-time. By H. T. Stainton (London, 1856), p. 65.

subtus albus, nigro late torquatus; lateribus nigro radiatis: rostro maximo.

Long. tota 10·5; alæ 4·5; caudæ 3·5; rostri a rictu 2·1.

Hab. In regionibus fl. Amazonum superioris (*Hawxwell*). Mus. Paris. et P. L. S.

When I drew up the characters of *Bucco macrorhynchus*, as given in the 'Annals of Nat. Hist.' for May 1854, p. 357, I had not in my possession specimens of the true *macrorhynchus* from Cayenne, and consequently confounded with it the present bird. But the much larger size of the bill and whole body, the greater extension of the white colour on the front, the narrower black band and the total absence of any fawn-coloured tinge on the belly and vent are quite sufficient to distinguish this *Bucco* from its Cayenne representative.

I have lately ascertained, through the kindness of Prince Bonaparte, that this is the species included under the name *Tamatia hyperrhynchus* in his *Conspectus Volucrum Zygodactylorum*, published in the 'Ateneo Italiano' of May last, and I have therefore adopted his specific designation. But no descriptions have yet appeared of the many new species of which the names only are inserted in that and other similar recent publications of the Prince.

The type specimens of the present bird are in the French National collection.

2. Bucco dysoni.

Tamatia gigas, Bp. Consp. Vol. Zygodact. p. 13?

Bucco dysoni, G. R. Gray in Mus. Brit.

B. supra fulgenti-niger; fronte usque ad oculos et collari postico albis: subtus albus; vitta pectorali lata nigra; lateribus nigro variis; rostro pedibusque nigris.

Long. tota 9·7; alæ 4·5; caudæ 3·4; rostri a rictu 1·8.

Hab. In America Centrali, Honduras (*Dyson*). Mus. Brit.

Obs. Species a *Buccone macrorhyncho* fronte latius albo, rostro majore, et ventre pure albo, a *Buccone hyperrhyncho* rostro minore et fronte minus albo diversa, et inter has duas media locanda.

A single specimen of this bird in the British Museum was procured by Mr. Dyson in Honduras. In my Synopsis of this family I have confounded it with its near affines, from which I now think, as might have been expected from the locality, it will bear separation. It is very probable that Prince Bonaparte's name, *gigas* (which was applied to a bird brought by Delattre from Nicaragua), was intended for this same species, but as the type has disappeared, and no specific characters have been published for the name, it is difficult to be certain on that point.

3. Bucco pulmentum.

Tamatia (*Nyctactes*) *pulmentum*, Bp. et Verr. MS.

B. supra fusco-brunneus; fronte et superciliis rufescentibus; torque angusto nuchali inconspicuo albido; dorsi medii alarum uropygiique plumis partim fulvo terminatis: subtus albus; gutture inferiore pallide rufescente; plaga utrinque gutturali *magna cum maculis crebris pectus totum et ventrem (præcipue ad latera) occupantibus atris: rostro nigro.*

Long. tota 5·0; alæ 3·1; caudæ 2·5.

Hab. In Peruvia Orientali et regionibus fl. Amazonum superioris: Pebas (*Cast.* et *Dev.*): Chamicurros (*Hawxwell*). Mus. Paris., Joh. Gould et P.L.S.

Obs. Sp. *Bucconi tamatiæ* affinissima, sed gula pallidiore et maculis ventris majoribus et intensioribus differt.

This appears to be a western representative of the *B. tamatia* of Cayenne, from which, however, I think it may be fairly separated. MM. Verreaux of Paris have lately received a considerable number of specimens of it from the Upper Amazon. They all present the same distinctive characters as are above noticed.

4. Monasa peruana.

Monasa peruana, Bp. et Verr. MS.

M. plumbescenti-nigra, capite et gutture intensioribus; fronte et menti summa parte albis: rostro ruberrimo.

Long. tota 11·0; alæ 5·0; caudæ 4·5.

Hab. In Peruvia Orientali in regionibus fl. Amazonum superioris: Chamicurros (*Hawxwell*). Mus. Joh. Gould et P.L.S.

Obs. Simillima *M. personatæ* sed rostro clarius rubro, mento ad ipsam apicem solum albo haud nisi dubie disjungenda.

My specimen of this bird was obtained from the MM. Verreaux, and carries the MS. name above quoted, which I have thought it as well to adopt. The characters which separate it from its well-known Brazilian representative are certainly very slight, but appear to be constant in at least a dozen examples I have examined from the same locality.

5. Bucco picatus.

B. supra niger; plaga in summis scapularibus utrinque magna et maculis in pileo rotundis cum loris albis: subtus albus; vitta lata pectorali nigra: cauda nigra, rectricibus tribus utrinque extimis in medio et harum omnium apicibus albo maculatis: rostro pedibusque nigris.

Long. tota 6·7; alæ 3·2; caudæ 2·3.

Hab. In reg. fl. Amazonum superioris; Chamicurros (*Hawxwell*). Mus. Joh. Gould.

Obs. Species *Bucconi tecto* forsan nimium affinis, et ob crassitiem majorem, torquem pectoris latiorem et caudam minus albo maculatam non sine dubio constituenda.

Mr. Gould's collection contains two examples of this bird, which he has entrusted to me for comparison with its Cayenne representative. It is not, however, without hesitation that I have determined to separate them from it. Besides their larger size and broader breast-band, the white medial square spot extends in the present species only through the three lateral rectrices, with a slight trace of it in the fourth.

In the Cayenne bird the outer five pairs are all strongly marked thus. The whole plumage of the bird is also generally more intensely black.

6. Malacoptila nigrifusca.

Malacoptila fusca, ex Bogota, Sclater, P. Z. S. 1855, p. 136.

M. nigricanti-brunnea, plumarum scapis pallide fulvis; loris et plumis mystacalibus cum plaga triangulari super-pectorali albis: ventre medio crissoque fere unicoloribus, albicantioribus; rostri basi læte aurantia, apice nigro; pedibus nigricanti-brunneis.

Long. tota 6·5; alæ 3·5; caudæ 2·5.

Hab. In Nova Granada, Santa Fé de Bogota. Mus. Brit. et Joh. Gould.

Obs. Sp. *Malacoptilæ fuscæ* affinissima sed statura minore et coloribus nigricantioribus: rostri basi lætius aurantia.

This New Grenadian bird, which in my Synopsis of this family and List of Bogota birds I united with the true *fusca* of Cayenne, certainly presents considerable claims for specific distinction. The body is generally smaller, the bill in particular is shorter and not so strong, and at the base is of a deep orange colour instead of pale yellow, the black not extending so far towards the base of the upper mandibles; the markings on the head, throat and breast also, are much blacker, and I have therefore named the bird *nigrifusca*. There are specimens of it in the British Museum and in Mr. Gould's collection.

The East Peruvian or High-Amazon examples on the other hand (which are held distinct by some naturalists under Du Bus' title *inornata*) resemble the Cayenne bird much more nearly. After remarking that the white lore-spot is nearly obsolete, and the skins are rather finer and larger, it is in truth difficult (at least with my present examples) to see further differences, and I therefore regard *M. inornata* as a very doubtful species.

Rio Napo specimens are still more like the true *fusca*.

On some New Species of Freshwater Tortoises from North America, Ceylon and Australia. By Dr. J. E. Gray, F.R.S., F.R.G.S. etc.

Fam. I. Emydidæ.

The freshwater Tortoises which have been referred to the genus Emys, as it is at present constituted, may be divided into two very distinct genera; and this is the more advisable as it is extremely difficult to distinguish the American species of which it is composed, and the separation of any of them by organic characters must facilitate the process. The genera may be thus named and defined:—

1. Emys.

The lower jaw rounded beneath, and covered with the hinder part of the horny beak; the toes strong, covered with broad band-like scales.

This genus includes *E. ornata, E. scripta, E. Holbrookii,* and many other species, both Asiatic and American.

2. Pseudemys.

The lower jaw flattened beneath and covered with a soft skin. The toes weak, slender, covered with small scales above, and very broadly webbed.

1. *Pseudemys concinna.*
2. *P. serrata.*

The genera *Batagur* and *Malaclemys* have nearly similar feet, and they appear, like *Pseudemys*, to be the most aquatic animals of the family.

The species which have hitherto been referred to the genus CISTUDO differ considerably in their habits, some being nearly terrestrial and others almost exclusively aquatic. The examination of the animal shows that there are good external characters by which they may be divided into natural groups agreeing with their habits and their geographic distribution.

I. The more terrestrial have the front of their legs covered with thick, imbricate, triangular scales, the toes only slightly webbed, and the sternum broad, hiding the legs when withdrawn, as—

1. CISTUDO.

The head rhombic, the forehead flat, and eyes lateral: confined to N. America; as

C. Carolinensis, with four, and *C. Mexicana*, with only three toes on the hind feet.

2. LUTREMYS.

The head oblong, depressed, with the eyes on the upper part of the cheek. Found in Europe, as *L. Europæa*.

II. The more aquatic kinds have the front of the legs covered with small scales and some broad, transverse, lunate plates; the toes webbed. They are confined to Asia; as

3. CUORA.

The head rhombic, the eyes lateral, the sternal lobes broad, hiding the legs when contracted, as *C. Amboinensis* and *C. trifasciata*.

4. CYCLEMYS.

The head depressed, eyes subsuperior, the sternal lobes rather narrow, not hiding the legs when contracted, as *C. dentata* and *C. platynota*. The latter species was referred to the genus *Testudo* by F. Müller, and when I first described it I considered it as an *Emys*, but the examination of a series of specimens of different ages shows that it is a species of Box Tortoise nearly allied to *C. dentata*.

It has been hitherto believed that there was only a single species of the genus KINOSTERNON, as now restricted, found in the United States; and all the adult specimens I have received from that country are, I must own, exceedingly alike, so much so that I cannot undertake to say that we have adult specimens of more than a single species. On examining the young specimens of this genus from the United States, in the Museum Collection, it is evident that there are at least three most distinct species found in that country, which probably in their eroded and discoloured adult state are so alike as to be mistaken for one another.

They may be thus described:—

1. Kinosternon Pensylvanicum.

Head brown-dotted; temples with two parallel distant streaks of white spots, from the upper and lower edge of the orbit, and a third streak across the lower jaw; neck white-dotted; back deep brown; lower side of marginal shields, the axillary and inguinal plates and each of the sternal plates with a large yellow spot; sternum broad, rounded before and behind.

Hab. North America, Florida, *E. Doubleday, Esq.*

2. Kinosternon Hippocrepis.

Head brown, with a broad white streak on each side, from the end of nose over the eyebrows to the sides of the nape; back pale and sternum brown; dorsal shield with a single apical and some scattered black spots; under side of each marginal and sternal plate rather paler in the middle; sternum rather broad, rounded in front and slightly truncated behind.

K. Pensylvanicum, Holbrook, N. Amer. Herp. t. 21.

Hab. North America, New Orleans, *E. Doubleday, Esq.*

3. Kinosternon punctatum.

Head brown, minutely white-dotted, without any streaks; the back brown, discal shield with a very distinct apical, and some scattered black spots; margin with a very narrow white line; under side whitish, with minute scattered black dots and line; sternum narrow, contracted at each end, and with straight sides behind, rather truncated in front and more distinctly and broadly so behind.

Hab. North America.

There are several specimens of the first species of different ages from various parts of the States, in the British Museum; I have therefore retained for it the more general name; and two young specimens and a half-grown one of the second species, and only a single young specimen of the third species; the latter is so distinct, by the narrow form of its sternum, from the other two, that it might be referred to the genus *Aromochelys* if the pectoral plates were not triangular; it may be considered as the species passing towards that genus, and I should think that the adult animal must differ considerably from the common form of *K. Pensylvanicum.*

Aromochelys.

The Musk Tortoise, or, as it is more commonly called, the Stinkpot of North America, is easily distinguished from the other *Kinosterna* by the narrowness of the sternum and the humeral plates being square, like the pectoral one, instead of triangular, as they are in *K. scorpoides* and *K. Pensylvanicum.* For this reason I have proposed to divide them into a distinct group under the name of *Aromochelys.*

I am the more inclined to do so, as there are two most distinct species in the British Museum Collection, which have either been confounded together by the American naturalists, or have been most unaccountably overlooked. They may be thus defined:—

1. Aromochelys odorata.

Head moderate, with two streaks from the nose, one above and the other under the eyes, to the side of the neck; the back oblong-convex, the vertebral line rather flattened; the gular plate small, triangular, the humeral plate rather oblique, shield brown, purple-brown spotted.

Holbrook, N. Amer. Herpet. t. 22.

Hab. United States and Louisiana.

2. Aromochelys carinata.

We have four specimens of this species in the Museum Collection. Cat. Tortoises B.M. t. 20 *a.*

Head very large, black-dotted, without any lateral streaks; back, oblong, very high, the vertebral line high and acutely keeled the whole length, shields grey-brown, spotted and lined with purple-brown; the gular plate very small, linear, transverse marginal, the humeral plate square, transverse, parallel to the pectoral plates.

Hab. North America, Louisiana.

There are two species of North American Tortoises which are referred to the genus Chelydra, which are so differently organized that they are evidently the types of two very distinct genera, which may be thus characterized:—

1. Chelydra.

Head moderate, rather depressed, covered with a soft skin, chin bearded, neck granular; back with two slight keels; marginal plates in a single series.

Chelydra serpentina.

2. Macrochelys.

Head large, angular, contracted in front, covered with symmetrical horny plates, neck with several series of spinose warts; back with three sharp continued tubercular keels; the lateral marginal plates in a double series.

M. Temminckii.

Fam. II. Chelydidæ.

When Australia was first visited by Sir Joseph Banks, he brought home with him from New Holland a freshwater Tortoise, which Dr. Shaw described under the name of *Testudo longicollis.* This has been made the type of the genus Chelodina. Recent travellers in Australia have shown that the genus is distributed over the country; each part appears to have a species peculiar to itself. In Capt., now Sir George Grey's Travels, I described and figured a species from Western Australia under the name of *Chelodina oblonga.* In a collection which we have lately received from Haslar Hospital, there are two very large specimens of the genus sent from Swan River by the late Mr. Collie, which, though similar in several respects to

Chelodina oblonga, may be considered as a distinct species, which I shall proceed to shortly characterize.

The species of the genus hitherto described have the thorax covered with very thin smooth shields, so transparent that a peculiar black reticulated appearance, which exists between the shields and the bones of the thorax, can be distinctly seen through them. This character is common to *C. longicollis* of New Holland, *C. oblonga*, and Mr. Collie's species from Swan River, which I propose to call, in honour of my late friend and excellent collector—

1. Chelodina Colliei.

The shield oblong, elongate, contracted and revolute on the sides; under side uniform pale yellow.

Hab. Swan River, *Alexander Collie, Esq.*

This species agrees with *C. oblonga* in the uniform colour of the back and sternum, which is only varied by the dark lines of the netted appearance before referred to; but it is easily known from that species by its larger size, the much narrower shape, and the lateral margin becoming strongly revolute, and the edge over the hinder limb raised up and rather expanded.

The British Museum have lately received, with some other specimens, from the Australian continent—but unfortunately the special habitat was not indicated—the shell of a Tortoise which has all the characters of the genus as at present defined, except that, instead of the shields on the thorax being thin, submembranous and semitransparent, they are thick, horny and concentrically grooved like the shields of many other genera. It is not accompanied by the head or limbs of the animal, so we have not the means of determining if they offer any characters which, with the peculiar structure of the shell, might render it desirable to form it into a separate genus. It may be defined and thus named :—

2. Chelodina sulcata.

Shell depressed, roundish ovate, brown; shield horny, thick, distinctly concentrically grooved.

Hab. Australia.

Fam. III. Trionycidæ.

The species of this family, which have the hind legs covered with moveable flaps affixed to the sides of the hinder lobe of the sternum, named *Cryptopus* by MM. Dumeril and Bibron, may be divided into two very distinct geographic genera.

1. Emyda, Gray.

The margins of the upper shield strengthened with bones; the sternum with three pairs of callosities and a small odd one behind the anterior pair. Asia.

2. Cyclanosteus, Peters.

The margin of the upper shield flexible, without any bones; the sternum with four pairs of callosities and an odd one behind the two anterior pairs; the pair on the hinder lobes small, far apart. Africa.

It has been usually stated that the only known species of the genus Emyda was generally distributed over India; we have in the British Museum specimens only from the Valley of the Ganges. The young specimens all agree in the head and shell being variegated.

We have lately received a specimen of this genus from Ceylon, collected by Mr. Thwaites, which differs in both the above particulars; and in the Museum of the Society there is the shell of an adult animal, sent home from Ceylon by Dr. Kelaart, which shows that it is a most distinct species. They may be thus characterized:—

1. Emyda punctata.

Back and upper part of the head pale spotted; the odd anterior callosity small, roundish triangular; the hinder callosity of adult ovate, inner edge semicircular; of young triangular, far apart.

Hab. India, Ganges.

2. Emyda ceylonensis.

Back and upper part of the head (in spirits) dull pale olive; lips, chin and lower part of the body whitish. The odd anterior sternal tubercle large, oblong, transverse; the hinder pair of callosities large, close, in adult nearly united, with straight parallel inner edges.

Emyda punctata, Kelaart, Prod. Faun. Ceylon. 179.

Hab. Ceylon.

Dr. Kelaart, in his work on the Ceylon animals, was not aware of the distinctness of this animal from the continental species; he observes that the head is black-lined when alive.

The new species described in this paper are figured in the Illustrated Catalogue of Tortoises in the Collection of the British Museum.

MISCELLANEOUS.

On the Vitality of the Anguillulæ *of Mildewed Wheat.* By C. Davaine.

The *Anguillulæ* of wheat in the larva state are endowed with the power of remaining dry and apparently dead for several years, and recovering their powers of movement when moistened. This is not the case with these animals after they have acquired sexual organs.

In the larva state also they exhibit a remarkable resistance to the action of violent poisons, provided these are not of a nature to act upon their tissues. The author has found by experiment, that opium, the salts of morphine, belladonna, atropine, strychnine, and its compounds, &c., have no action upon these animals. In a concentrated solution or paste of these substances, they continued to live and move for a fortnight. Nicotine, on the contrary, soon destroys their movements, but not their vitality, for after remaining several days in contact with this substance, they become as lively as ever when freed from it by washing.

Organic matters, and especially animal matters in a state of decomposition, have the same action as nicotine upon the *Anguillulæ*. A little piece of meat, cheese, some paste, &c., put into the water containing them, will render the whole of them straight and stiff in the course of a few hours in hot weather. By drying and again moistening them, or by washing them constantly with pure water, they soon begin to move again, and the author has repeated this resuscitation frequently with the same individuals. So great is the influence of decomposing animal matters upon the *Anguillulæ*, that if a few of them be crushed in opening a mildewed grain, this will be sufficient to prevent the others from moving when placed in a small quantity of water.

Substances which act chemically upon the tissues, and especially acids, destroy these animals more or less quickly; sulphuric acid, diluted with 200 volumes of water, kills them in a few hours, and may be employed to destroy them in seed corn. This action, which is common to all acids, is the more singular, as other *Anguillulæ* live and breed in vinegar.

These animals also support an intense cold. The author has exposed them to a temperature of —4° F. for several hours without killing them. Heat on the contrary is fatal to them, and they perish at about 148° F., whilst the Rotifera and Tardigrada support a heat of 212° F. The author remarks, that as wheat loses its germinative power at about 148° F., it was unnecessary that these animals should be enabled to bear a higher temperature.

The adult *Anguillulæ* exhibit far less tenacity of life in all these respects. The larvæ live two months or more in water; the adults on an average a day and a half. The extreme limit was five days. The larvæ live at least two hours in sulphuric acid diluted with 200 volumes of water; the adults less than one hour. In a mixture of 3 parts of water and 1 of alcohol, the larvæ live for six hours or more, the adults only two hours. The larvæ kept for more than a month in glycerine are soon revived when put into pure water; the adults could not be resuscitated after lying in this substance for two hours. Five hours' exposure to a temperature of —4° F. does not injure the vitality of the larvæ, whilst exposure for the same period to a temperature of + 3° to + 4° F. always kills the adults. The larvæ may be kept dry for several years and revived by placing them in pure water; whilst the adults after a desiccation of a few hours have entirely lost their vitality.

The author has also made some experiments with the view of determining whether these singular little animals would undergo any metamorphosis if placed in conditions different from those in which they usually occur, and found that changes of habitat produced no modifications in their characters, which would approximate them to the other Nematoid worms. He placed the larvæ in vegetable mould, in vinegar and flour paste, and administered them to animals. In no case did the *Anguillulæ* acquire the appearance of the Nematoid worms which live naturally in such situations, and when administered to cold-blooded animals they were evacuated in a motionless state, but still alive.—*Comptes Rendus*, July 21, 1856, p. 148.

Notice of a new species of Nocturnal Lizard from Mexico. By Dr. J. E. Gray, F.R.S. &c.

Among the animals collected at Cordova in Mexico by M. Sallé, lately added to the Zoological Collection of the British Museum, is a fine specimen of nocturnal Lizard, belonging to the genus *Cubina*, which appears to have hitherto escaped the notice of zoologists.

Cubina grandis.

Blackish, brown beneath, crown black spotted; nape with an elongated oblique spot on each side, forming an imperfect crescent; back with five narrow, the tail with eight broad white cross rings, the one on back of the neck just in front of the shoulders crescent-shaped, the rest transverse.

The back and legs covered with close, rounded, smooth tubercles; the tail with regular rings of small, less raised tubercular scales; the crown of the head with smooth scales; the temple with conical acute tubercles; the belly covered with smooth, rather elongated, square, four-sided shields; the under side of the tail with smaller, narrow, more elongated similar shields; the chin and throat with small granular scales; labial shields moderate, four-sided, with three rows of larger six-sided shields on the edge of the jaw, below the lower labial plates, the hinder one of the series being rather smaller and slightly keeled; the toes elongate, narrow, black above, with a white ring over each joint.

Body and head, 5; tail, 5 inches.

Hab. Mexico, near Cordova (*M. Sallé*).

On a new genus and species of Trochilidæ *from Ecuador.* By John Gould, F.R.S. &c.

This fine species of Humming Bird is remarkable for its size, deeply forked tail, and the harmonious hues of its plumage, which, although less glittering and metallic than in many other species, is nevertheless strikingly beautiful. I consider this bird to be new to science, both generically and specifically, and as the name of *Victoria regia* has been given to one of the finest flowers of the same part of South America, I am desirous of dedicating this new Humming Bird to the Empress of the French, and I accordingly propose to name it *Eugenia imperatrix.* Its native habitat is the vast Andean forests in the neighbourhood of Quito in Ecuador, where it procures its insect food from the bell-shaped flowers of the *Daturæ.*

Genus Eugenia.

Gen. Char. Bill rather lengthened, straight and strong; wings long and pointed; tail lengthened and very much forked, the feathers narrow and rigid; tarsi clothed with feathers nearly to the toes; feet small.

Eugenia imperatrix.

Male. Face and fore part of the neck brilliant grass-green; crown of the head, back, neck, chest and upper part of the flanks very deep green; on the centre of the throat a gorget of reddish-violet; abdomen and under tail-coverts shining, greenish-yellow; wings purplish-brown; tail deeply forked, the feathers black, narrow and rigid; some tufts of white downy feathers across the lower part of the abdomen; thighs brown in front, white behind.

Total length $6\frac{1}{4}$ inches; bill $1\frac{1}{4}$: wing $3\frac{1}{3}$; tail 3.

Female. Upper surface green; throat, chest and abdomen greyish-white spangled with green, the spangles being very minute on the throat and gradually increasing in size downward to the flanks; tail blackish-brown; tarsi white.

Total length $5\frac{1}{2}$ inches; bill $1\frac{3}{8}$; wing $2\frac{3}{4}$; tail $2\frac{3}{8}$.

Hab. Ecuador.—*Proc. Zool. Soc.*, Nov. 13, 1855.

METEOROLOGICAL OBSERVATIONS FOR JULY 1856.

Chiswick.—July 1. Cloudless, with very dry air. 2. Dry haze: very fine. 3. Clear and very fine. 4. Fine: overcast: slight rain. 5. Fine: overcast: very fine. 6. Very fine: lightning, with rain at night. 7. Densely clouded: rain. 8. Very heavy rain, cold and boisterous. 9. Fine. 10. Very fine. 11. Cloudy: slight drizzle: fine. 12. Overcast. 13. Very fine: overcast: cloudy. 14. Very fine: overcast. 15. Cloudy and fine: lightning, with rain at night. 16. Rain: heavy clouds and showers: very fine. 17. Very fine. 18. Overcast: drizzly: very fine. 19. Fine: overcast. 20. Slight drizzle: overcast: rain. 21. Very fine. 22. Sultry. 23. Slight fog: very hot: cloudy: lightning. 24. Shower: very hot. 25, 26. Exceedingly fine. 27. Overcast: rain. 28. Cloudy: very fine: hazy. 29. Slight fog: very fine. 30. Uniform haze: very fine. 31. Slight fog: very sultry: clear and fine.

Mean temperature of the month	61°·20
Mean temperature of July 1855	62 ·99
Mean temperature of July for the last thirty years	63 ·11
Average amount of rain in July	2·558 inches.

Boston.—July 1—4. Fine. 5. Cloudy. 6. Cloudy: rain P.M. 7. Cloudy: rain A.M. and P.M. 8. Fine: rain A.M. and P.M. 9. Fine: rain P.M. 10. Fine. 11. Cloudy. 12. Cloudy: rain A.M. and P.M. 13. Cloudy. 14. Fine. 15. Cloudy. 16. Cloudy: rain A.M. and P.M. 17. Fine. 18. Rain A.M. and P.M. 19. Fine. 20. Cloudy. 21, 22. Fine. 23, 24. Cloudy. 25. Fine: rain P.M. 26. Cloudy. 27. Cloudy: rain A.M. 28—31. Fine.

Sandwick Manse, Orkney.—July 1. Bright A.M.: clear P.M. 2. Clear A.M. and P.M. 3. Clear A.M.: showers P.M. 4. Drizzle A.M. and P.M. 5. Cloudy A.M.: drizzle, showers P.M. 6. Showers A.M.: drizzle, showers P.M. 7. Rain A.M.: bright P.M. 8. Drizzle, showers A.M. and P.M. 9. Drizzle, showers A.M.: cloudy P.M. 10. Cloudy A.M. and P.M. 11. Cloudy A.M.: rain P.M. 12. Bright A.M.: bright, fine, thunder P.M. 13. Bright A.M.: cloudy, fine P.M. 14. Clear, fine A.M.: cloudy, rain P.M. 15. Cloudy A.M. and P.M. 16. Drizzle A.M.: rain P.M. 17. Clear A.M. and P.M. 18. Rain A.M.: showers P.M. 19, 20. Drizzle A.M.: damp P.M. 21. Bright, fine A.M. and P.M. 22. Clear, fine A.M.: cloudy, fine P.M. 23. Rain A.M.: cloudy, fine P.M. 24, 25. Bright A.M.: bright, fine P.M. 26. Clear A.M.: showers P.M. 27. Bright A.M.: showers P.M. 28. Showers A.M.: cloudy, fine P.M. 29. Clear, fine A.M.: rain P.M. 30. Bright A.M.: hazy P.M. 31. Cloudy, fine A.M.: rain P.M.

Mean temperature of July for previous twenty-nine years ...	55°·22
Mean temperature of this month	54 ·77
Mean temperature of July 1855	59 ·19
Average quantity of rain in July for previous sixteen years ...	2·45 inches.

Meteorological Observations made by Mr. Thompson *at the Garden of the Horticultural Society at* Chiswick, *near London; by* Mr. Veall, *at* Boston; *and by the* Rev. C. Clouston, *at Sandwick Manse*, Orkney.

Days of Month.	Barometer.					Thermometer.					Wind.			Rain.		
	Chiswick.		Boston. 8¾ a.m.	Orkney, Sandwick.		Chiswick.		Boston. 8¾ a.m.	Orkney, Sandwick.		Chiswick. 1 p.m.	Boston.	Orkney, Sandwick.	Chiswick.	Boston.	Orkney, Sandwick.
1856. July.	Max.	Min.		9¾ a.m.	8½ p.m.	Max.	Min.		9¾ a.m.	8½ p.m.						
1.	30·202	30·178	29·74	30·17	30·17	71	44	53	49	49½	ne.	n.	nw.	....	·06	....
● 2.	30·193	30·162	29·74	30·17	30·20	72	36	55	51	48½	ne.	nw.	nw.	....	....	....
3.	30·217	30·170	29·76	30·16	30·10	73	37	58	54½	50½	ne.	n.	sw.	....	....	·02
4.	30·100	30·022	29·62	29·92	29·95	78	48	63	52½	50½	nw.	wnw.	nw.	·01	....	·08
5.	30·014	29·993	29·54	29·87	29·71	76	45	63	56	50½	w.	wnw.	wsw.	....	....	·03
6.	30·002	29·943	29·48	29·59	29·56	77	49	62	52½	48½	w.	w.	wnw.	·02	....	·07
7.	29·769	29·342	29·23	29·45	29·48	62	44	62·5	47	43½	sw.	wsw.	wnw.	·25	·06	·27
8.	29·682	29·308	28·83	29·48	29·56	48	39	56	49½	46	nw.	nw.	nw.	·48	·49	·05
9.	29·851	29·745	29·32	29·57	29·65	64	37	57	50	47	nw.	nw.	wnw.	·01	·46	·02
☽ 10.	29·926	29·910	29·50	29·72	29·75	74	50	55	55	51½	nw.	nw.	se.	....	·08	....
11.	29·906	29·848	29·43	29·62	29·62	73	56	65	57	51½	sw.	wsw.	w.	·02	....	·38
12.	29·874	29·790	29·33	29·64	29·64	70	42	66	54½	51	sw.	w.	calm	·01	....	....
13.	29·898	29·871	29·38	29·71	29·80	73	52	59	54½	52	sw.	nw.	nw.	....	·16	....
14.	29·993	29·920	29·47	29·83	29·66	73	52	63	58	52½	s.	s.	se.	....	....	·22
15.	29·990	29·834	29·43	29·51	29·53	77	52	70·5	61½	59½	sw.	ssw.	se.	·11	....	·04
16.	29·992	29·737	29·20	29·64	29·77	68	43	69	54	49½	sw.	sw.	nw.	·08	....	·19
○ 17.	30·104	30·080	29·56	29·85	29·85	71	40	58	54	49	w.	w.	nw.	....	·19	....
18.	30·030	30·009	29·48	29·63	29·57	77	49	61·5	51	52½	sw.	w.	wsw.	·01	....	·34
19.	30·005	29·979	29·44	29·71	29·85	76	61	66·5	53	52½	w.	w.	wnw.	....	·02	·02
20.	29·997	29·941	29·48	29·89	29·93	71	57	67	53	50	nw.	w.	wnw.	·04	....	·01
21.	29·991	29·949	29·39	29·87	29·81	75	60	69	57	50	nw.	nw.	ese.	·07	....	....
22.	29·939	29·833	29·23	29·72	29·63	83	47	67·5	65½	57	sw.	sw.	sse.	....	....	·02
23.	29·730	29·604	29·03	29·59	29·50	86	57	75	58½	57	se.	sw.	se.	....	....	·19
☾ 24.	29·683	29·607	29·30	29·44	29·53	77	54	63	60½	55	sw.	w.	calm	....	....	....
25.	29·953	29·801	29·46	29·65	29·67	76	40	64	60½	53	sw.	sw.	sse.	....	....	....
26.	30·060	30·010	29·57	29·63	29·71	76	41	67	60	56	sw.	sw.	ssw.	·02	·21	·10
27.	30·103	30·022	29·46	29·74	29·82	77	50	65	57	54	sw.	sw.	wsw.	·22	·07	·04
28.	30·064	29·980	29·65	29·87	30·00	79	50	66	57½	53	sw.	sw.	wnw.	·08	....	·04
29.	30·194	30·135	29·64	29·97	29·75	80	51	68	57½	56	sw.	s.	s.	....	....	·73
30.	30·244	30·213	29·65	29·87	30·04	87	50	70	56½	54	w.	sw.	w.	....	....	·17
● 31.	30·227	30·161	29·67	30·01	30·06	90	52	68	58	57	s.	sw.	sw.	....	....	·33
Mean.	29·998	29·906	29·45	29·758	29·770	74·51	47·90	63·6	55·35	54·20				1·43	1·80	3·36

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SECOND SERIES.]

No. 106. OCTOBER 1856.

XXV.—*Monograph of the British* Umbilicariæ. By the Rev. W. A. Leighton, B.A., F.B.S.E.

[With a Plate.]

The *Umbilicariæ* constitute a distinct and well-marked group of Lichens. Their thallus bears a general external resemblance to that of some species of *Endocarpon* (e. g. *End. miniatum*), but the different internal structure shows these genera to have no real connexion. Their apothecia approximate in external form to those both of *Lecidea* and *Opegrapha*. But this resemblance is limited to external character alone, for dissection demonstrates that there is no affinity in structure between the plants. The apothecia of the *Umbilicariæ* are entirely destitute of that black carbonaceous excipulum which is so conspicuous a feature of the *Lecideæ*. Their structure greatly assimilates, and indeed is almost identical with, that of the apothecia of the plant generally known as *Lecidea vesicularis*, Ach. With the *Opegraphæ* the resemblance is altogether external, the gyrations or reduplications to which the apothecia are subject alone constituting the similarity; internal structure being here also entirely different.

The structure of the thallus appears to be alike in all the plants included in the genus, however dissimilar their external aspect may appear. The only differences apparently arise from one portion or layer being more or less developed in growth, probably from local circumstances, than another. This has been admirably investigated, described and figured by M. L. R. Tulasne, in his "Mémoire des Lichens," published in the 'Annales des Sciences Naturelles,' 3 série, tom. xvii. The thallus of *U. pustulata*, he says, presents a double cortical layer. The superior cortex is formed of small polygonal cells intimately united, and its superficial brown colour is veiled by a sort of furfuraceous powder, whose cellular elements, very irregular, are unequally distributed and variously associated. The cortical layer of the inferior face of the thallus is about double the thickness of the preceding, and forms with it nearly a fourth part of the entire thickness of the lichen. This part of the plant is greyish, of a horny consistence, and very hygrometric. It is constituted, as nearly all the tissues of this sort, by globular utricules, with extremely thick walls, and so united to each other, that the external contours of each of them are indistinct. This horny layer bears on its free face an infinity of minute papillæ of a conical or pyramidal form, and which are continuous with it, that is to say, formed of a tissue entirely similar, but of a very deep brown colour. The fibrous medulla which occupies the middle of the thallus, is, as in most foliaceous lichens, a loose tissue filled with air, above which, the spherical gonidia form a slight continuous layer. The structure of the other species scarcely differs in any material point of view. In our plate (Pl. X. fig. 1) we have copied M. Tulasne's exquisite illustrative section.

The apothecia arise from the medullary layer, and their development appears to take place somewhat in the following manner. In the spot where an apothecium is about to appear, the cortical layer is, by the uplifting of the medullary layer, formed into a small wart or tubercle. This tubercle opens in the middle, the hymenium appears exposed to view, the cortical layer is on either side thrown back or reflected upon itself so as to constitute a kind of excipulum to the hymenium, which is gradually and progressively protruded upwards by the medullary layer, until a fully expanded apothecium is formed, sessile or closely appressed on the surface of the thallus. The apothecia are of a deep black or brown colour, but a vertical section shows this tint to be confined exclusively to the surface of the disk and of the excipulum. The base of the hymenium is not subtended by any carbonaceous mass, as in the *Lecideæ*, the medullary layer becoming in that part of a brown colour more or less deepened in tint. The apothecia are either simple, forming a single patellula, or compound, consisting of numerous gyrations having much the general appearance of the lirellæ in the *Opegraphæ*. The internal structure is the same in both cases; and dissection shows that the compound apothecia result, not from a division of the disk of a single patellula, but from a great number of apothecia springing from the same spot, forced, by excessive compression against each other and growth within a limited circular space, to assume a gyrate direction, and to exhibit the singular appearances for which the apothecia of the genus are so conspicuous and remarkable.

So far as my opportunities of research extend, the first writer who mentions these plants is Tournefort, in his Institutiones Rei Herbariæ, 1710, who describes, in the concise manner usual with earlier writers when treating of Lichens, two species, *U. pustulata* and *grisea*. Vaillant, following his great master, in his Botanicon Parisiense, 1727, describes and figures the same two species, with that characteristic accuracy and fidelity for which his plates are so valuable. Micheli, in his Nova Genera Plantarum, 1729, makes *U. pustulata* the sole type and constituent of his 18th Ordo of Lichens, in which the seeds are disposed "in comosa arbuscula" over the whole surface of the plant. These seeds, which are now ascertained to be pulverulent excrescences of the thallus, he figures with much accuracy, and also the apothecia, of which however he takes no notice in his description, possibly supposing them to be only the incipients of the fructification which would be ultimately developed into the "comosa arbuscula." His tab. 47 represents characteristically a very large specimen in that torn or deeply divided state frequently observable when the plants attain considerable magnitude, and apparently resulting from this excess of growth. He complains that Vaillant's figure is taken from too small a specimen, but identifies it with his own, having received an authentic specimen from Vaillant himself. Dillenius, in his Historia Muscorum, 1741, describes at length and figures *U. proboscidea*, Turn. and Borr., *grisea*, Ach., *erosa*, Hoffm., *arctica*, Ach., *polyphylla*, T. and B., *pellita*, Ach., and *pustulata*, Ach.

Linnæus, in Species Plantarum, 1763, under his section Lichenes Umbilicati includes six species, *velleus*, *pustulatus*, *proboscideus*, *deustus*, *polyphyllus*, and *polyrrhizos*. The same arrangement is followed by Pollich (Flor. Palat. 1777), Lightfoot (Fl. Scot. 1777), Weber (Spicil. Gotting. 1778), Hudson (Fl. Angl. 1778), Hagen (Tent. Pruss. 1782), Humboldt (Fl. Frib. 1793), Retz (Fl. Scand.1795), Withering (Arrang. 1795), Afzelius (Act. Upsal. 1788), Westring (Act. Sc. Stockh. 1793), and Acharius (Act. Sc. Stockh. 1794), varying indeed in the number of species described according to the circumstances of their respective localities. Hoffmann, in his Plantæ Lichenosæ in 1788 (according to the date on his tab. 2) first uses the generic name *Umbilicaria*. He figures with inimitable beauty and accuracy eleven species. This name *Umbilicaria* was immediately adopted by Baumgarten (Flor. Lips. 1790), Schrader (Spicil. 1794), and Acharius (Prodr. 1798). In this latter work it should be mentioned that Acharius refers *murinus* to the genus *Endocarpon*. The generic name *Umbilicaria* is very aptly taken from the umbilicate thallus; but Acharius, in his Meth. Lich. 1803, changed it to *Gyrophora* from the external appearance of the fructification, because he thought it most probable that future observation would show that *Lecidea Oederi, silacea, privigna,* and other species also, ought to be included in the same genus, because their apothecia became deformed or gyriform like those of *Umbilicaria,* in which case the former name *Umbilicaria* would not be applicable to the genus thus comprehensively considered. Dissection and the microscope have shown that these conjectures of Acharius were groundless, and that there was no real necessity for a change of the generic name. He describes in this work fifteen species, all of which are true *Umbilicariæ,* but refers *pustulatus* to *Lecidea.* Ventenat again changes the generic name to *Capnia.* DeCandolle, in Flor. Franç. 1805, adopts the genus *Umbilicaria* of Hoffmann and Acharius, and enumerates thirteen species, several of which are now considered as varieties or states of the same plants. Acharius retains his name *Gyrophora* in his Lich. Univ. 1810, describing eighteen species, including *murinus* and *pustulatus.* Flörke has some remarks on the genus in the Berlin Magazine for 1810, but which I have not seen. Wahlenberg (Fl. Lapp. 1812) changes the name of the genus to *Gyromium,* but without assigning any reason for so doing, which name he continues in his Flor. Carpath. (1814), Flor. Upsal. (1820), and Flor. Suec. (1824–26). In this latter work he explains the cause of the change to be, from the similarity of the fructification to intestinal convolutions. Turner and Borrer in the Lichenographia Britannica (1813) retain the name *Gyrophora,* as all the generic distinctions in that work had been taken from the fructification. They describe ten species as found in Britain, with an elaborate care and minute fidelity and accuracy which cannot be praised too highly. Another valuable feature of this work was the determination of the plants of Linnæus and Dillenius from their respective herbaria. Acharius (Syn. 1814) extends the number of species to nineteen; one of them, *G. Clementei,* growing on wood, is now referred to *Thelephora quercina,* Pers., all the rest being saxicolar plants. Schærer, in Meisner's Naturw. Anz. 1817, has a paper on the *Gyrophoræ,* and another on the "*Umbilicariæ Helveticæ*" in Seringe's Musée Helvétique d'Hist. Nat. 1821. These he arranges under six species, which he describes at length, adding full synonyms from Vaillant downwards, and illustrates them with five plates filled with beautifully coloured figures of all the species and varieties. In his Spicilegium he refers *U. pustulata* to *Lecidea,* and places all the rest under four species, viz. *U. depressa, U. polymorpha, U. ænea,* and *U. erosa;* whilst in his Enumeratio (1850) he again includes *pustulata,* and rearranges the various forms into eight species. British authors, as Purton, Midl. Fl. (1817), Hooker, Fl. Scot. (1821), and Greville, Fl. Edin. (1824), adopt *Gyrophora* as the genus. Fries in all his works resolutely maintains the original name, *Umbilicaria*, of Hoffmann. Eschweiler, Syst. Lich. 1824, places *Gyrophora* in company with *Solorina*, Ach., *Dermatocarpon*, Eschw., *Endocarpon*, Hedw., *Capitularia*, Eschw., and *Peltidea*, Ach., in his Cohors V. *Dermatocarpeæ*. Wallroth, Crypt. Germ. (1831), makes *Umbilicaria* a section of his genus *Graphis*, considering the affinity in structure of the apothecia with those of the *Graphideæ*, hinted at by Bernhardi, Flörke and DeCandolle, to be correct and well founded. Hooker in Brit. Flor. (1833) follows the arrangement of Fée (Cryptog. Ecorces, 1824) into *Gyrophora* and *Umbilicaria*, from the different external aspect of the apothecia. His distribution of the species differs somewhat from that of the 'Lichenographia Britannica.' Dr. Taylor in Flora Hibernica (1836) again unites the two genera. Merat in Flor. env. Paris (1836) puts *U. pustulata* into a new genus called *Lasallia*. Chevallier (Flor. Paris, 1836) and Flotow (Lichenes Flor. Siles., 1850) separate *Umbilicaria* and *Gyrophora*. Tuckerman, Syn. Lich. Amer. (1848), retains the entire genus *Umbilicaria*, Hoffm., with a modified generic character.

Massalongo (Licheni Crostosi, 1852) retains *Umbilicaria*, Hoffm., for the generality of the species, but refers *U. pustulata* to a new genus, *Macrodictya*, his distinctions being taken from the dissimilarity of the sporidia. In his Memorie Lichenog. (1853) he rejects his new genus *Macrodictya* and adopts Merat's *Lasallia*. In his Systema Lichenum Germaniæ (1854) Koerber separates *Umbilicaria* (*pustulata*) from *Gyrophora*. Nylander in his "Nouvelle Classification des Lichens" in Mém. Soc. des Sc. Nat. de Cherbourg (1854 & 1855), retains the original and comprehensive genus of Hoffmann, *Umbilicaria*, as the type of his tribe *Gyrophoreæ*.

From the preceding summary it is seen, that whilst the plants have retained their relative position as members of a closely connected group, considerable difference of opinion has existed as to the name which should be assigned to it, and whether *Umbilicaria pustulata* should be included in the same genus, or form a distinct genus by itself. From the identity of structure both of thallus and apothecium, I incline to think that it ought, with the other plants, to constitute one and the same genus, and that the original name of Hoffmann, *Umbilicaria*, which appears to have been changed from no really substantial scientific reasons, should be restored to it.

The learned authors of the 'Lichenographia Britannica' complain, and with justice, that the genus has been divided into too many species. In my opinion our British *Umbilicariæ* appear to resolve themselves into two species only, *U. pustulata*, which has peculiar sporidia, and *U. varia*, which may include all the rest, the sporidia being alike in all; and this latter species comprises two series distinguished by the copper or grey colour of the thallus.

1. *Umbilicaria varia*. Thallus coppery or ashy-grey, simple or compound, naked or fringed at the margins; upper surface smooth, efflorescent, granulate, pustulate, areolate, corrugate or reticulated; lower surface smooth, pitted, granulate, papillose, fibrous or reticulated; sporidia in asci, eight, minute, oblong, pale.

* *Thallus dark copper-coloured when dry.*

α. *polyphylla*, Schrad. Thallus thin, unequally lobed, naked and smooth on both sides; upper side greenish copper-colour, under black.

Lichenoides tenue pullum, foliis utrinque glabris, Dill. 225. t. 30. f. 129. A. B. C (1741).
Lichen &c. undique glaber, Linn. Fl. Lapp. no. 452 (excl. syn.).
Lichen polyphyllus, Linn. Sp. Pl. 1618 (ed. 2. 1763); Huds. Fl. Brit. 551; Lightf. Fl. Scot. 2. 863; Robson, Br. Fl. 300; Web. Spicil. 258; Humb. Fl. Frieb. 29; Retz. Scand. 288; With. Arr. 4. 65; Sm. E. Bot. t. 1282.
Lichen glaber, "Ach. in Act. Stockh. xv. 95. t. 2. f. 5" (1794) (fide Ach. et T. & B.); Ach. Prodr. 144.
Umbilicaria polyphylla, Schrad. Spicil. 102 (1794); Hoffm. Fl. Germ. 2. 109; Pl. Lich. 3. 14. t. 59. f. 2; α, Tuckerm. Syn. 71.
Gyrophora glabra, Ach. Meth. 101 (1803); α, Syn. 63. excl. syn. var. *anthracina*; α. & β, Hook. Fl. Scot. 2. 41; Heppe, Fl. Wurzburg. 69; Chev. Fl. Paris, ed. 2. 1. 643.
Umbilicaria glabra α, DC. Fl. Franç. ed. 3. 3. 412 (1805).
Gyrophora heteroidea α. & β, Ach. L. Univ. 218 (1810); Moug. & Nestl. 342!
Gyromium polyphyllum, Wahl. Fl. Lapp. 481 (1812); Fl. Carpath. 394; Fl. Upsal. 423; Fl. Suec. 481.
Gyrophora polyphylla, Turn. & Borr. Lich. Brit. 214 (1813); Hook. Br. Fl. 2. 217; Koerber, Lich. Germ. 95.
Umbilicaria ænea, α. *glabra*, Schær. Spicil. 90. 364 (1826–33); Exs. 149!
Umbilicaria polyphylla, Fries, L. Ref. 352. excl. *b.* & *c.* (1831); S. V. S. 117; Leight. Lich. Brit. Exs. 65!
Umbilicaria polyphylla, α. *glabra*, Schær. Enum. 28 (1850).
Graphis ænea, β. *discolor*, Wallr. Crypt. Germ. 1. 341 (1831).

a. *monophylla*. Thallus of a single peltate leaf.—Turn. & Borr. *l. c.*

Snowdon, *Dillenius*. Cheshire and Cornwall, *Lich. Brit.* Clova! Craig Raynoch! *Mr. W. Gardner in herb. Borrer.* Yorkshire! *Mr. G. Dixon.* Scotland! *Mr. G. Lawson.* Ingleby and

Howden Gill, Cleveland, Yorkshire, *Mr. W. Mudd*! Barmouth, *Rev. T. Salwey*! Wrekin and Arcoll Hills, Shropshire!

"*Thallus* peltate, flattish, consisting of a single leaf, adhering to the stone by a small thickish callous disk, mostly orbicular, but sometimes inclining to elliptical, from half an inch to an inch and a half in diameter; the edges slightly cleft into numerous, irregular, rounded lobes, and minutely, but unequally, crenate: *upper surface* of a greenish copper-colour when moist; when dry, black, or of a very dark brown closely approaching to it, smooth, or rarely very slightly wrinkled, and naked, occasionally marked with minute black dots: *under surface* for the most part perfectly black, whether wet or dry, and usually covered with a fine sooty efflorescence, scarcely perceptible without a microscope, which does not stain the fingers; when this is wanting, the surface is generally most minutely granulated, and in some instances blotched with a colour similar to that of the upper side: *substance* coriaceous, but so thin as to be almost membranous, pliant and soft when moist, rigid and extremely brittle when dry. *Tricæ* very rarely produced, scattered, when present, all over the thallus, sessile, but fixed only by their centre, of an irregularly angular figure; their *margin* thin, notched, enclosing a more or less convex *disk*, the *gyri* of which are not arranged concentrically, but compose, for the most part, several separate groups."—*Turn. & Borr. Lich. Brit.**

Specimens from Upsal, *Fries fil.*, in my herbarium are identical with this form.

b. *congregata*, T. & B. Thalli small, clustered, much curled, edges erect or reflexed.

Maze Beck, Westmoreland! *Mr. W. Robertson in herb. Borrer*. Mynydd-y-Myfyr near Oswestry, Shropshire! *Rev. T. Salwey*. Scotland! *Mr. G. Lawson*. Wrekin and Arcoll Hills, Shropshire! Ingleby, Yorkshire, *Mr. W. Mudd*!

Specimens! from Acharius in herb. Borrer, labelled by himself "*Gyrophora anomæa var. variegata*," are minute specimens of this state of the plant.

The states *monophylla* and *congregata* grow together in some abundance on the Wrekin and adjoining hills, and may be seen passing into each other by every degree of gradation.

c. *sulcata*, T. & B. Thallus marked on the upper side with superficial cracks.

On Ben Ferg, a mountain in Inverness-shire, by the head of Loch Ericht! *Mr. Borrer*. Clova! *Mr. G. Lawson*.

* We have adopted the descriptions from this privately printed work, as little or nothing can be added to their fidelity and accuracy.

"*Thallus* somewhat thicker than in 'a,' simple or more or less compound; *upper surface* marked with a few superficial, undulating, indented lines, the edges of which occasionally separate so as to leave a smooth black interstice; *under surface* as in 'a,' but more commonly blotched with the paler colour of the upper side."—*Lich. Brit.*

This state seems apparently a transition to *hyperborea.*

d. *lacera.* Thallus very deeply divided, divisions lacero-lobate.

Craig Raynoch! *Mr. W. Gardner in herb. Borrer.* Scotland! *Mr. G. Lawson.*

The mode of division of the margins of this state is different from that of the preceding ones, and assimilates to that observable in *anthracina.*

A specimen in my herbarium, collected by M. Philippe at Tourmalet, Pyrenees, agrees with this state.

Mr. Borrer's herbarium contains specimens! of *G. anthracina* from Acharius and Schærer, with which I have not noticed anything identical among British plants. Their general appearance is different from *polyphylla,* but the sporidia are similar. (See Pl. X. fig. 3.)

PLATE X. fig. 2.

β. flocculosa, Hoffm. Thallus thin, unequally lobed; upper side of a greenish copper-colour, dotted, and rough with sooty granulations; under, black, naked, pitted.

Lichen flocculosus, Wulf. in Jacq. Coll. 3. 99. t. 1. f. 2 (1789), fide Turn. & Borr.
Lichen deustus, Schrank, Fl. Salisb. 234 (1792); Westring in Act. Stockh. 1793 (fide Ach.); Ach. Prodr. 145 (excl. Linn. syn.).
Umbilicaria flocculosa, Hoffm. Fl. Germ. 2. 110 (1795); Pl. Lich. 3. fasc. 4. 3. t. 68. figs. 1–4; Massal. Ricerch. 61 (excl. syn.).
Gyrophora deusta, Ach. Meth. 102 (1803); L. Univ. 255; Syn. 66 (excl. Linn. syn. in all); Sm. E. Bot. t. 2483.
Gyrophora flocculosa, Turn. & Borr. Lich. Brit. 217 (1813); Koerber, L. Germ. 95.
Gyromium deustum, Wahl. Fl. Carpath. 394 (1814); Fl. Upsal. 423; Fl. Suec. 856 (excl. Linn. syn.).
Umbilicaria polyphylla, c. deusta, Fries, L. Reform. 352, excl. Linn. syn. (1831); Nyl. Nouv. Classif. 175.
Graphis ænea, α. concolor, Wallr. Crypt. Germ. 1. 341 (1831).
Gyrophora deusta, Hook. Fl. Scot. 42 (1821); Brit. Fl. 2. 218 (excl. Linn. syn.); Grev. Fl. Edin. 328.
Umbilicaria ænea, γ. flocculosa, Schær. Spicil. 91. 364 (1823–36); Exs. 152!
—— *polyphylla, β. deusta,* Tuckerm. Syn. 71 (1848).
—— *polyphylla, β. flocculosa,* Schær. Enum. 28 (1850).
—— *varia, var. flocculosa,* Leight. Brit. Lich. Exsicc. 219!

Highlands of Scotland, *Mr. Dickson.* Corstorphine and Craiglockhart Hills, Maughan, *Dr. Greville*. North of England! *Rev. John Harriman in herb. Borrer*. By the lake by the ascent of Ben Nevis! northern ridge of Ben Cruachan! *Mr. Borrer*. Caer Caradoc, Shropshire! states a. b. & c. growing together.

a. *monophylla*. Thallus of a single peltate leaf.

" *Thallus* consisting generally of a single peltate leaf from 1 to 2 inches in diameter, attached to the rock by a central callous disk, orbicular, flattish, but curled and reflexed at the edges, which are irregularly lacerated or divided into a few unequal shallow lobes: the *upper surface* dark greenish-brown when moist; when dry, of a rusty-brown approaching to black, minutely dotted and sprinkled with a coarse sooty efflorescence, very copious in some specimens, but in others rare, sometimes a little wrinkled about the centre, and occasionally bearing numerous small leafy scales: the *under surface* dark brown or black, naked, quite smooth in general, though now and then most minutely granulated and pitted, more copiously in some specimens than in others, with small depressions, which are often so numerous as to give it an absolutely reticulated appearance: *substance* coriaceous, very thin, so as to be almost membranous; flexible when moist, but rigid and brittle when dry. *Tricæ* rare, scattered about the thallus, sessile, but attached only by the centre, orbicular, their *margin* slightly elevated and entire, their *disk* convex; the *gyri* most frequently concentric, sometimes, but rarely, forming irregular groups."—*Lich. Brit.*

Specimens from Upsal, Sweden! *Fries fil.*, and from the Pyrenees! *M. Philippe*, in my own herbarium, agree with our British plants.

b. *polyphylla*, T. & B. Thalli small, clustered, curled.

Whitwick Rocks, Leicestershire! *Rev. A. Bloxam.*

Thallus composed of numerous small remarkably curled leaves arising from a common central disk and growing in an irregularly orbicular group, the diameter of which is not greater than that of the simple leaf of *monophylla*.

c. *squamigera*. Thallus rough with small scale-like leaves.

d. *erosa*. Thallus with ragged and perforated edges.

The tricæ are figured in 'E. Bot.' from foreign specimens received from Dr. Swartz. None of the British specimens in Mr. Borrer's herbarium bore any fructification, nor those in Schærer's Lichenes Exsiccati.

Closely allied to α. *polyphylla*, and apparently approximating to ε. *erosa* by the state d. *erosa*.

Plate X. fig. 4. Sporidia.

γ. hyperborea, Hoffm. Thallus thin, jagged, and somewhat lobed, a little perforated, naked on both sides; upper side greenish-brown, pustulate; under side blackish-brown, nearly smooth, slightly pitted.

"*Lichen superficie subtus lacunata*, Linn. Fl. Lapp. n. 453" (fide Wahl.).
—— *pullus*, "Wulf. in Jacq. Misc. 2. 83. t. 9. f. 3" (1781) (fide Dicks.); Dicks. Crypt. 2. 23 (secund. specim. in herb. Borrer!).
—— *erosus*, Westr. in Act. Stockh. 1793 (fide Ach.).
—— *hyperboreus*, Ach. in Act. Stockh. xv. 89. t. 2. f. 2 (1794); Prodr. 146.
Umbilicaria hyperborea, Hoffm. Fl. Germ. 2. 110 (1795); Pl. Lich. 3. fasc. 4. t. 71; Stenh. in Sched. Crit. fasc. 5 & 6. no. 126; Fries, L. Ref. 353; S. V. S. 117; L. S. 126 (fide Nyl.); Tuckerm. Syn. 73; Massal. Ricerch. 63. fig. 117; Nyl. N. Class. 175!
Lichen Jacquini, With. Arr. 4. 62? (1796).
Umbilicaria papillosa, DC. Fl. Franç. 3rd ed. 3. 411 (1805).
Gyrophora hyperborea, Ach. Meth. 104 (1803); L. Univ. 225; Syn. 66; Turn. & Borr. Lich. Brit. 227; Heppe, Fl. Wurzb. 70; Moug. & Nest. Stirp. Crypt. Vosges. 1047!; Koerber, Lich. Germ. 95.
Gyromium hyperboreum, Wahl. Fl. Lapp. 482 (1812); Fl. Ups. 424; Fl. Suec. 856.
Umbilicaria ænea, β. hyperborea, Schær. Spicil. 91. 364 (1823–36); Exs. 150! 151!
Graphis ænea, γ. papulosa, Wallr. Crypt. Germ. 341 (1831).
Umbilicaria polyphylla, γ. hyperborea, Schær. Enum. 29 (1850).

By the Truim, near Dalwhinnie, Inverness-shire? *James Brodie of Brodie, Esq.*

"*Thallus* peltate, composed of a single leaf, attached to the stone by a thick, callous, central base, irregularly orbicular, 2 inches or more in diameter, flattish, folded in a most uncertain manner, erose and laciniated at the edges, so as to be torn into many shapeless lobes of variable size, and perforated here and there with equal irregularity: *upper surface* dusky greenish-brown when moist, much darker and losing the tinge of green, or sometimes almost black, when dry; always naked, and all over rugged, with irregular pustular elevations of the cuticle, which has the appearance of having burst, leaving smooth black interstices, varying much in width and figure between the elevations: *under surface* deep blackish-brown, smooth and naked, irregularly pitted all over, and thence appearing obsoletely reticulated; sometimes, in very old specimens, slightly granulated, and pierced here and there with perforations of the inferior coat of the thallus: *substance* coriaceous, thin, flexible when moist, and somewhat so, though brittle, even when dry. *Tricæ* sessile, attached by the centre, irregularly orbicular, elliptical, or variously distorted and angular, flat, or more generally more or less convex; their *margin* nearly entire; *gyri* of the *disk* often parallel and straight, but most frequently variously twisted and disposed in several groups, and in this case the common margin of the tricæ is often wanting. In old specimens the *thallus* is sometimes found partially separated into two coats, but much less frequently and remarkably, as in ε. *erosa*. The edges of the blisters of the cuticle become also now and then detached, and somewhat elevated, so as to give the *thallus* the appearance of being covered with leafy scales."—*Lich. Brit.*

Mr. Borrer states that he has sought for the plant in vain in the particular station specified by Mr. Brodie.

In my own herbarium is a specimen received from Mr. George Dixon, of Great Ayton, Yorkshire, given to him by a friend who collected it somewhere in Scotland; but I could not ascertain the exact locality by subsequent correspondence. Specimens from Upsal, Sweden, from Fries fil. and Dr. Nylander are identical.

PLATE X. fig. 5 & fig. 5 *a*. (1. Section of thallus and apothecia. 2. Sporidia.)

δ. *arctica*, Ach. Thallus thickish, crenate, slightly lobed, naked on both sides; upper side greenish-brown, rugged with pustules; under, blackish-brown, nearly smooth.

Lichenoides atrum corii Persici instar exasperatum, Dill. 110. t. 30. f. 119, fide herb. Dilleniani cl. Borrero teste (1741).
Gyrophora arctica, Ach. Meth. 106. t. 2. f. 6 (1803); L. Univ. 221; Sm. E. Bot. t. 2485; Turn. & Borr. Lich. Brit. 225; Sommerf. Suppl. Fl. Lapp. 177.
Gyromium proboscideum, β. arcticum, Wahl. Fl. Lapp. 483 (1812); fide speciminis a Wahlenbergio seipso recepti teste cl. Smithio in E. Bot. t. 2485.
Gyrophora proboscidea, β. arctica, Ach. Syn. 65 (1814); Hook. Br. Fl. 2. 217.
Umbilicaria polymorpha, γ. arctica, Schær. Spicil. 88 F. 363 (1823–36); Exs. 556!; Enum. 27; Tuckerm. Syn. 71.

Rocks in the county of Durham?! *Mr. Robson in herb. Borrer.* Devonshire? *Mr. Hudson.*

"*Thallus* peltate, flattish, consisting of a single leaf, affixed to the rocks by a thick, callous, central disk, orbicular, from an inch to two inches or more in diameter; its edges irregularly crenate, divided into a few shallow rounded lobes, and somewhat reflexed: *upper surface* of a dull greenish-brown when moist, changed by drying to a pale pruinose grey in the centre, whence it gradually darkens towards the edges, where it is blackish; or sometimes it is dark brown all over; naked, everywhere very rugged, with irregular pustular elevations of the cuticle, which here and there towards the edges of the thallus has the appearance of having burst, as if from being overstretched, leaving depressed, smooth, undulating interstices: *under surface* of a paler brown and subpruinose, black (in our specimens) about the centre, quite smooth or very minutely papillose: *substance* coriaceous, thickish, flexible when moist; rigid, almost horny, but tough, when dry. *Trica* slightly elevated, orbicular, varying to angular and subreniform, somewhat convex; their *margin* entire, scarcely elevated; *gyri* of the *disk* sometimes concentric, but more frequently disposed in several irregular groups, usually, not constantly, leaving a minute cavity in the centre.

The fragment of a specimen from Mr. Robson in herb. Borrer has all the appearance of belonging to γ. *hyperborea*. It seems scarcely sufficient to enable us to form a decisive opinion on this plant.

Plate X. fig. 6.

ε. *erosa*, Hoffm. Thallus thickish, splitting when old into two or three laminæ, jagged and somewhat lobed, perforated; upper side greenish-brown, naked, divided by flexuose anastomosing lines into convex areolæ; under side paler, papillose, separately pierced, fibrous.

Lichenoides rugosum durum pullum, peltis atris verrucosis, Dill. 220. t. 30. f. 118 (1741) (fide herbarii Dilleniani cl. Lightfootio teste, *l. c. infra*).
Lichen polyrrhizos, Huds. Fl. Angl. 550 (excl. syn. Linn.) (1778).
—— *torrefactus*, Lightf. Fl. Scot. 2. 862 (1777) (sec. specim. a Lightfootio seipso recepta cl. Borrero teste in Lich. Brit. cit. infra); With. Arr. 4. 62 (excl. syn. præter Dill.).
—— *erosus*, Web. Spicil. 259 (1778); Swartz in Act. Ups. iv. 250 (fide Ach. & Schær.); Ach. in Act. Stockh. xv. 87. t. 2. f. 1; Prodr. 145.
—— *reticularis*, Westr. in Act. Stockh. xiv. 45 (fide Ach.) (1793).
Umbilicaria torrefacta, Schrad. Spicil. 104 (1794).
Lichen Cribellum, Retz. Fl. Scand. 287 (1795).
Umbilicaria erosa, Hoffm. Fl. Germ. 2. 111 (1795); Pl. Lich. 3. fasc. 4. 7. t. 70; DC. Fl. Franç. ed. 3. 2. 411.
Umbilicaria erosa α, Schær. Spicil. 93. 364; Exs. 153!; Enum. 29; Stenh. in Sched. Crit. fasc. 5 & 6. no. 127; Fries, L. Reform. 354; Summa Veg. Scand. 117; Tuckerm.! Syn. 73; Massal. Ricerch. 62. fig. 116; Nyl. N. Class. 175!
Gyrophora erosa, Ach. Meth. 103 (1803); L. Univ. 224; Syn. 65; Sm. E. Bot. t. 2066; Moug. & Nestl. Crypt. Vosges. 250!; Turn. & Borr.! Lich. Brit. 229; Hook. Fl. Scot. 2. 42; Brit. Fl. 2. 218; Tayl. Fl. Hib. pt. 2. 155; Koerber, Syst. Lich. Germ. 96.
Gyromium erosum, Wahl. Fl. Lapp. 482 (1812); Fl. Suec. 856.
Graphis ænea, δ. *dispansa* & ε. *cribrosa*, Wallr. Crypt. Germ. 342 (1831).

Highlands of Scotland, *Lightfoot*. St. Vincent's Rock near Bristol, *Hudson*. Llanberris, *Rev. Hugh Davies*. On the vitrified forts in the Highlands of Scotland; Durham; Yorkshire; North Wales, *Sir J. E. Smith*. Mangerton and other mountains in Ireland, *Dr. Taylor*. Corry Leese, Ben Nevis! *Mr. Borrer*. Ben Beck! Craig Koynoch! *Mr. W. Gardner in herb. Borrer*. Clova! *Mr. G. Lawson*. Capel Cerig, North Wales! *Mr. H.*

Piggot. Birkdale, Westmoreland! *Mr. W. Robertson in herb. Borrer.* Dartmoor! *Mr. Borrer.* Swinhope Fell, Durham! *Mr. W. Mudd.* Barmouth, N. Wales! *Rev. T. Salwey.*

"*Thallus* peltate, consisting of a single leaf, attached by a thick, callous, central base, suborbicular or oblong, an inch or two in diameter, flattish, but elevated towards the centre, so as to have an irregularly convex appearance, undulated, and not unfrequently erect or reflexed at the edges, rugged all over, and torn, without any order, into various rounded lobes of most uncertain size, which are most usually shallow, but occasionally reach almost to the root, and slightly imbricated: it is also perforated, chiefly towards the edges, with numerous cavities of no definite size or figure, giving to some specimens the appearance of being fringed with beautiful lacework; in other specimens the perforations are found all over the thallus, and again in others they are almost, if not altogether, wanting: *upper surface* dusky-greenish-brown when moist, when dry deep brown, and frequently almost black, always naked, in a young state even, and marked with various undulating black indented lines, which, as the plant becomes older, grow more numerous, and, frequently anastomosing, divide the cuticle into irregular areolæ, which swell into pustular elevations: *under surface,* when wet, semi-transparent, generally light greyish-brown, but sometimes of the same colour as the upper one, turning darker, often blackish, from drying; minutely granulated, so as to look like shagreen when magnified, entire in young specimens, in old ones ragged with irregular holes, which have elevated thickened lips, and do not extend to the upper coat of the thallus; besides which, there also grow out of the under surface, in all stages of its existence, fibres of the same colour and substance as itself, aptly compared in 'English Botany' to shavings, performing, according to Dillenius and Schrader, the office of roots: *substance* coriaceous, variable in thickness, flexible when moist, rigid and brittle when dry. *Tricæ* numerous, scattered all over the thallus, affixed by their centres, sessile or slightly elevated, flat or variously convex, varying in shape from linear through every gradation to orbicular; sometimes surrounded by a nearly entire slightly elevated *margin*, but more frequently wanting it, and consisting merely of irregular clusters of twisted *gyri**."—*Lich. Brit.*

The sporidia were not seen in the specimens of *U. Muhlenbergii* from Mrs. Merry in herb. Borrer; but in specimens of *U. Muhlenbergii* and its variety *alpina* in the same herbarium, received from America from Mr. Edward Tuckerman, jun., they were identical with those of *erosa* (see Pl. X. figs. 9 & 10).

* For the spermagonia of this form see Tulasne, *l. c.*

Specimens of *erosa* from Upsal, Sweden, *Fries fil.*; Stockholm, *Dr. Nylander*, and Saibten, *M. Philippe*, in my own herbarium, are identical with our British plant.

PLATE X. fig. 7. Sporidia. Fig. 8. Section of thallus and apothecia.

ζ. *pellita*, DC. Thallus thin, unequally lobed and crenate; upper side greenish copper-colour, smooth; under side black, papillose, reticulated and densely fibrous; tricæ immarginate, growing out into tufts of fibres.

Lichenoides pullum superne et glabrum, inferne nigrum et cirrosum, Dill. 226. t. 30. f. 130 (1741).
Lichen polyrhizos, Linn. Sp. Pl. 1618? ; Lightf. Fl. Scot. 2. 864; Robson, Br. Fl. 301; With. Arr. 4. 64 (excl. syn. 2do Dill.).
—— *velleus* α, Huds. Fl. Angl. 550 (1778) (excl. var. β).
Umbilicaria vellea, Hoffm. Pl. Lich. 2. 9. t. 26. f. 3 (excl. Linn. syn.) (1791), admirable; Schrad. Spicil. 105 (excl. syn. Lightf.).
Lichen hirsutus, Westr. in Act. Stockh. 1793 (fide Ach.).
—— *pellitus*, Ach. in Act. Stockh. xv. 99. t. 3. f. 2 (1794); Prod. 149; Sm. E. Bot. t. 931.
Gyrophora pellita, Ach. Meth. 108 (1803); L. Univ. 228. t. 2. f. 10; Syn. 67; Turn. & Borr.! Lich. Brit. 238; Hook. Fl. Scot. 2. 42; Brit. Fl. 2. 219; Tayl. Fl. Hib. pt. 2. 155; Chev. Fl. Paris. 1. 644.
Umbilicaria pellita, DC. Fl. Franç. 3rd ed. 2. 409 (1805).
—— *depressa*, β. *spadochroa* F, Schær. Spicil. 83. 362 (1823–36).
Gyromium polyrrhizon, Wahl. Fl. Suec. 858 (1824–26).
Umbilicaria polyrrhizos, Fries, L. Reform. 358 (1851); Summa Veg. Scand. 117; Schær. Enum. 29; Nyl. N. Class. 175.

On the rocks called Llyn Llydaw, Snowdon; and about Llyn Cwm y Ffynnon tas; also on the summit of the mountains at Cwm Brwynog towards Ardhu near Llanberris, *Dillenius*. Highlands and Lowlands of Scotland, *Lightfoot*. Clark's Park and Paradise near Moneymusk, Aberdeenshire, *Withering*. Carnedd Llewellin, near the summit. On Moel Shabôd near Capel Cerrig, Caernarvonshire, *Mr. Griffith*. Yorkshire, *Mr. W. Brunton*. Durham, *Rev. J. Harriman*. Cheshire, *Turner and Borrer*. On rocks on Tonlagee, Co. Wicklow, *Dr. Taylor*. Scotland! *Mr. G. Donn in herb. Borrer*, without locality (fructu)! *Mr. Sowerby in herb. Borrer*. Cronkley (fructu)! *Mr. W. Robertson in herb. Borrer*. Loch Phadrick! Craig Koynoch! Clova! *Mr. W. Gardner in herb. Borrer*. Ben Ferrag! Llyn Canvay! *Mr. Borrer*. Near Lake Tumanel, Cumberland (fructu)! *Mrs. Joshua Stanger*. Barmouth, N. Wales! *Rev. T. Salwey*. Clova! *Mr. G. Lawson*.

"*Thallus* peltate, sometimes simple, but generally consisting of many leaves, spreading from a common central disk, by which they are affixed to the stone, in a roundish cluster varying from 1 to 3 or 4 inches in diameter; many such clusters often forming together irregular patches of considerable extent: the leaves vary much in size, in proportion as the thallus is more or less compound: when it consists of a single leaf, this is sometimes 2 inches in diameter, of an irregularly orbicular outline, with a few, rounded, shallow, crenate lobes, and nearly flat; in the more common and complicated state, each leaf is seldom an inch in diameter, usually much smaller, much and variously crumpled, suborbicular, very uncertain in the number and shape of its lobes, which are usually, however, few and shallow, their edges waved and crenate: *upper surface* of a greenish copper-colour when wet; copper-brown, sometimes blackish, when dry; very smooth and even, excepting a few scattered minute black dots, sometimes impressed, at other times slightly elevated: *under surface* invariably quite black, clothed for the most part with innumerable entangled black fibres, which most frequently are protruded beyond the edges, so as to give them the appearance of being fringed (which sometimes also they are in fact), less frequently naked here and there, or nearly all over, and then rough with minute shagreen-like granulations, and irregularly reticulated (which is most remarkably the case towards the centre), with elevated veins or threads, which are often detached, except at their extremities, so as to form a coarse lacework: *substance* coriaceous, but thin, flexible when wet, very rigid and brittle when dry. *Tricæ* rare, orbicular or elegantly lobed, flat, appressed to the thallus, to which they are affixed by the whole under side, always destitute of a *margin*, and composed entirely of numerous narrow *gyri*, which are much and variously subdivided and contorted, but seem to spread from a common centre, and frequently unfold, or grow out into elevated irregular clusters of much-branched minute black fibres, and these clusters are of more frequent occurrence than the tricæ themselves."—*Lich. Brit.*

Our British plant coincides with specimens of *U. polyrhizos* (Linn.) in my herbarium received from Fries fil., collected at Upsal, Sweden.

Plate X. fig. 11.

In Mr. Borrer's herbarium are authentic specimens! from Acharius of *G. hirsuta* and *G. vellea** which appear to be identical. In the former the sporidia were not seen, but those of the latter were double the size of those of *pellita* (see Pl. X. figs. 12 and 13), consequently showing them to be distinct species. Schærer's Exs. 137! and 138! were also identical with the Acharian specimens.

No British specimens have occurred to our notice; though Robson in his British Flora, p. 300, gives as a habitat for the

* For the spermagonia see Tulasne, *l. c.*

plant of Dillenius, 545. t. 82. f. 5, "on rocks near Settle in Yorkshire."

** *Thallus ashy-grey when dry.*

η. grisea, Hoffm. Thallus thin, crenate, somewhat lobed, papillose on both sides; upper side pale ash-coloured, naked; under mostly naked, blackish.

Lichen pulmonarius saxatilis, e cinereo-fuscus, minimus, Tourn. Instit. 549 (1719); Vaill. Paris. 116. t. 21. f. 14.
Lichenoides saxatile, foliis minus divisis, cinereo-fuscum, Dill. in Raii Syn. 73 (1724).
—— *coriaceum cinereum, peltis atris compressis*, Dill. 219.
Lichen deustus, Robs. Br. Fl. 300 (1777) t. 30. f. 117 (1741) (fide herbarii Dilleniani cl. Borrero teste).
—— *griseus*, Swartz in N. Act. Stockh. v. p. 91. t. 2. f. 3 (fide Ach.); Westr. in Act. Stockh. 1793 (fide Ach.); Retz. Scand. 286.
Umbilicaria grisea, Hoffm. Fl. Germ. 2. 111 (1795).
Lichen Dillenii, With. Arr. 4. 63 (1796).
—— *murinus*, Ach. Prodr. 143 (1798).
Umbilicaria murina, DC. Fl. Franç. 3rd ed. 3. 412 (1805); Nyl. N. Class. 175.
Gyrophora hirsuta, γ. murina, Flörke in Berlin Mag. 1810, p. 67 (fide Schærer).
Gyrophora murina, Ach. Meth. 110 (1803); L. Univ. 231; Syn. 69; Sm. E. Bot. t. 2486; Stenh. in Sched. Crit. fasc. 5 & 6. no. 132 (1825); Hook. Brit. Fl. 2. 218; Chev. Paris. 1. 643. t. 14. f. 11 *c*.
—— *grisea*, Turn. & Borr. Lich. Brit. 236 (1813).
Umbilicaria depressa, β. spadochroa A, Schær. Spicil. 82. 362 (1823–36).
Gyromium velleum, δ. murinum, Wahl. Fl. Suec. 857 (1824–26).
Graphis vellea, β. alutacea, Wallr. Crypt. Germ. 344 (1831).
*Umbilicaria vellea, γ. hirsuta, * murina*, Fries, L. Reform. 358 (1831); Summa Veg. Scand. 117.
—— *vellea, γ. spadochroa, a. grisea*, Schær. Enum. 24 (1850).

Found on St. Vincent's Rocks near Bristol by Mr. Dare, *Dillenius*.

"*Thallus* peltate, consisting generally of a single, orbicular, crumpled, concave leaf, from an inch to an inch and a half in diameter; sometimes of two or three smaller leaves; attached to the stone on which it grows by a callous central disk, divided at the edges into a few, shallow, rounded lobes, and irregularly notched or crenate: *upper surface* of an ash-colour, with a slight tinge of brownish-green when wet; white ash-colour and subpruinose, but still brownish towards the edges, when dry; granulated, as if minutely cracked all over, but smooth to the touch, and scarcely appearing rough to the naked eye: *under surface*, whether wet or dry, dark brown, varying to almost black, covered with a minute shagreen-like roughness, naked, or very rarely producing a few scattered branched fibres: *substance* thin, flexible when wet, and still somewhat flexible, but brittle, when dry. *Tricæ,* except in their very youngest state, when they appear as round black dots, depressed, and almost immersed in the thallus, orbicular and reniform, surrounded when young by a *margin,* which afterwards disappears. *Disk* at first flat, very convex in a more advanced stage; its *gyri* arranged concentrically."—*Lich. Brit.*

Doubtful if of British growth, but inserted on the authority of Dillenius, whose herbarium contains only two specimens (foreign ?), marked as having been received from Celsius.

Distinct from *U. hirsuta* by the different sporidia (see Pl. X. fig. 12).

PLATE X. fig. 14.

θ. *deusta,* Linn. Thallus thin, crenate, slightly lobed, naked on both sides; upper side greenish-brown, rugged and reticulated; under, ash-coloured, smooth.

Lichen deustus, Linn. Sp. Pl. 1618 (excl. syn. Vaill. & Dill.) (1763), fide herb. Linn. cl. Borrero teste); Huds. Fl. Angl. 550 (rev. Daviesio teste); Lightf. Fl. Scot. 2. 861.
—— *proboscideus,* Afzel. in Act. Stockh. 1788 (fide Ach.); Ach. Prodr. 147 (in part).
Umbilicaria mesenterica, Schrad. Spicil. 103 (1794).
Gyrophora proboscidea α. (in part), Ach. ! Meth. 105 (1803); L. Univ. 220; Syn. 64; Sm. E. Bot. t. 2484; Turn. & Borr. ! Lich. Brit. 222; Hook. Fl. Scot. 2. 41; α, Brit. Fl. 217; Heppe, Fl. Wurzb. 69; Johnst. Fl. Berw. 2. 99; Chev. Fl. Paris. 1. 644; Koerber, Syst. Lich. Germ. 96.
Gyromium proboscideum, Wahl. Fl. Lapp. 483 (1812); Fl. Carpath. 394; Fl. Suec. 857.
Umbilicaria polymorpha, β. deusta, Schær. Spicil. 88. 363 (1823–36); Exs. 148 !; Enum. (in part) 26.
Graphis corrugata α, Wallr. Crypt. Germ. 338 (1831).
Umbilicaria proboscidea α. (in part), Fries, L. Reform. 354 (1831); Summa V. Scand. 117; L. S. 128 (fide Nyl.); Nyl. N. Class. 157 !

St. Vincent's Rocks near Bristol and about Llanberris, *Hudson.* Highland rocks of Scotland, *Lightfoot.* North of England and Wales, *Sir J. E. Smith.* Rocks near the summit of Hedgehope, Northumberland, *Dr. G. Johnston.* Ben Lawers, Scotland ! *Mr. Borrer.*

"*Thallus* peltate, flattish, but umbonated in the centre, and rather elevated and undulated at the edges, consisting generally of a single leaf, affixed to the rock by a thick callous central disk, which scarcely ever forms any stalk, or sometimes, though rarely, of many leaves growing together and diverging from a common centre: leaf orbicular, from an inch to an inch and a half in diameter, irregularly crenate at the edges, and often here and there divided into a few shallow rounded lobes: *upper surface* a dull greenish-brown when moist, when dry changing to a pale pruinose grey in the centre, whence it gradually darkens towards the edges, where it is nearly black; in some specimens all over blackish; always marked, especially about the centre, with elevated reticulated veins, which are very conspicuous in most individuals, though occasionally almost wanting: *under surface* quite smooth, except now and then a few granulations towards the central part, naked, of a smoky-brown, varying in depth, somewhat palest when wet, and always lightest near the middle: *substance* thin, between coriaceous and membranous, flexible when moist, and often scarcely rigid, though very brittle, when dry. *Tricæ* numerous, scattered all over the thallus, quite sessile, though affixed only by their centre, depressed, usually orbicular, but varying to angular and reniform, surrounded by an entire elevated *margin*. *Disk* nearly flat; its *gyri* either concentric or arranged in several parcels, lying together without any regular order, and often leaving in the middle a subtriangular cavity."—*Lich. Brit.**

Swedish specimens from Stenhammer and Nylander, labelled *Umbilicaria proboscidea* (L.) Fries, are identical.

b. *fimbriata*, Turn. & Borr. Thallus edged with a few black, branched, tooth-like fibres.

Gyrophora deusta, β. *fimbriata*, Turn. & Borr. Lich. Brit. 222.
—— *proboscidea*, Moug. & Nest. Stirpes Vosges. 249!

Similar in substance, colour, and every other respect with 'a,' except in having the edges of the thallus here and there toothed and fringed with a few scattered black branching fibres; evidencing an approach to *proboscidea*. There are also occasionally a few fibres sprinkled over the underside.

Highlands of Scotland! *Mr. Borrer.* Between Glen Callater and Lochnagar, Scotland! *Mr. J. Tatham.* Clova! and about Loch Phadrich! *Mr. W. Gardner in herb. Borrer.* Swinhope Fell, Durham! *Mr. W. Mudd.* Glenmalure, co. Wicklow, *Mr. Isaac Carroll.*

Specimens in my herbarium collected at Tourmalet, Pyrenees, by M. Philippe and Mr. Spruce, coincide with this state.

c. *corrugata*, Turn. & Borr. Thallus thin, rough with elevated reticulations.

Umbilicaria corrugata, Hoffm. Pl. Lich. 2. 65. t. 43. f. 4–7 (1794), admirable; Massal. Ricerch. 61. fig. 113.
Lichen proboscideus (in part), Ach. Prodr. 147 (1798).
Gyrophora proboscidea, β. *exasperata*, Ach.! Meth. 105 (1803).

* For the spermagonia see Tulasne, *l. c.*

Umbilicaria proboscidea γ, DC. Fl. Franç. ed. 3. 3. 410 (1805).
Gyrophora proboscidea γ, Ach. L. Univ. 221 (1810).
—— *proboscidea α.* (in part), Ach. Syn. 64 (1814).
—— *deusta, γ. corrugata*, Turn. & Borr. Lich. Brit. 222 (1813).
Umbilicaria proboscidea α. (in part), Fries, L. Reform. 354 (1831).
Gyrophora proboscidea (in part), Chev. Fl. Paris. 1. 644 (1836).
Umbilicaria polymorpha, β. deusta (in part), Schær. Enum. 26 (1850).

Highlands of Scotland! *Mr. Borrer.*

Similar in all respects to 'a,' except in its upper surface having extremely prominent reticulations, rising to nearly a line in height, and looking like a series of erect curled squamæ.

d. *mesenteriformis*, Turn. & Borr. Thallus thickish, the upper side rough with elevated reticulations, and somewhat papillose.

Lichen mesenteriformis, Wulf. in Jacq. Misc. 2. 85. t. 9. f. 5 (fide Turn. & Borr.) (1781).
Gyrophora deusta, δ. mesenteriformis, Turn. & Borr. Lich. Brit. 222 (1813).

Highlands of Scotland! *Mr. Borrer.*

Upper surface of the thallus singularly rugose, almost papillose. The reticulations nearly as prominent as in 'c,' and sometimes growing out into new leaves: substance considerably thicker than in the other states.

I must refer here a specimen! amongst Mr. Spruce's Lichenes Pyrenæi collected at Lac Lehon.

Plate X. fig. 15.

ι. *proboscidea*, DC. Thallus thickish, unequally lobed, fringed at the edges, naked on both sides; upper side greenish-brown, rugged; under, ash-coloured, smooth.

Lichenoides corneum, marginibus eleganter fimbriatis, Dill. 218. t. 29. f. 116 A (1741); Fl. Dan. t. 471. f. 1, 2 (fide Turn. & Borr.).
Lichen proboscideus, Linn. Sp. Pl. 1617 (excl. syn. Amœn. Acad. & Dill.) (1763) (fide herb. Linn. el. Borrero teste); Huds. Fl. Angl. 551; Wulf. in Jacq. Misc. 2. 80. t. 9. f. 2 (fide Turn. & Borr.); Hedw. Crypt. 2. 5. t. 1 A (fide Turn. & Borr.); Retz. Scand. 288; With. Arr. 4. 65; Sm. E. Bot. t. 522, two upper figures.
—— *polyrrhizos*, Weis. Crypt. 81 (1770); Web. Spicil. 265.
—— *crinitus*, Lightf. Fl. Scot. 860 (1777).
—— *cylindricus*, Afzel. in Act. Stockh. 1788 (fide Ach.); Ach. Prodr. 148.
—— *foliaceus umbilicatus, peltis turbinatis truncatis perforatis*, Linn. Fl. Lapp. 359 (Sm. 2nd ed. 1792).
Umbilicaria crinita, Hoffm. Pl. Lich. 2. 67. t. 44. f. 1, 2, 3, 4, 5, 6, 8 (1794); Massal. Ricerch. 61. fig. 111.
Gyrophora cylindrica α, Ach. Meth. 107 (1803); L. Univ. 223; Syn. 65; Hook. Fl. Scot. 2. 42; Brit. Fl. 2. 218; Johnst. Berw. 2. 99; Wallr. Crypt. Germ. 339; Tayl. Fl. Hib. pt. 2. 155; Koerber, Syst. Lich. Germ. 97.
Umbilicaria proboscidea α, DC. Fl. Franç. 3rd ed. 3. 410 (1805).

Umbilicaria proboscidea, β. *cylindrica*, Fries! L. Reform. 356 (1831); Summa V. Scand. 117.
Gyromium cylindricum, Wahl. Fl. Lapp. 483 (1812); Fl. Suec. 857.
Gyrophora proboscidea α, Turn. & Borr.! Lich. Brit. 219 (1813).
Umbilicaria polymorpha, α. *cylindrica* A. & D, Schær. Spic. 86 (1823–36); a. *monophylla*, Exs. 143!; b. *polyphylla*, Exs. 146!; a. *crinita*, & d. *fimbriata*, Enum. 26.
Gyrophora crinita, Chev. Fl. Paris. 1. 644 (1836).
Umbilicaria cylindrica, Tuckerm. Syn. 71 (1848); Nyl. N. Class. 175.
—— *varia, var. proboscidea*, Leight. Brit. Lich. Exs. 95!

On Snowdon on the rocks called Llyn Llydaw, and near Llyn Cwm y Ffynnon tas; also on the summit of the mountains from Cwm Brwynog towards Ardhu near Llanberris. On lofty rocks of the Berwyn Mountain, *Dillenius*. Rocks on the Highland mountains, as on Goatfield in the Isle of Arran, on the mountains of Breadalbane, Ben Nevis in Lochaber, *Lightfoot*. On rocks in the mountainous parts of Dartmoor, Devonshire, *Mr. Newberry*. Summit of Carnedd Llewellin, *Mr. Griffith*. Scotland, Wales, and North of England, *Sir J. E. Smith*. On Cheviot, *Mr. Winch*. Near the summit of Hedgehope, Northumberland, *Dr. G. Johnston*. On rocks at Connavalla, Ireland, *Dr. Whitley Stokes*. On Mangerton, Ireland, *Dr. Taylor*. Rocks about Loch Phadrick! rocks Stroine-dhu! summit of Carlowrie! *Mr. W. Gardner in herb. Borrer*. Birkdale, Westmoreland! *Mr. W. Robertson in herb. Borrer*. Clova! *Mr. G. Lawson*. Scawfell! *Mrs. Joshua Stanger*. Yorkshire! *Mr. G. Dixon*. Summit of Arran Mowddy! *Mr. Borrer*. Falcon Clints, Teesdale, co. Durham! *Mr. W. Mudd*.

"*Thallus* peltate, ascending, composed usually of numerous imbricated curled leaves, attached to the rock by a thick central callous disk, which is sometimes drawn up into a sort of stalk, whence they spread in nearly a circular form, making patches of 1 or 2 inches in diameter: the leaves, taken individually, vary in shape from orbicular through every intermediate degree to cuneiform, and are divided very irregularly, some down to the centre, others slightly, into rounded lobes, the edges of which are crenate or dentate, and everywhere fringed with black branched compressed fibres, a line or two long, composed of the substance of the thallus itself, so that they may perhaps most properly be regarded as elongated teeth, though they have entirely the appearance of cilia of a different substance: these, from the remarkably undulated mode of growth of the edges of the thallus, often look at first sight as if they were disposed in two or three rows: the *upper surface* is of a dull greenish-brown when moist; and of a smoky-grey, with a pruinose appearance, and sometimes speckled with white, when dry; always roughish with minute elevated reticulations of the cuticle, very visible in some specimens, but in others scarcely to be detected: the *under surface* is quite smooth and naked, except occasionally a few scattered fibres, which are either branched or simple, shorter and usually much paler than those which fringe the edges of the thallus: it is of a pale ash-colour near the centre, but gradually darker towards the edges, where it is brown, with a greenish tinge when moistened: *substance* coriaceous, flexible when moist, extremely rigid and almost horny when dry, but still tough. *Tricæ* plentifully produced all over the thallus, and often clustered, turbinate in their first state, afterwards becoming supported upon extremely short peduncles, mostly orbicular, but not unfrequently reniform, surrounded by a nearly entire undulated *margin*, nearly of the same height as the *disk*, so that the whole surface is flat; the *gyri* are mostly concentric, leaving in the centre a subtriangular cavity, but are not rarely disposed in various parcels, lying together without any regular order."—*Lich. Brit.*

Specimens in my own herbarium collected "in alpibus Jemtlandiæ"! by Fries fil.; "ad rupes in Pyrenæis orientalibus"! by Dr. Cam. Montagne and M. Philippe, are identical.

b. *denticulata*, Turn. & Borr. Edges of the thallus coarsely fringed and toothed.

Lichenoides corneum &c., Dill. 218. t. 29. f. 116 B.
Lichen proboscideus, Sm. E. Bot. t. 522, two lower figures.
Gyrophora cylindrica, *β. denticulata*, Ach. Meth. 107.
—— *cylindrica α.* (in part), Ach. L. Univ. 223.
—— *proboscidea*, *β. denticulata*, Turn. & Borr. Lich. Brit. 219.
Umbilicaria polymorpha, *α. cylindrica* B, Schær. Spic. 87; Exs. 144!
—— *polymorpha*, *α. cylindrica*, b. *denticulata*, Schær. Enum. 26.

Rocks about Loch Phadrick! rocks, Ben-na-Bourd! *Mr. W. Gardner in herb. Borrer.* Clova! *Mr. G. Lawson.* Summit of Arran Mowddy! *Mr. Borrer.* Galtymore, co. Tipperary! *Mr. I. Carroll.*

In all respects similar to 'a,' except that the marginal fibres are coarser and larger, and more evidently a prolongation of the thallus.

A "forma minor in alpibus maritimis Liguriæ occiduæ," received by me from Prof. De Notaris, seems referable here.

c. *denudata*, Turn. & Borr. Edges of the thallus almost naked.

Umbilicaria crinita, Hoffm. Pl. Lich. 2. 67. t. 44. f. 7.
Gyrophora proboscidea, *γ. denudata*, Turn. & Borr. Lich. Brit. 219.
Umbilicaria polymorpha, *α. cylindrica* C, Schær. Spicil. 88; Exs. 145! (not

characteristic, at least in my copy; but specimen! in herb. Borrer received from Schærer good).

Umbilicaria polymorpha, α. cylindrica, c. nudiuscula, Schær. Enum. 26.

Highlands of Scotland, *Turner and Borrer*. Summit of Glyder! Falcon Clints! Westmoreland Mountains! *Mr. Borrer*.

d. *exasperata*, Turn. & Borr. Thallus polyphyllous, ragged, rough on the upper side.

Gyrophora proboscidea, δ. exasperata, Turn. & Borr. Lich. Brit. 219.

County of Durham, *Mr. Robson*.

Remarkably curled and undulated, and divided into numerous small irregular laciniæ: upper surface remarkably rough.

I have seen no specimens, but this and *denudata* appear to be connecting links with *θ. deusta*.

PLATE X. fig. 16. Section of thallus and apothecium. Fig. 17. Ascus. Fig. 18. Sporidia.

2. *Umbilicaria pustulata*, Hoffm. Thallus thin, torn, and lobed, papillose and naked on both sides; upper side pale olive-green, blistered and sprinkled with fibrous glomeruli; under side brownish, deeply pitted: sporidia in asci, one or two, very large, oblong, pale, wrinkled or reticulated on the surface, 3-septate?

Lichen crustæ modo saxis adnascens, verrucosus, cinereus, et veluti deustus, Tourn. Instit. 549. (1719) (fide Turn. & Borr.); Vaill. Paris. 116. t. 20. f. 9.

Lichen pulmonarius saxatilis, inferne reticulatus, et lacunatus, superne cinereus, ac verrucosus; receptaculis florum et seminibus nigricantibus, et veluti deustus, Micheli, 89. t. 47 (1729).

Lichenoides pustulatum cinereum et veluti ambustum, Dill. 226. t. 30. f. 131 A. & B (1741); Fl. Dan. t. 597. f. 2 (fide Turn. & Borr.).

Lichen pustulatus, Linn. Sp. Pl. 2nd ed. 1617 (1763); Fl. Lapp. 359; Lightf. Fl. Scot. 2. 858; Robson, British Fl. 300; Huds. Fl. Angl. 549; Pottich, Palat. 3. 250; Web. Spicil. 261; Leers, Fl. Herborn. 265; Humb. Fl. Frib. 28; Retz. Scand. 287; With. Arr. 4. 64; Ach. Prodr. 146; Sm. E. Bot. t. 1283; Westr. 161, cum icone (fide Turn. & Borr.).

Umbilicaria pustulata, Hoffm. Pl. Lich. 2. 13. t. 28. f. 1, 2, & t. 29. f. 4 (1791); Schrad. Spicil. 102; DC. Fl. Franç. 3rd ed. 3. 411; Hook. Fl. Scot. pt. 2. 42; Brit. Fl. 2. 219; Stenh. in Sched. Crit. fasc. 5 & 6. no. 125; Fries, L. Reform. 350; S. V. S. 117; Chev. Fl. Paris. 1. 642.

—— *pustulata α*, Tuckerm. Syn. 70; Bohler, Lich. Brit. 125!; Schær. Enum. 25; Leight. Brit. Lich. Exs. 166; Koerber, Lich. Germ. 93; Nyl. Nouv. Class. in Cherb. Mém. 3. 175.

Lecidea pustulata, Ach. Meth. 85 (1803); Schær. Spicil. 106. 190; Exs. 156!

Gyrophora pustulata, Ach. L. Univ. 226 (1810); Syn. 66; Moug. & Nestl. Stirp. Vosges. 60!; Turn. & Borr. Lich. Brit. 232; Purton, Midl. Fl. 2. 598; Heppe, Fl. Wurzb. 71; Tayl. Fl. Hib. pt. 2. 155; Spruce's Lich. Pyren.!

Gyromium pustulatum, Wahl. Fl. Upsal. 424 (1820); Fl. Suec. 858.
Graphis pustulata, Wallr. Crypt. Germ. 345 (1831).
Lasallia pustulata, Merat, Paris. 202 (183); Massal. Mem. 118.
Macrodictya pustulata, Massal. Ricerch. 59. fig. 109 (1852).

On rocks and stones in mountainous districts. By the road from Pemnorvay to Dolbelmen, and under Keven Lees Castle, *Dillenius*. Malvern Hills, *Stokes*. Old wall, about half way between Caernarvon and Beddgelart, *Rev. H. Davies*. Near Biddiston Lighthouse, Cheshire, *Mr. Bradbury*. Near Halifax, *Mr. Bolton*. Nant Hevynant Vale, near Snowdon, *Turner and Borrer*. Near Bantry, Ireland (fruit), *Miss Hutchins*. Ireland, *Dr. Taylor*. Highland mountains of Scotland, *Lightfoot*. Dartmoor! Devonshire (fruit), *Sir W. J. Hooker*. Hey Tor! Moel Hebog! Loch Sligachan, *Mr. Borrer*. North Wales, *Rev. T. Salwey*. Nesscliffe! Caer Caradoc! Shropshire.

" *Thallus* a single leaf, attached to the rock by a thick, callous, central disk, orbicular in its youngest state, but afterwards varying from orbicular to elliptical, or sometimes quite irregular in its form, from 1 to 8 or 10 inches in diameter; flat, except at the edges, where it is elevated, cleft at first into a few, shallow, rounded lobes, which, as the plant grows older, deepen and become torn, so as to be entirely shapeless: *upper surface* pale dull olive-green when moist; whitish ash-colour, with more or less of a brownish or sometimes of a glaucous tinge, when dry, and, then particularly, palest at the centre; uneven in every part, except sometimes for a very small space round the centre, with pustular elevations of the whole substance of the thallus, of an elliptical figure, and varying in size from that of hemp-seed to that of turnip-seed, large and small being mixed together without any order, though they generally decrease in size towards the edges of the thallus; the whole surface, as well of the pustules as of the interstices, is rough with minute granulations (bearing no slight resemblance, in miniature, to those on the surface of *Lycoperdon Proteus*), which are most evident at the centre, and scarcely observable in any other part by the naked eye, and produces also scattered clusters of black branching fibres, most numerous towards the border, where they often become confluent; similar fibres generally lining the edges of any cavities in the thallus, and sometimes that of the whole thallus itself (as represented in the upper fig. in E. Bot.), with a beautiful black continuous fringe: *under surface* brownish olive-green when wet; when dry, varying from dark brown to ash-colour, and generally slightly pruinose, naked, minutely granulated and full of cavities, exactly corresponding with the pustules of the upper surface, which in some specimens are so numerous, that the under surface has at first sight the appearance of a coarse network; the interior of the cavities black, and rather more minutely granulated than the other parts: *substance* coriaceous, thin, very flexible when wet, but exceedingly brittle when dry. *Tricæ* of extremely rare occurrence, scattered among the tufts of flocculi, principally towards the edges of the thallus; patelliform, sessile, yet slightly elevated, urceolate when young, afterwards subturbinate, orbicular, their largest size about equal to that of rape-seed; their *margin* at first raised, thick, often very rugged and even flocculose, sometimes entire or only waved, gradually becoming narrower, and at length obliterated, as the *disk*, which in the young fruit is concave, becomes flat, and at last slightly convex. This part is, in all its stages, opake, and of an uneven appearance, when observed with a glass; in old convex tricæ it is occasionally rugged with irregular warts, usually depressed at the centre, and approaching more or less nearly to the appearance of imperfect *gyri*. These warts in our specimens do not assume a concentric arrangement, but are either scattered singly or clustered into little groups."—*Lich. Brit.* *Sporidia* one or two in each ascus, of a very large size, oblong, pale, and wrinkled with network, without apparent septa, though not unfrequently three darker lines may be seen like horizontal septa *.

It would seem that the external darker portion of the cortical layer of the apothecium frequently developes into minute, branched, thick, fleshy fibres, which increase into the tufts or flocculi above mentioned.

Specimens in my own herbarium from Upsal, collected by Fries fil. and Dr. Nylander; from Italy, Prof. De Notaris; from Aste, M. Philippe; from S. de Amoreira, Estremadura, S. de Cintra, and S. de Gerez, Nos. 21, 32 & 107 of Dr. Fr. Welwitsch's 'Cryptotheca Lusitana,' are in all respects identical with our British plant.

Mr. Menzies' specimen from the Cape of Good Hope! in herb. Borrer, mentioned in Lich. Brit. 234, is smoother and less granulated on both surfaces, tinged of an ochrey-red; the apothecia very numerous, much more sessile, their margins entire or irregularly waved and undulated, but not at all fibrous. Sporidia similar to those of British specimens. A specimen in my own herbarium received from Prof. De Notaris, collected by Zeyher at the Cape of Good Hope, and labelled "*Lasallia* (Gyrophora, *Eschw.*) *porphyrea*, De Not.," appears identical with Mr. Menzies' in structure and sporidia. The thallus when wetted becomes of a vivid scarlet hue.

Of the two specimens of *G. Pennsylvanica* in herb. Borrer!

* For the spermagonia see Tulasne, *l. c.*

mentioned in the note, Lich. Brit. 235, as received from Mrs. Merry, the under surface of one was very finely and less conspicuously granulated, whilst that of the other was very coarsely granulated, but not more so than is observable in Devonshire specimens ! of *U. pustulata* in the same herbarium. The upper surface was smoother and browner, though still with the pale yellow tinge; the pustules less numerous and rounder, but still variable. The apothecia were sessile, either simple or gyrate from compression and aggregation. The sporidia in both are identical with those of our *U. pustulata*, of which we cannot but regard them as varieties or states.

Specimens of *U. Pennsylvanica* ! and of *U. pustulata β. papulosa* ! from North America, from Mr. Tuckerman, in herb. Borrer, had sporidia identical with our *U. pustulata*.

Fée describes the sporidia of *U. pustulata* as elliptical, 4-celled.

Plate X. fig. 19. Section of thallus and apothecium, younger state. Fig. 20. Section of ditto, older state. Fig. 21. Sporidium.

EXPLANATION OF PLATE X.

Fig. 1. Section of thallus and apothecium of *Umbilicaria pustulata*, Hoffm., from Tulasne.
Fig. 2. *Umbilicaria polyphylla*, Schrad.: sporidia.
Fig. 3. *Umbilicaria anthracina*, Ach. & Schær. Exs. 154 : *a*, ascus and paraphyses; *b*, sporidia.
Fig. 4. Sporidia of *Umbilicaria flocculosa*, Hoffm.
Fig. 5. Sporidia of *Umbilicaria ænea*, *β. hyperborea*, Schær. Exs. 150.
Fig. 5*a*. 1. Section of thallus and apothecia of *Umbilicaria ænea*, *β. hyperborea*, Schær. Exs. 151. 2. Sporidia.
Fig. 6. Sporidia of *U. arctica*, Ach. Specimen from Mr. Robson.
Fig. 7. Sporidia of *U. erosa*, Hoffm.
Fig. 8. Section of thallus and apothecium of *U. erosa*, Hoffm.
Fig. 9. Sporidia of *U. Muhlenbergii*, var. *alpina*, from Mr. Tuckerman.
Fig. 10. Sporidia of *U. erosa*, from Mr. Tuckerman.
Fig. 11. Sporidia of *U. pellita*, DC.
Fig. 12. Sporidia of *U. vellea*, Ach., from himself, in herb. Borr.
Fig. 13. Sporidia of *U. depressa*, var. *hirsuta*, Schær. Exs. 137.
Fig. 14. Sporidia of *U. grisea*, Hoffm.
Fig. 15. Sporidia of *U. deusta*, Linn. and Turn. & Borr.
Fig. 16. Section of thallus and apothecium of *U. proboscidea*, DC.
Fig. 17. Ascus of *U. proboscidea*, DC.
Fig. 18. Sporidia of *U. proboscidea*, DC.
Fig. 19. Section of thallus and apothecium of *U. pustulata*, Hoffm., in a young state.
Fig. 20. Section of same in a mature state.
Fig. 21. Sporidium of *U. pustulata*, Hoffm.

The sporidia are all equally magnified, and therefore in relative proportion.

XXVI.—*On the Development of the Lampreys.* By August Müller*.

M. August Müller has observed some interesting facts in the history of the small Lamprey, which occurs abundantly in the fresh waters near Berlin. The animals appear suddenly at the spawning season in clear brooks, where they glide about amongst the stones, or, attaching themselves to these by the mouth, float in the stream. After spawning they disappear entirely; and, during the period of their occurrence, none but full-grown individuals are to be seen.

At the spawning time they are seen in small groups of ten or more individuals, and the spawning is effected in the following manner:—The male fastens with his mouth upon the neck of the female behind the eyes, and then twists his body half round towards her belly, when the emission of the ova and seminal fluid takes place.

The recently emitted ova are less than half a line in diameter, white, slightly yellowish, and enclosed in a thin gelatinous capsule, which is difficult of detection even after swelling in water. The segmentation is complete, as already stated by Schultze†, and commences about ten hours after fecundation. The process is described much in the same terms as by Schultze: the yelk is divided into a smaller upper, and a large lower portion, from the former of which the embryo is developed; the upper portion is composed of small, and the lower of large masses, and the centre is occupied by a cavity, which afterwards becomes smaller, and gradually draws towards the head of the embryo.

The hinder end of the egg becomes flattened, and on the upper part of this flat space the anal opening makes its appearance, surrounded in front and on the sides by a horse-shoe-shaped ridge, and from this a narrow canal is soon traceable half across the egg, beneath the region of the dorsal cord. The brain and spinal cord then become more strongly developed; they are divided by a longitudinal furrow, which soon closes again. The dorsal cord never advances further than between the labyrinths of the ears. Its contents appear striated towards the period of exclusion, as is also the case in the embryos of some bony fishes; but in the Lamprey the striæ consist of series of cells. The head grows out, and exhibits two lateral swellings, separated by a cleft in the middle. Above these is the cavity of the mouth, and subsequently the nasal opening makes its appearance, and gradually moves from the ventral to the dorsal surface.

* From Müller's Archiv 1856, No. iv. p. 323. Communicated by W. S. Dallas, F.L.S.

† See Annals, vol. xvii. p. 443.

The hinder portion of the body is thick, and contains the vesicular intestine, which is still filled with cells of segmentation. A yelk-sac is never present. The long neck begins to move, and at its base the heart is seen, without a pulsating bulb.

About the eighteenth day the young animal escapes from the egg, when it is white and opake; but its substance gradually becomes clear, until the movement of the blood can be recognized, when it begins to develope pigment. The brain and spinal cord resemble a constricted thread, thickened anteriorly. The eyes appear as dark points on the sides of the brain. The neck exhibits eight clefts, of which the anterior soon closes, and the cavity of the mouth is united with the branchial cavity by a small opening. The intestine consists of a very fine membrane, covered with a very long bacillar epithelium. Along the back of the intestine runs a fold which receives a vessel, and the ureters rise on the dorsal side of the intestine, and form but few ramifications, in which ciliary movement is seen. The dorsal wall of the mouth has at first two, but afterwards several papillar elevations. In front of the heart is a longish oval organ, like a vesicle, and divided down the middle; this becomes the muscular portion of the sucking apparatus of the Lamprey.

A muscular veil is now developed in the mouth, which prevents the exit of water; and the papillæ of the upper surface of the mouth increase in number and form branches, constituting a sort of net which prevents the entrance of foreign bodies. At this period the author was surprised by the great similarity of his young fishes with those of the genus *Ammocœtes,* which occur in the same waters with the Lampreys, and for some time he endeavoured in vain to find any difference between them. After keeping them for two years they died, without exhibiting any tendency to take on the form of their parents; and during the whole of this period they appeared to be genuine *Ammocœtes*. The author was therefore led to imagine, that the supposed genus *Ammocœtes* was in reality founded upon the young of *Petromyzon*.

To ascertain the correctness of this supposition he sought for *Ammocœtes* in course of metamorphosis, and found them in a condition which distinctly showed their intermediate state. The silvery lustre of the skin which distinguishes the Lampreys was already perceptible, and the dorsal fin was elongated. The eye was distinct, but in some individuals was still dull, whilst in others it was perfectly clear. The mouth was narrower than in the true *Ammocœtes*; in the latter it measures $3\frac{1}{2}$ millimeters, during the metamorphosis 3, and in the fully developed animal in spring $5\frac{1}{2}$. The distance of the nasal opening from the anterior margin of the mouth increases in a regular ratio; thus, in the *Ammocœtes* it is $4\frac{1}{2}$, in the metamorphosis 6–7, and in the developed *Petromyzon* 9 millimeters. The cleft which separates the upper from the lower lip in the *Ammocœtes* was still distinctly present in some animals, but had completely disappeared in others.

The papillæ of the mouth were reduced, but bore no horny armature, and the veil of the mouth still existed in some individuals, especially those which exhibited the cleft between the upper and lower lips most distinctly. When the opening of the mouth was completely rounded, the veil was reduced to a small remnant. The branchial apertures had lost the external valves which in *Ammocœtes* prevent the ingress of water; and, in the most developed individuals, these apertures were furnished with a border. The inner branchial apertures were narrowed, but wider than in the Lamprey. In the structure of the œsophagus and other particulars of their anatomy, the animals also exhibited the same intermediate condition. The ova in the ovaries had already become white and opake; those present in the ordinary *Ammocœtes* being transparent. They exhibited the germinal vesicle distinctly, and the testes had developed cells for the formation of spermatozoa.

The metamorphosis goes on rapidly from this point. In sixteen days the yellow teeth made their appearance in many animals, and the sucking apparatus was in action; but it had not acquired its ordinary energy in four weeks in animals kept in confinement.

With this change of form comes a corresponding change in the mode of life. The *Ammocœtes* shun the light, and bury themselves in the sand at the bottom of the water. Their respiratory organs are protected by the network in the mouth; they live upon the substances which are collected by it in their mouths, and their œsophagus exhibits ciliary epithelium. The author found the shells of *Bacillariæ* in all the *Ammocœtes* which he examined. The *Petromyzon*, on the contrary, being well furnished with eyes, seeks the light, and swims about in the clearest water, or fixes itself by suction, when respiration is effected by the ingress and egress of the water through the external branchial apertures.

There is therefore no doubt that the *Ammocœtes* are the larvæ of *Petromyzon*, just as the Tadpoles are the larvæ of the Frog. As however only one European species of *Ammocœtes* has been described, although we have several species of Lampreys, the author thought it worth while to examine the *Ammocœtes* of the River Lamprey. He found this to be exactly similar to that of the small Lamprey above described; both possess a gall-bladder and otolithes, although these only persist in the small Lamprey. With regard to the Sea Lamprey he could ascertain nothing.

It appears from his observations that the duration of the larval existence must be three years. The spawning takes place in the spring, and only once in the year. In May he took six *Ammocœtes*; three small ones, measuring on an average about $2\frac{2}{3}$ inches, and weighing on an average $9\frac{1}{3}$ grains, and the other three measuring about 6 inches, and weighing on an average 87 grains. The three first must have been those of the preceding year, the larger ones must have been two years old; and as they showed no trace of metamorphosis, they could not have produced perfect Lampreys until the third year. Large individuals of *Ammocœtes* also occur after the time of the metamorphosis, and these probably do not undergo their change until the fourth year. In the perfect state, the Lampreys live a very short time. Immediately after the spawning season they disappear entirely, and their dead bodies may be seen floating in the water, the ovaries of the females being quite empty. This long duration of the larval state is remarkable, as in the only other Vertebrata which undergo a metamorphosis (the Batrachia) this usually takes place at an early period, and the animal continues to grow long after it has acquired its mature form. The metamorphosis of the Lampreys, therefore, resembles that of the Insects, in which the larval period is the most important portion of the animal's existence,—its principal business in the perfect state consisting in providing for the continuance of the species.

In conclusion, the author refers to the doubts which these observations may induce as to the systematic position of the Lampreys. In the occurrence of the metamorphosis, and the complete segmentation of the yelk, they resemble the Batrachia; and they also differ from the Fishes in the occurrence of a pair of elastic swellings in the *bulbus arteriosus*, one above each semilunar valve, whilst the inner wall of the bulb is destitute of the trabecular system which is generally present in Fishes. The structure of the brain also is different from that prevailing amongst the Fishes; but, according to the author's views, the nature of the dorsal chord and its appendages is decidedly piscine. The result of his examination of comparative characters is, in fact, to leave the Lampreys exactly in their former position. He promises a longer memoir on this subject, illustrated with figures.

XXVII.—*Monograph of the genus* Catops. By Andrew Murray, Edinburgh.

[Continued from p. 156.]

Exotic Species.

18. *C. celer*, Lucas.

Catops celer, Lucas, Explor. de l'Algérie, Anim. Art. ii. p. 225.

Oblongo-ovatus, fulvo-pubescens; capite subtilissime granario; antennis ferrugineis, ultimis articulis fuscis; thorace granario, angulis posticis acuminatis; elytris granariis; corpore infra granario; pedibus ferrugineis femoribusque nigricantibus.
Long. $1\frac{1}{2}$ lin., lat. $\frac{3}{4}$ lin.

Very closely allied to the *C. nigrita*; black, covered with a yellow, silky, very dense pubescence. The head is very finely shagreened and scarcely pubescent. The labial as well as the maxillary palpi are of a clear ferruginous colour. The antennæ are ferruginous, with the four last joints of a deep brown. The thorax is very finely shagreened, much more pubescent than the head; it is very slightly convex, rounded on the sides, with the posterior angles projecting and pretty strongly acuminate. The scutellum is very finely granulated and scarcely pubescent. The elytra are a little more strongly granulated than the head and thorax, and are very pubescent. All the body below is granulated, scarcely pubescent, and of the same colour as above. The legs are ferruginous, very lightly pubescent, with the thighs blackish.

Found by M. Lucas in Algeria under stones in the month of June. He mentions Oran and the Bondjaréa as localities where he took it, and he observes that it is very agile.

The above description is reproduced from that of M. Lucas. I have seen specimens in his possession, but not having had an opportunity of comparing them with the specimens in my own cabinet, I am not able to pronounce positively upon them. The same remark applies to the other two species from Algeria described by him (*marginicollis* and *rufipennis*).

19. *C. fuscipes*, Menetr.

Catops fuscipes, Menetries, Mém. Acad. Imp. Sciences St. Pétersb. 6 sér. vi. (1849) p. 53.

"Oblongo-ovatus, convexus, posterius valde angustatus pallide rufo-ferrugineus; capite, thoracis dorso, pectore abdomineque nigro-fuscis; antennis tenuibus longitudine dimidii corporis;

thorace antrorsum angustato, lateribus deflexo, angulis posticis productis acutis; elytris stria tantum suturali exarata*."
Long. $1\frac{3}{4}$ lin., lat. $\frac{3}{4}$ lin.

Menetries says that this species somewhat resembles his *C. lateritius* (already described (No. 5) in the first group), but that it is much more convex and *narrower behind, with the posterior angles of the thorax pointed and prolonged backwards*; he adds that moreover it has no perceptible striæ on the elytra, except one along the suture, but that it is particularly the colour which distinguishes it at the first glance.

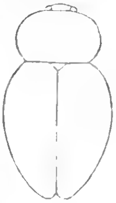
I have not seen this species, but the above description, particularly the portion which I have printed in italics, would seem to indicate an affinity to *C. nigricans*, and the pale colour has probably arisen from immaturity. I have therefore, in the absence of any more precise information, placed it in this group.

Menetries does not mention its locality, but as it comes immediately after *C. lateritius*, and he institutes comparisons between them, it is probable that they were found not far from each other. In that case the locality of this species would be Novaïa Alexandrovskaïa.

20. *C. vestitus*, mihi.

Oblongo-ovatus, fuscus, dense griseo-pubescens; antennis clavatis, nigris, basi ferrugineis; thorace transverso, granulato, angulis posticis obtusis; elytris stria suturali.
Long. 2 lin.

Fig. 23.



Oblong-oval, blackish-brown; mouth and legs ferruginous; clothed with a thick, coarse, griseous pubescence, of a more lively fulvous colour on the thorax. The antennæ are clavate, black, except at the base, which is ferruginous; they are not so slender at the base as is usually the case, making the club look less thickened than it is in reality. The first joint is large, the second shorter and narrower; the rest are nearly all of equal length, with the exception of the seventh and ninth, which are a little longer, and the eighth, which is shorter. They gradually increase in thickness up to the seventh, which is the broadest and largest of them all; the eighth joint is smaller and thinner than the seventh and ninth, but not very minute; the terminal joint is suddenly acuminate at the tip, looking as if truncate at the end, with a short spike projecting from the centre. The thorax is transverse, broadest a little behind the middle. The posterior

* Menetries in *loc. cit.*

angles are obtuse, except at the very angle, where there is an exceedingly minute rectangular starting-point. The surface is coarsely granular. The scutellum is small. The elytra are granulated and have a distinct sutural stria, but apparently no others—at least the traces, if any, are exceedingly indistinct. The anterior tarsi and first joint of the middle tarsi are dilated in the male.

This species has some resemblance to *C. chrysomeloides,* but it is smaller, the thorax is narrower and more transverse, the antennæ are not so heavily clubbed, and the joints are differently proportioned. It has also some resemblance to *C. tristis,* but the form of the thorax as well as a difference in the pubescence distinguish it. The pubescence is coarser and more dense than in most other species.

From the East Indies (Boys' collection). The above description is taken from a unique (male) example kindly presented to me by my friend Mr. Westwood.

21. *C. Spencianus,* Kirby.

Choleva Spenciana, Kirby, Fn. Bor. Amer. p. 108 (1837).
Catops cadaverinus, (Esch.) Mannerh. Beitr. zur Käf. Faun. der Aleutischen Inseln, Sitka, und Calif., aus d. Bull. Naturforsch. Moscow, xvi. (1843) p. 82. no. 173.
—— *fuscus,* Hoff. var. Dej. Cat. 3rd ed. 133.

Fig. 24.

"Oblongo-ovatus, fusco-piceus, tenue-pubescens; antennis mediocribus, clavatis, basi ferrugineis; thorace brevi transverso, basi parum latiore, angulis posticis obtusis; elytris rufescentibus punctatis, stria suturali impressa; pedibus ferrugineis piceis; femoribus infuscatis.
"Long. $1\frac{1}{2}$ lin., lat. 1 lin.*"

Body black, covered with decumbent pale hairs. Head minutely punctured; antennæ shorter than the prothorax, the two first joints ferruginous, the eighth shorter and smaller than the rest; mouth and palpi ferruginous; prothorax not visibly punctured, with all the angles rounded; base with a slight sinus on each side; elytra acute, very minutely punctured, with a hair emerging from each puncture, without furrows, except a single one parallel with the suture, ferruginous, black at the tip; abdomen piceous, rufous at the base; legs ferruginous.

Found in the Sitka Islands by Eschscholtz and Kuprianoff.

A comparison of the authentic unique specimen of Kirby's *Choleva Spenciana* preserved in the British Museum, with specimens of Mannerheim's *Catops cadaverinus,* shows that they are the same species.

* Mannerheim in *loc. cit.*

Mr. Kirby remarks regarding it, that "This species appears to present the type of a new family of *Choleva*, not noticed in Mr. Spence's 'Synopsis Sectionum' in his admirable Monograph of that genus. From his first section (*Choleva*, Steph.) it borrows the rounded posterior angles of the prothorax; from his second (*Catops*, Steph.) its clavated antennæ; and from his third (*Ptomaphagus*, Steph.) its unfurrowed elytra: it seems properly included in the second, with which it most agrees in habit*."

Var. *b*. Mann. Bull. de la Soc. Mosc. 1843, pp. 173, 254.

Ferrugineo-testacea; capite fusco; thoracis disco antennisque infuscatis; elytris pallide livido-testaceis, postice nonnihil obscurioribus.

As Count Mannerheim observes, this species is somewhat allied to *C. morio*, Erichs. (*fuscus*, Gyll.), but distinguished from it by the thorax being smaller and narrower and the elytra longer. The colour both of the pubescence and body is paler.

In carcases in the island of Afognak; taken sparingly in the month of August by M. Holmberg, who also took it in California. It was likewise brought by M. Frankenhäuser from the interior of the Peninsula of Kenai.

For the figure of this and the other American species I am indebted to my friend Dr. Leconte of Philadelphia, who has kindly furnished me with drawings of them made expressly for my use in this paper. They are in half outline, and all his figures are four times enlarged. The head is brought up simply to show proportions.

22. *C. brunnipennis*, Mann.

Catops brunnipennis, Mann. Nachtrag zur Käfer-Fauna der Nord-Amerikanischen Länder der Russischen Reiches, Mosc. 1853, p. 14.

"Oblongo-ovatus, convexus, crebre subtilissime reticulato-strigulosus, nigro-piceus, griseo-pubescens; antennis thorace vix brevioribus, ferrugineo-testaceis, clava parum incrassata fusca, articulo octavo minutissimo; thorace longitudine sesqui latiore lateribus modice rotundatis, antice latitudine basis haud angustiore, angulis omnibus subrotundatis; elytris obscure castaneis, apice subacuminatis, stria suturali leviter exarata; pedibus piceo-testaceis.

Fig. 25.

"Long. $1\frac{3}{4}$ lin., lat. $\frac{3}{4}$ lin.

"Longer than *C. cadaverinus*, Esch., more narrowed behind,

* Kirby in *loc. cit.*

besides differing from it in having the antennæ more slender, the thorax much broader, shorter, and not narrowed in front.

"Found tolerably frequently near the river Tschunuktnu in the Peninsula of Kenai, in carcases at the end of June, M. Frankenhäuser*."

The reader owes the figure of this species to Dr. Leconte.

23. *C. luridipennis*, Mann.

Catops luridipennis, Mann. dritten Nachtrag zur Käfer-Fauna der Nord-Amerikanischen Länder des Russischen Reiches, Mosc. 1853, p. 84.

Fig. 26.

"Ovatus, convexus, crebre subtilissime reticulato-strigulosus, nigro-piceus, griseo-pubescens; antennis thorace nonnihil longioribus, crassiusculis nigris, articulo octavo minuto; thorace longitudine fere duplo latiore, lateribus rotundato, antice latitudine basis haud angustiore, angulis omnibus rotundatis; elytris obscure castaneis, apice obtusis rotundatis, stria suturali leviter exarata; tarsis rufis.

"Long. $1\frac{1}{2}$ lin., lat. $\frac{3}{4}$ lin.†"

Mannerheim says that this species is allied to his *C. brunnipennis*, but is shorter, and is besides distinguished by having the antennæ thicker, the thorax shorter, its sides more rounded, and the elytra rounded at the apex.

Collected in carcases in the months of July and August by M. Frankenhäuser on the banks of the Tschunuktnu in the Peninsula of Kenai: not frequent.

24. *C. simplex*, Say? Lec.

Catops simplex, Say? Journ. Acad. Nat. Sc. Philad. v. 184; Leconte, Synopsis of the Silphales of America in Proceedings of Acad. Philad. 1853, 281.

Fig. 27.

"Piceus, fulvo-sericeus, dense punctulatus; thorace antrorsum subangustato, lateribus rotundatis, basi late rotundato; elytris obsoletissime striatis, stria suturali profundiore; antennis basi testaceis; tibiis calcaribus mediocribus armatis.

"Long. $1\frac{3}{4}$ lin.

"The anterior tarsi and first joint of the middle tarsi of the male are moderately dilated; the antennæ are as long as the head and thorax, moderately thickened; the seventh joint is a little larger than the sixth, and equal to the ninth; the eighth is about one-half smaller‡."

* Mannerheim *in loc. cit.* † *Ibid.* ‡ Leconte in *loc. cit.*

The above is Dr. Leconte's description; the following is Say's: "Pale brownish, sericeous; terminal and five basal joints of the antennæ rufous. Inhabits Arkansas. Head dark ferruginous; antennæ dark ferruginous, the five basal joints and terminal joint rufous; palpi and mandibles ferruginous; thorax rather paler than the head, quadrate, a little transverse, sides regularly arcuated; posterior margin not wider than the anterior; posterior edge rectilinear; angles rounded; elytra paler than the thorax, light brownish, with obsolete striæ, more obvious towards the tip; very numerous minute punctures furnishing minute hairs; beneath piceous; feet rufous; thighs yellowish beneath. Length nearly $\frac{3}{20}$ths of an inch. This species occurred on dung*."

Dr. Leconte in speaking of his species remarks, that he is not positively certain that it is Say's species, which was found in Arkansas, while his was from New York. He adds, "The thorax is more narrowed in front than described by him; although the legs are in reality black, the lustre of the fulvous hair is such, that one might readily be tempted to describe them as testaceous at base."

25. *C. clavicornis,* Lec.

Catops clavicornis, Lec. Synopsis of Silphales of America in Proceed. Acad. Philad. 1853, 281.

Fig. 28.

"Oblongo-ovatus, ater, subtiliter pubescens, dense punctulatus; thorace antrorsum valde angustato, lateribus rotundatis, basi late rotundato; elytris versus apicem obsolete striatis, stria suturali profunda; antennis thorace brevioribus, magis clavatis.

"Long. $1\frac{3}{4}$ lin.

"One female: New York. This species is readily distinguished from the preceding (*C. simplex*) by the shorter, more clavate antennæ, which are only indistinctly testaceous at the base; the seventh joint is about twice as large as the sixth; the eighth is smaller than the sixth, and appears only about one-third as large as its neighbours. The spines of the tibiæ are somewhat smaller than in the preceding species (*simplex*)†."

2nd Subdivision. *Thorax forming a continuous or nearly continuous line with the elytra; middle tarsi of the males widened in some species, in others not.*

In the last subdivision our arrangement led us gradually from

* Say in *loc. cit.*

† Leconte in *loc. cit.*

the species with slender antennæ to those with the heaviest and thickest-clubbed antennæ. The affinity to these leads us now to reverse this order, and to commence this subdivision with those having similar thick antennæ.

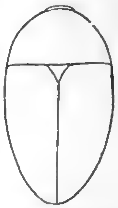
A. *Antennæ heavily clubbed and middle tarsi widened in the males.*

26. *C. fumatus*, Erichs.

Choleva Watsoni, Spence, Linn. Trans. xi. 156.
Catops agilis, Fab. Syst. Eleuth. ii. 565. 6; Gyll. Ins. Suec. i. 277. 2; Panz. Faun. Germ. 95. 10; Duft. Fn. Aust. iii. 75. 4.
Catops fumatus, Erichs. Käf. d. M. Br. i. 240. 12; Sturm, Deut. Fn. xiv. 31. 15. t. 176. f. *c*. C; Heer, Fn. Helv. i. 382. 15; Redt. Fn. Aust. 144. 7; Kraatz, Stett. Ent. Zeit. xiii. 436. 22; Fairm. & Laboulb. Fn. Ent. Fr. i. 303. 14.

Oblongo-ovalis, fusco-piceus; *antennis brevibus, clavatis, basi apiceque ferrugineis*; thorace brevi, basi latiore, *angulis posticis rectis*; elytris pedibusque testaceis.
Long. $1\frac{1}{2}$ lin.

Fig. 29.



One of the smaller species. Oblong oval. Deep brown. Antennæ short and thick, a little longer than the thorax, brown; last joint broader than long, both it and the three first joints ferruginous. Head black, densely punctate. Thorax with reddish transparent margins, slightly arched; densely and finely punctate, almost twice as broad as long, as broad at the base as the elytra, or very nearly so, narrowed in front; posterior angles right-angled, pointed; posterior margin almost straight. Elytra oval, acuminate, densely punctate, without traces of striæ, except the sutural; reddish-brown, often brownish at the extremity. Under side blackish-brown. Legs ferruginous.

Distinguished from the other European species of this subdivision, except *alpinus* and *scitulus*, by its short, thick, heavily-clubbed antennæ.

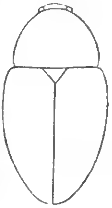
The *alpinus* is clearer in colour, is longer, and has the thorax usually narrower than the elytra. *Scitulus* differs from *fumatus* in having the antennæ longer, the elytra broader, the posterior angles of the thorax projecting, and the colour somewhat different, the elytra being brown, without the reddish tint which is characteristic of *fumatus*, particularly at the base of the elytra, and having a marked sericeous lustre.

One of the commonest species. It is found in Scotland and England, and all over Europe, under detritus, in decaying fungi and under leaves.

27. *C. alpinus*, Gyll.

Catops alpinus, Gyll. Ins. iv. 3121. 2; Heer, Fn. Helv. i. 318. 11; Kraatz, Stett. Ent. Zeit. xiii. 435. 21.
Catops subfuscus, Kellner, Stett. Ent. Zeit. viii. 177. 4; Redt. Fn. Aust. 771.

Fig. 30.*



Oblongo-ovalis, fusco-piceus; *antennis abrupte clavatis, basi ferrugineis*; thorace brevi, *angulis posticis obtusiusculis*; elytris pedibusque rufo-brunneis.
Long. $1\frac{1}{2}$–$1\frac{3}{4}$ lin.

Very like *C. fumatus*, but usually somewhat larger, with a narrower thorax, the posterior angles of which are obtuse, and the basal margin not so broad as the elytra. The antennæ are as long as the head and thorax, with the basal joints reddish and thick; club blackish; the last joint is usually black, but sometimes yellowish at the tip. The head is black, densely and finely punctate, with a yellowish pubescence. The thorax is blackish-brown, densely punctate, densely clothed with yellow hairs, at the basal margin not so broad as the elytra, cut straight, and slightly sinuate on both sides of the scutellum, the anterior angles obtuse and the posterior angles slightly rounded. The elytra are oval, densely punctate, lightly clothed with yellow pubescence, clear reddish-brown, generally blackish at the tip and towards the suture. The legs are brownish-red.

The normal specimens are readily distinguished from *fumatus* by their larger size and more elongate form, and by the thorax being narrower than the elytra; but these characters are sometimes wanting, and in form the smaller specimens do not differ from *C. fumatus*; the clearer colour, the particularly strong dark club of the antennæ with its eighth joint proportionately smaller, then serve to distinguish it; but on the whole I am very doubtful of its being more than a variety of *fumatus*, and it is with hesitation I have placed it as a distinct species.

Generally distributed over the north of Europe; but I have not yet seen British specimens.

28. *C. brevicollis*, Kraatz.

Catops brevicollis, Kraatz, Stett. Ent. Zeit. xiii. 436. 23.

"Ovatus, fusco-piceus; *antennis ferrugineis obsoletissime clavatis, articulo ultimo duobus præcedentibus longitudine æquali, acuminato*; thorace fusco, transverso, basi latiore, *angulis posticis rotundatis*; elytris substriatis pedibusque rufo-testaceis.
"Long. $1\frac{1}{2}$ lin."

I have not seen this species. The following is M. Kraatz's description:—

* The comparative breadth of the elytra is rather exaggerated in this figure.

"Nearly in the middle between *C. fumatus* and *C. scitulus.* Easily distinguished from both by the wholly different thorax and form of the antennæ. Pitchy-brown; elytra and legs brownish-yellow. The antennæ are somewhat longer than the head and thorax, reddish-brown throughout; the club scarcely perceptibly thickened; the five last joints are only a little stouter than those preceding, and are of equal breadth; the first joint is somewhat longer and a little stouter than the second; the third somewhat shorter than the second, distinctly larger than the fourth, almost equal to the sixth; fifth scarcely larger than those on each side of it; seventh half as long again and somewhat stouter than the sixth, equal to the ninth; eighth scarcely slenderer, and half as long as those on each side of it; tenth a little shorter than ninth; eleventh as long as ninth and tenth together, from the middle outwards sharply acuminate. The head is pitchy-black, very finely moderately densely punctate; the mouth brownish-yellow. The thorax of the breadth of the elytra, broadest at the base, more than twice as broad as long, tolerably strongly and symmetrically narrowed from the base towards the front. The anterior angles are rounded, somewhat depressed; the obtusely rounded hinder angles project a little beyond the anterior margin of the elytra; the posterior margin is very feebly sinuated on both sides near the middle; the upper side is moderately, densely, finely shagreen-punctate, pitchy-black; the sides and posterior margin brownish, tolerably closely covered with a long yellowish-grey pubescence. The elytra are uniform, only slightly narrowed behind, densely and finely punctate, with a slight bloom or hoar-frost on them, sparingly and finely pubescent, brownish-yellow. The under side of the body is pitchy-black. The legs are reddish-yellow*."

M. Kraatz has established this species upon one example from Sicily, communicated by Zeller to the Royal Museum of Berlin.

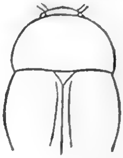
29. *C. scitulus*, Erichs.

Choleva fumata, Spence, Linn. Trans. xl. 155. 4.
Catops scitulus, Erichs. Käf. d. M. Brand. i. 241. 13; Sturm, Deutschl. Faun. xiv. 33. 16; Redt. Faun. Aust. 772; Kraatz, Stett. Ent. Zeit. xiii. 437. 24; Fairm. & Laboulb. Fn. Ent. Fr. i. 304. 17.

Ovatus, fuscus; antennis leviter clavatis, ferrugineis; thorace postice latiore, *angulis posticis productis, rectis*; elytris pedibusque obscure fusco-testaceis.

Long. $1\frac{1}{2}$ lin.

Fig. 31.



Oval, brown. Antennæ as long as head and thorax, ferruginous, a little deeper before the

* Kraatz in *loc. cit.*

extremity. Head brownish-black, densely punctate. Thorax large, deep brown, densely punctate, only one-third broader than long, as broad at the base as the elytra, narrowed in front from the middle, rounded on the sides; posterior angles pointed, a little projecting behind, which makes the posterior margin visibly sinuated on each side. Elytra oval, slightly acuminate, densely punctate, without vestiges of striæ, except the sutural; testaceous-brown, extremity blackish. Legs ferruginous.

Resembles *C. fumatus*, but differs by having the antennæ longer, the elytra broader, and the posterior angles of the thorax projecting a little behind, and its colour darker and concolorous; and covered with a fine silky pubescence, so that when looked at from behind, a paler sericeous band appears to stretch across the elytra.

Not common. Has been taken near Berlin, in Thuringia, Erlangen, Switzerland, near Paris, near London, and in the south of England. I have not seen any examples taken in Scotland.

B. *Antennæ not heavily clubbed; middle tarsi of males rarely widened.*

30. *C. depressus*, mihi.

Fig. 32.*

Breviter ovatus, postice attenuatus, ferrugineus; antennis subfiliformibus; thorace transverso, subdepresso, postice latiore, *lateribus postice leviter inflexis*; angulis posticis fere acutis; elytris pallidioribus, substriatis.

Long. $1\frac{7}{8}$ lin.

Entirely of a pale ferruginous colour; the elytra paler, and the legs testaceous. The antennæ are slender, pale ferruginous; first joint stouter and longer than the second; third joint nearly twice as long as the second; fourth nearly as long as the third; fifth and sixth joints nearly equal in length—if there is any difference, the fifth is longer than the sixth, but this is scarcely perceptible; they are also all of the same breadth, and each is shorter than the third; the seventh is a little longer than the sixth, and broader; the eighth is only half as long as the seventh, but scarcely narrower; the ninth and tenth are nearly equal in length, rather broader than the seventh; the eleventh is nearly round, but with a slight obtuse point at the tip. Head brown, pretty

* The sinuations of the thorax and prominence of the shoulders are rather exaggerated in this figure.

closely and distinctly punctate, most deeply in front, and with a shallow frontal depression; clothed with a yellowish pubescence. Thorax transverse, subdepressed, narrowest in front; the posterior angles meeting, and as broad (or nearly so) as the base of the elytra, the lateral margins with a slight appearance of inflexion just before the posterior angles; the anterior angles rounded; the posterior angles somewhat acute; posterior margin broadly sinuate towards the sides; shagreen-punctured, clothed with a yellowish pubescence. Elytra $2\frac{1}{2}$ times as long as the thorax, ferruginous-red; shoulders prominent, and tapering from them towards the apex; turned rapidly in at the apex, so as to make it appear almost slightly truncate; a depression surrounds the scutellum (which is large and triangular) and extends along on each side of the suture for more than half the length of the elytra, the back of each elytron rising in a somewhat humped manner from the depression; there is a deep sutural line running up the middle of this depression; it touches the suture at the apex, expands as it goes along, and contracts almost to the suture again when it reaches the scutellum; the elytra are tolerably distinctly striated, the striæ deepest at the apex; shagreen-punctured, and clothed with a close testaceous yellow pubescence. Legs and under side of same colour as upper side, but rather paler, clothed with a similar pubescence.

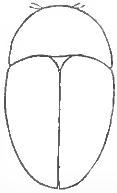
At first sight this species is very like *fuscus*, many specimens of which have the same depression on the back of the elytra; but it is distinguished at once by the different form of the posterior part of the thorax, which in *fuscus* turns in to meet the base of the elytra, while in this species it does not. The joints of the antennæ are also somewhat different in their proportions, and the elytra taper more rapidly to the apex, and the apex itself at its extremity has a tendency to become semi-truncate for a short space, while in *fuscus* the apex is rounded off to the suture. There is, however, no doubt that this is very much akin to *fuscus*, and, in a strictly natural arrangement, should come next to it; but no arrangement will provide for all the aberrant forms which occur, and an occasional separation of nearly allied species must be submitted to, for the sake of the greater facility of determination afforded by artificial divisions.

The above description is taken from a single female specimen which I found in M. Chevrolat's collection, and which, although unique, he has kindly ceded to me. It stood among his European species, but the exact locality was not mentioned.

31. *C. umbrinus*, Erichs.

Catops umbrinus, Erichs. Käf. d. M. Brand. i. 235. 4; Redt. Fn. Aust. 771; Kraatz, Stett. Ent. Zeit. xiii. 407. 7; Fairm. & Laboulb. i. 303. 15.

Fig. 33.



Ovatus, brunneus; antennis subfiliformibus; thorace transverso, postice latiore, angulis posticis elongatis, *acutis*; elytris substriatis.

Long. $1\frac{3}{4}$ lin.

Short oval, brown. Antennæ scarcely thickened at the extremity, ferruginous, lighter at the base, clear yellow at the apex. Head almost black; mouth reddish. Thorax densely and finely punctate, broadest behind, posterior margin sinuate, and the posterior angles pointed, projecting, embracing the base of the elytra. Elytra very slightly widened in the middle, obtusely rounded at the apex, finely and densely punctate with indistinct striæ, scarcely more visible behind. Legs reddish. Middle tarsi of males widened.

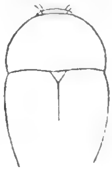
The completely oval shape of this species, the outline of the thorax fitting exactly to the elytra, distinguishes it from all but a few. Its slender antennæ distinguish it from those in the preceding section of this subdivision. It is the largest species of this section, and comes nearest to *C. velox*. Its larger size, darker colour, the posterior angles of the thorax more projected behind, and the middle tarsi widened in the males, distinguish it from that species.

Widely distributed over the Continent, but I am not aware of its having been taken in Britain*. It has been taken near Stettin, Berlin, in Austria, near Kiew, Paris, Fontainebleau, &c., on trees and under leaves.

32. *C. velox*, Spence.

Choleva velox, Spence, Linn. Trans. xi. 154. 13.
Catops velox, Erichs. Käf. d. M. Brand. i. 241. 14; Sturm, Deutschl. Faun. xiv. 3. 5. 17. t. 277. f. *b*. B; Heer, Fn. Helv. i. 383. 17; Redt. Fn. Aust. 144. 15; Kraatz, Stett. Ent. Zeit. xiii. 437. 25; Fairm. & Laboulb. Fn. Ent. Fr. i. 304. 18.

Fig. 34.



Ovatus, ferrugineus; capite fusco; antennis longioribus, obsolete clavatis, ferrugineis; thorace transverso, basi latiore, *margine postico leviter sinuato*, angulis posticis rectis; elytris obsoletissime striatis, *subtilissime transversim rugulosis*.

Oval, ferruginous-red; head brown, reddish

* I recorded this in my 'Catalogue of Scottish Coleoptera' as having been taken by Mr. Morris Young near Paisley, but I am now satisfied that this was a mistake.

in front, extremely finely punctate. Antennæ as long as the head and thorax, slender, very feebly thickened towards the extremity, ferruginous, the last joint not more slender than the preceding, excised at the extremity. Thorax densely and finely punctate, as broad behind as the elytra, one half broader than long, rounded on the sides, narrowed in front; posterior angles right-angled, pointed a little inwards; posterior margin lightly but visibly sinuate on each side; ferruginous, with the disk darker, and the margins semi-transparent. Elytra scarcely widened in the middle, obtusely rounded at the extremity, with very indistinct striæ; surface densely punctate, finely wrinkled across. Anterior legs slightly widened at the extremity; middle tarsi not widened in the males.

Distinguished from *C. scitulus*, to which it has considerable outward resemblance, by its more slender antennæ, its paler colour, the margins of the thorax lighter-coloured than the disk, its transversely wrinkled elytra, and its middle tarsi not widened in the males.

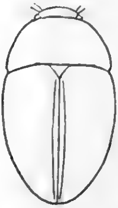
Differs from *C. umbrinus* by its smaller size, its lighter colour, the posterior angles of the thorax not produced behind, the elytra transversely wrinkled, and the middle tarsi not widened in the males.

Found throughout Britain and over the Continent not unfrequently. It has also been taken by Chaudoir at Kiew, and by Wollaston at Madeira, where, however, it appears to be excessively rare.

33. *C. badius*, Dahl., Sturm.

Catops badius, Meg. Dahl. Col. et Lepid. 30; Sturm, Deutschl. Fn. xiv. 40. 20. t. 278. *b*. B; Heer, Faun. Helv. i. 383. 19; Redt. Fn. Aust. 145. 15; Kraatz, Stett. Ent. Zeit. xiii. 437. 26.

Fig. 35.



Ovatus, piceo-brunneus; antennis longioribus, obsolete clavatis, ferrugineis; thorace transverso, basi latiore, *margine postico recto, angulis posticis rectis, prominulis*; elytris obsoletissime striatis.

Long. 1–1$\frac{3}{4}$ lin.

Perfectly egg-shaped, the sharper end behind, gently convex, clear pitchy-brown, the whole upper side clothed with a fine, adpressed, yellowish-grey pubescence. The antennæ are a little longer than the head and thorax, ferruginous-yellow, somewhat thickened towards the point; the seventh joint longish, the eighth shorter, but as broad as the last, the terminal joint obtuse roundish. The head is very finely punctate, the eyes black. The thorax is finely and densely punctate, short, behind exactly as broad as the base of the elytra, strongly narrowed in front, the anterior and posterior margins not sinuate, the sides lightly rounded, the posterior angles right-angled, somewhat projecting over the shoulders of the elytra. The scutellum large, triangular, finely punctate. The elytra are oblong-oval, widest in the middle, behind acuminate-oval, finely shagreened, with a deeply impressed sutural stria, but without traces of other striæ. The under side of the body and the legs are of the same colour as the upper, only somewhat lighter.

Distinguished from *C. velox* by its decidedly more slender form, by its colour always pitchy-brown and not reddish-brown, and by the posterior angles of the thorax somewhat projecting over the margins of the elytra.

Differs from *C. præcox* by its thorax not being wider than the elytra, and from *C. brunneus* by its larger size, and the posterior angles of the thorax not being obtuse.

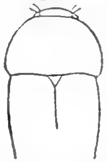
This species seems rare. Sturm simply says it is found in Austria. Kraatz says he has only seen two specimens, which came from Vienna. I have not seen it.

34. *C. præcox*, Erichs.

Choleva Wilkinii, Spence, Linn. Trans. xi. 157.
Catops præcox, Erichs. Käf. d. M. Br. i. 242. 15; Sturm, Deutschl. Fn. xiv. 37. 18. t. 277. f. *c*. C; Heer, Fn. Helv. i. 318. 18; Redt. Fn. Aust. 145. 16; Kraatz, Stett. Ent. Zeit. xiii. 438. 27; Fairm. & Laboulb. Fn. Ent. Fr. i. 304. 19.

Oblongo-ovatus, ferrugineus; antennis longioribus, obsolete clavatis, ferrugineis; thorace brevi, basi latiore, *margine postico recto, angulis posticis obtusis*; elytris obsoletissime striatis, *paulo angustioribus quam thorace*.

Fig. 36.



One of the smallest species, of a peculiar shape, oblong-oval, gradually narrowed behind, with the apex somewhat truncate, brownish ferruginous, clothed with a very fine and thin yellowish pubescence. The antennæ are ferruginous-red, almost longer than the head and thorax; only the three last joints are perceptibly thicker than those preceding, and the eighth joint decidedly shorter, but not more slender than the seventh. The head is frequently brownish or blackish on the front. The thorax is large, transverse, very slightly, but still perceptibly, broader than the elytra; the sides are rounded, more narrowed in front than behind; the posterior angles obtuse; the posterior margin straight, very finely and densely punctate. The scutellum is of the form of an equilateral triangle. The elytra are oblong, straight, perceptibly narrowed behind, with the apex truncate, somewhat flat, more distinctly punctate than the thorax, and very feebly and indistinctly striated, with the exception of the sutural stria, which is deeply impressed. The anterior tibiæ are slightly widened towards the extremity.

Where the characteristic breadth of the thorax is well developed, this species can be recognized by the base of the thorax being a little wider than the base of the elytra, and by the elytra narrowing backwards and becoming truncate: where this is less conspicuous, the smaller size, narrower shape, the straight margins of the elytra, and their narrowing behind, distinguish it from *C. velox*. From *C. badius*, its smaller size, much lighter colour, straight posterior margin of thorax not projecting backwards at the posterior angles, separate it; and it is readily distinguished from the following species (*C. brunneus*) by the finer punctuation of the elytra.

Spread over all Europe, including Scotland and England, but everywhere scarce.

35. *C. transverso-striatus*, Dej. Cat.

Catops transverso-striatus, Dej. Cat. 3rd ed. p. .

Angustatus, elongatus; antennis longioribus quam capite et thorace; elytris postice attenuatis, striatis et fortiter elongatis, transversim strigosis.

Mas, elytris longissimis. Long. $1\frac{1}{4}$ lin.

Fœm., elytris minus elongatis. Lat. 1 lin.

This species bears considerable resemblance to *C. præcox*, is of the same colour, but is larger, and in the male especially has the elytra much more elongate. It has also the elytra very deeply transversely strigose, and has seven distinctly impressed irregular striæ, besides a deep sutural stria.

Male. Pubescent, of a yellowish testaceous or pale brown colour. The antennæ are testaceous, slender, longer than the head and thorax. The first and second joints are long, the first a little shorter and thicker than the second; the second, third and fourth are about equal in length; the fifth, sixth and seventh are all nearly of the same breadth and thickness, but each a little shorter than the one preceding it; the eighth is slightly shorter than those on each side of it. The last three are thickened; the last is short and a little acuminate. The head is a little darker than the rest of the body, and the mouth somewhat lighter. The thorax is pubescent, smooth, not punctate, but feebly granulose, broader than long, rounded on the sides, broadest a little behind the middle, bisinuate at the base, with the posterior angles projecting slightly backwards. The scutellum is large and acutely triangular. The elytra are very long, being five times the length of the thorax, and taper towards the apex in a wedge-shape. They are very deeply transversely wrinkled, with a profound sutural stria, and seven other striæ less deeply impressed but still quite distinct. The apex of each elytron is somewhat rounded. The margins of the elytra are broadly inflexed, leaving a prominent lateral ridge.

Female. The above description will apply also to the female, with the following alterations:—She is much shorter and comparatively broader, and the elytra are not so disproportioned in their length. The antennæ are shorter and thicker, the base and apex much paler than the middle. The impressed striæ on the elytra are much less evident, but the transverse strigations are equally distinct.

No species that I have seen has the transverse strigations so strongly marked. It may at first sight be mistaken for a very large *præcox*, but these strigations and the almost disproportionate length and wedge-shape of the elytra in the male distinguish it readily.

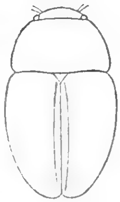
I found three males and one female under this name, marked as coming from Portugal, in the collection of the Count Dejean; the kindness of M. le Marquis de Laferté Senectère having placed that collection in my hands for examination.

36. *C. brunneus*, Dahl., Sturm.

Catops brunneus, Knoch, Dahl. Col. et Lepid. 30; Sturm, Deutschl. Fn. xiv. 38. 19. t. 278. f. *a*. A; Redt. Fn. Aust. 145. 16; Kraatz, Stett. Ent. Zeit. xiii. 439. 28.

Ovatus, piceo-brunneus, *fumatus*; capite fusco; antennis longioribus, obsolete clavatis, ferrugineis; thorace transverso, basi latiore, *margine postico recto, angulis posticis obtusis*; elytris brunneis. Long. 1 lin.

Fig. 37.



As large as the preceding species (*C. præcox*), but of a wholly different shape. It is broad-oval, moderately flat, behind broadly truncate, ferruginous-brown and shining. The antennæ are as long as the head and thorax, thin, gradually somewhat thickened towards the apex, the terminal joint roundish, pubescent, the eighth joint short. The head broad, pitchy-black, finely punctate; the parts of the mouth ferruginous-red. The thorax is large, broad, as broad at the base as the elytra, only slightly narrowed in front; the sides lightly rounded; the posterior angles obtuse; the basal margin straight; it is moreover slightly convex, somewhat darker on the back, very finely and densely punctate, and thinly clothed with a fine yellowish-grey pubescence. The scutellum is obtusely triangular, densely punctate. The elytra are of a short and broad oval form, broadly truncate at the apex, finely shagreen-punctured, thinly clothed with a yellowish-grey pubescence, deeply impressed with a sutural stria, and without any traces of other striæ. The abdomen is pitchy-black; the legs are ferruginous-yellow.

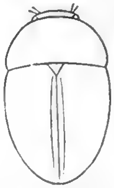
The salient points in which it differs from the preceding have been already noticed. It is larger, more densely pubescent, more thickly punctate and less shining than the following species (*C. anisotomoides*).

The above description is reproduced from Sturm, as I have not seen the species. It has been taken in Hungary and Austria.

37. *C. anisotomoides*, Spence.

Choleva anisotomoides, Spence, Linn. Trans. xi. 156. 16.
Catops anisotomoides, Sturm, Deutschl. Fn. xiv. 42. 21. t. 278. f. *c*. C; Heer, Fn. Helv. i. 384. 20; Redt. Fn. Aust. 145. 16; Kraatz, Stett. Ent. Zeit. xiii. 439. 29; Fairm. & Laboulb. Fn. Ent. Fr. i. 304. 20.

Fig. 38.



Ovatus, piceus, nitidulus; antennis longioribus, obsolete clavatis; thorace transverso, basi latiore, margine postico recto, angulis posticis obtusis; elytris piceis seu rufo-piceis.
Long. $\frac{3}{4}$ lin.

Oval, very convex. Pale ferruginous-brown, somewhat shining, variable in depth of colour, deeper on the disk of the thorax and of the elytra, with a fine brown pubescence. Antennæ tolerably long, scarcely thickened at the extremity. Thorax transverse, as broad at the base as the base of the elytra, narrowed a little in front, very densely but finely punctate; posterior margin straight, posterior angles obtuse. Elytra elongate-oval, scarcely widening behind the base, then gradually becoming narrower; densely punctate, but not so finely as the thorax; suture raised; sutural stria deep, almost reaching the scutellum; no traces of other striæ to be seen. Legs and antennæ of the same colour as the body.

The smallness of its size, and its short and more convex form, distinguish it from *C. velox*. It is nearer in point of size to *C. præcox*, but the more elongate form of the latter and its differently shaped thorax distinguish it; and a tendency which it has to curl itself up like an *Agathidium* will suggest what it is.

Distributed over all Europe, and generally common. In Scotland and England it is scarcer; but in France and Germany it is very common. Fairmaire says it is found almost all the year round in vegetable detritus, principally on the banks of lakes and marshes.

[To be continued.]

XXVIII.—*Contributions to the Anatomy of the Infusoria**. By N. Lieberkuhn.

The essential characters, discernible by direct observation, assigned by Ehrenberg to the genus *Ophryoglena*, are, that the mouth and the anal point do not lie at the same end of the body; that the body bears cilia over the whole surface, and that a forehead-eye exists; and, more particularly, "the mouth is a pit below the forehead, and the anal point is observed on the back at the base of the tail."

Of the three species, *Ophryoglena atra, acuminata* and *flavicans*, the latter is thus described:—*O.* corpore flavicante, ovato, turgido, postico fine attenuato obtuso, ocello rubro frontali. Size $\frac{1}{12}$th of a line. It is added of *O. flavicans*,—"It resembles a *Bursaria*, and I only distinguish it from this by the eye-spot, hitherto unknown in the family, the physiological importance of which I . established. The cilia of the mouth are longer than in the preceding species. The mouth, passing away from the forehead, forms a deep pouch, and near this there always exists a light, but not so distinct, spot as in the preceding species." It was made to take in indigo.

During last winter and spring, I frequently found in the water of the Spree, where Spongillæ were present, an Infusorium which shares the essential peculiarities of *Ophryoglena flavicans*, and manifests, in addition, some hitherto unknown. Its yellowish body is entirely covered with cilia; the cilia are placed in longitudinal rows; it is ovate, attenuated towards the posterior extremity, without becoming prolonged into a point. At the part called by Ehrenberg the forehead (*Stirn*), it bore a pigment-spot varying from brown-red to dark brown, situated close by the mouth, which formed a deep pouch. According to Ehrenberg, the spot is not always so distinct as in the other species, and the animalcule in question likewise exhibits this irregularity: the pigment-spot of *Ophryoglena atra*, which I found frequently in the stagnant water near Pichelsberg, is ordinarily more distinct. The inconstancy of the colour of the eye-spot of our Infusorium affords no essential distinction, if we entertain Perty's statement, that the pigment-spot of *Ophryoglena griseovirens* is reddish in young specimens and blackish in old ones (Perty, zur Kenntniss kleinster Lebensformen in der Schweiz, p. 142).

The animalcule I observed differs in size, which amounted to $\frac{1}{4}$th of a line, and also in the constant presence of two contractile vesicles; for Ehrenberg ordinarily saw only one, rarely two,

* Translated from Müller's Archiv, January 1856.

which he regarded as indicative of the commencement of division.

The animalcule took up abundance of indigo. I did not see any excretion of substances, and hence I cannot state anything about an anal point; no special orifice was visible.

The presence of an eye-spot, the position of the mouth, the complete investment of the body with cilia, require the assignment of the animalcule to the *Ophryoglenæ*; and the described form of its body, its colour, the peculiar pouch-like form of the mouth, the variability of the distinctness of the pigment-spot,—all these make it appear warrantable to name the animalcule *Ophryoglena flavicans*, until more certain distinctive characters have been discovered. The following notices regarding it relate more particularly to the existence of a hitherto unobserved watch-glass-like organ near the pigment-spot, and to the vascular system.

The Eye-spot and the watch-glass-like Organ.

In order to describe accurately the position of these organs, it is necessary previously to give a more particular account of the mouth of the animalcule. The mouth forms a narrow slit in the form of a semicircular line, and lies in a small depression. In a large specimen, measuring $\frac{6}{10}$ths of a millimetre in length and $\frac{11}{100}$ths of a millimetre in breadth, the distance of the upper point of the mouth from the end of the head was $\frac{1}{10}$th of a millimetre, of the lower from the upper point of the mouth $\frac{21}{1000}$ths of a millimetre. The oral cilia, placed all round the margin of the slit, are far longer than the cilia of the rest of the body, although these are also remarkable for length; the cilia of the mouth are seen to project far beyond the others when the animalcule lies so that the mouth is on the outline of its figure. The oral slit leads directly into a sac-like space, which may be traced for a short distance into the cavity of the body, whenever the latter is not filled up with the strongly refractive granules; we may also then detect a membrane constantly vibrating backwards and forwards in the interior of the sac. But this part ordinarily only becomes distinctly visible when the oral portion, with the pouch, has been isolated by the compression of the animalcule; the mouth is the entry into the pouch; at the opposite side is an orifice, through which substances which have been taken in by the mouth are conducted further. Near to this is attached the vibrating membrane, and it is fixed by one angle to the internal wall of the sac, while the other parts project freely into the cavity of the latter. That it is not merely an apparently undulating membrane, as Stein correctly asserted of the ciliary wreath of the Trichodinæ, is at once ascertained by compressing the isolated oral structure while the membrane still vibrates.

Close by the oral slit, on its concave side, lies the pigment-spot. Its form is extremely irregular, sometimes globular, sometimes ellipsoidal, in many cases toothed. Ordinarily it is so distinct as to be at once perceived; sometimes, however, it is so small that it can only be detected by close examination. In animalcules filled with strongly refracting substances alone, it is always difficult to discover it. The pigment-spot of *Ophryoglena atra* has, on the whole, more uniformity of form and magnitude. If we squeeze down an *Ophryoglena flavicans* between the covering glass and the slider, we find that the pigment-spot is composed of a heap of minute, scarcely measurable granules, strongly refracting light. I never could discover a lens in the pigment. All the specimens examined by me possessed but a single pigment-spot. Beside this lies always a hitherto unobserved structure, the form of which is perfectly described when we call it a watch-glass on a small scale. This watch-glass-like organ is transparent and colourless, and shows no trace of fibrous or any other structure. The circular base has a diameter of about $\frac{1}{100}$th of a millimetre; its depth amounts to about a third part of this diameter; the convexity is very considerable. The watch-glass-shaped organ usually turns its convex side towards the pigment-spot; its concave side is directed towards the point of the head; it does not seem to be moveable by the animalcule. When isolated, it withstands the action of water for a longer time than is usually the case with the other parts of the body of this Infusorium. After lying some time in water, it swells up in some degree, and frequently becomes perforated by a hole in the middle. The presence of the watch-glass-shaped organ is not dependent on the presence of a pigment-spot; for *Ophryoglena atra* possesses a pigment-spot, but no watch-glass-shaped organ, while *Bursaria flava* has a watch-glass-shaped organ, but no pigment-spot. In other Infusoria with eye-spots, as in the *Euglenæ* and *Peridinia*, I have sought in vain for this organ. I have not met with any facts throwing light on its function.

The Nucleolus.

This structure, first described by Von Siebold in *Loxodes Bursaria*, and subsequently observed by Stein in *Prorodon*, is properly the only part, except the eye-point, which distinguishes the *Ophryoglena* in question from *Bursaria flava*,—at least in all the specimens which I have hitherto observed. These two animalcules stand, on the whole, much nearer together than *Bursaria leucas* and *Ophryoglena atra*, which resemble each other very much in form and in the structure of the mouth; Ehrenberg himself, too, has said, that he only distinguished *Ophryoglena flavicans* from a *Bursaria* by its eye-spot. *Bursaria flava,* which I found in great numbers, in spring and summer, in stagnant water in the Berlin Thiergarten, has the same structure of the mouth, the same throat-like prolongation, and the same undulating membrane as *Ophryoglena flavicans*; the watch-glass-shaped organ also stands in the same place, near the concave side of the mouth, and likewise regularly has its convexity directed towards the point of the head; the only difference is a slightly larger size, the diameter of the base amounting to $\frac{15}{1000}$ths of a millimetre, when the animalcule did not exceed $\frac{1}{4}$ of a millimetre in length. In the interior of the body frequently occur long, yellow-ochre-coloured globular granules, about $\frac{1}{100}$th of a millimetre in diameter, rendering the animalcule opake; among these were isolated colourless spheroidal cavities, like those which Ehrenberg describes in *Bursaria flava.* I could not find an anal orifice; but sometimes there was at the posterior extremity of the body a light spot and a depression, which Ehrenberg refers to the anal orifice. I found the form of the body to agree exactly with that of *Bursaria flava* as figured by Ehrenberg, as did also the position of the contractile vesicle; so that Ehrenberg's description exactly applied: "*Bursaria* corpore ovato-oblongo, flavo, sæpe postica parte paullo tenuiore, subacuto, ore corporis aliqua parte superato."

Let us now return to the description of the nucleolus in *Ophryoglena flavicans.* As this animalcule usually contains in its interior extremely few, and at the same time minute granules of strong refractive power (in rare cases I found them like those which occur in *Bursaria flava*), the internal structures are generally readily perceived. The nucleolus is shaped like a grain of barley, and is marked at each end with a few sharply defined streaks or furrows; its length is somewhat more than $\frac{2}{100}$ths of a millimetre, its thickness in the middle about $\frac{1}{100}$th of a millimetre. Its substance has a stronger refractive power than that of the rest of the body, but far less than the fat-like globules. Under the highest magnifying power, no structure could be distinguished; and it withstands for a considerable time the action of water. The nucleolus is situated on the middle of the *testis,* as Ehrenberg called this organ, or the nucleus, as it is termed by Von Siebold. The nucleus is about one-fifth of the entire length of the animalcule, and its breadth in the middle is about one-third of its length. Its longitudinal axis ordinarily coincides nearly, like that of the nucleolus, with the long axis of the animalcule. It is of ovate form; its substance displays no recognizable structure.

The nucleolus has very different characters in all the specimens of *Bursaria flava* I have hitherto observed. It was always so small that it was difficult to find it, and never became visible until the Infusorium was compressed, while in *Ophryoglena flavicans* it may usually be seen through the integuments. Its form is globular, and it presents no structure. It generally adheres firmly to the surface of the ovate nucleus.

The nucleus is not any larger in the rather larger specimens of *Bursaria flava* which possess two contractile vesicles. I met with some of them occasionally in company with the one-vesicled. They did not differ from the rest at all in shape, in the condition of the ciliary clothing, or in the formation of the mouth, so that I held them to be identical until I observed the second contractile vesicle, or the somewhat differently formed and smaller watch-glass-shaped organ; which last, in the specimens I have hitherto examined in respect to this point, had not a circular, but an elliptical base,—so far at least as a judgment can be formed from the mere aspect. Measurements made on one specimen gave—length of the animalcule, $\frac{4}{10}$ths of a millimetre; greatest thickness, $\frac{2}{10}$ths of a mill.; diameter of the globular nucleus, $\frac{7}{100}$ths of a mill.; of the nucleolus, $\frac{7}{1000}$ths of a mill.; distance of the mouth from the head-point, $\frac{12}{100}$ths of a mill.; distance of the contractile vesicles apart, $\frac{1}{10}$th of a mill.; of the hinder one from the tail-point, $\frac{7}{100}$ths of a mill.; greatest diameter of the base of the watch-glass-shaped organ, $\frac{7}{1000}$ths—smallest, $\frac{4}{1000}$ths of a millimetre.

The Vascular System.

This consists of two contractile vesicles, and a system of canals which open into them. The best subjects for the examination of these objects are usually found in those specimens of *Bursaria flava* which contain in their interior only the smallest forms of the strongly refractive granules. I frequently found such among the others in the pools of the Berlin Thiergarten. The contractile vesicles lie in the immediate vicinity of the mouth, a little behind it: if we conceive the animalcule to lie upon its back, with the mouth upwards and the end of the head turned away from the observer, the contractile vesicle will be placed to the left of the mouth, on its convex side, distant from it about a quarter of a circumference; when there are two vesicles, the anterior contractile vesicle lies exactly in the same spot, and the posterior is cut by a straight line drawn from the anterior vesicle to the tail-point. The position is just the same in the *Ophryoglenæ* above described. If we examine a *Bursaria* of this kind with a power of about 300 diameters, we perceive near the surface a quantity of light streaks, which run together towards the contractile vesicle from the anterior and posterior parts of the body, in more or less considerable curves. In each streak we detect an extremely delicate but perfectly distinct canal, terminating ultimately in the contractile vesicle; its walls and its contents are readily distinguished by their different refractive power. When one of these canals is traced backwards from its orifice, we may often perceive, after it has run a short distance, a ramification; this may frequently be traced to one of the extremities of the body, and sometimes it gives off another branch; ultimately the canals become so excessively fine, that they are invisible. Their opening into the vesicle and their course in running from it are seen very distinctly when the contractile vesicle is turned directly upwards; we may then recognize how the canals run between the contractile reservoirs, which lie very close to the surface of the body, and between the surfaces of the body inside the cortical substance; and the orifices may likewise be seen. Another remarkable position is when the nucleus is turned next the observer at the surface of the body; the canals are then seen remarkably clearly on its bright background. A few canals always run over directly, with a slight curvature, towards the posterior part of the mouth. When the animalcule lies so that the contractile vesicle appears at the margin of the body, there is sometimes an appearance as if one or more of the canals opened externally at this point; but close examination shows that they curve round and run towards other parts of the body.

The number of vessels opening into the contractile vesicle in *Bursaria flava* is about thirty; this number, or a few more or less, existed in all the specimens which I examined in reference to this point. They are apparently uniformly distributed over the whole surface.

The specimens of *Bursaria flava* with two contractile vesicles have the system of canals double, each system grouped independently around its reservoir. The canals of the posterior reservoir stretch into the district of the anterior; but I have never been able to detect any communication between the two. In the *Ophryoglenæ* from the Spree, very little could be detected of the canals, even when the interior of the body contained only slightly refractive substances. When a suitable specimen is somewhat compressed between the glasses, so that it cannot move about, the vessels are especially seen when they have the nucleus for a background, and when they end in the contractile vesicle.

I have never been able to trace any vessels into the interior of the body; for instance, towards the nucleus. I am also ignorant at present whether that part of the contractile vesicle which is turned toward the centre of the body of the animalcule receives any vessels.

Both *Bursaria flava* and *Ophryoglena flavicans* belong to those Infusoria in which the contractile reservoirs may assume the well-known stellate form. Von Siebold describes this phænomenon, in *Paramecium*, in the following words:—"These pulsating spaces have a very striking shape; they consist of two central round cavities, around which stand from five to seven smaller pear-shaped reservoirs, with points directed outwards, in the shape of a star. In the pulsation of these strange star-shaped reservoirs sometimes the stars disappear entirely, sometimes only the central round spaces, and sometimes only the rays." The opake *Bursariæ* exhibit this phænomenon just in the same way as it is described by Von Siebold; and those specimens in which the vascular system can be detected, offer the explanation of it. The small pear-shaped spaces are really the commencements of the vessels, which expand with the accumulated fluid, and the rays are the further prolongations of the same, which may be traced to the ends of the body.

At the moment when the contractile vesicle has attained the greatest expansion, that is, when the diastole is terminated, it appears in the form of a globe filled with colourless fluid, from which the vessels run out on all sides in the cortical substance as canals, apparently of equal diameter; they have at this time the smallest diameter they can assume at their embouchure into the reservoir. In opake specimens, this is the moment when the opened contractile vesicle is observed. A little before we observe the commencement of the systole, the vessels begin to expand slowly, at points distant about one diameter of the contractile vesicle from the surface of the latter, to many times their original size. The more the systole progresses, the wider and longer become the swollen places, and they approach gradually to the contractile vesicle. If we make an observation at the moment when the diameter of the contractile vesicle is diminished to about one-fourth of its original size, the shape of the apparatus agrees in all essential points with the well-known stellate figure, represented by Dujardin in *Paramecium Aurelia,* with the single exception that the embouchures of the rays are distinctly visible, and their peripheral prolongations run out widely in the form of canals over the entire animalcule. Opake specimens of the *Bursaria* display the phænomenon only in such a degree that the rays terminate in delicate attenuated points, at a distance of about one diameter of the reservoir from the latter. When the contractile vesicle has closed completely, the fusiformly expanded vessels only are seen, as they run together with their apices to one point. This completes the systole. The diastole then recommences. If we examine the animal at the moment when the reservoir has again attained half its greatest diameter, we find a totally different appearance from that at the corresponding epoch of the systole. The vessels are not expanded now in the form of a spindle, but of a funnel, with the base of the funnel in the contractile vesicle, and the point prolonged out into the vessel. This is the form which Ehrenberg has figured in *Paramecium Aurelia*, only omitting the further prolongations of the vessels; Von Siebold rejects Ehrenberg's figure, and recognizes Dujardin's; but both are really correct, only representing different instants; Dujardin gives a stage of the systole, Ehrenberg of the diastole.

The more the contractile vesicle now expands, the more is the depth of the funnel decreased, and its diameter proportionately increased; or, in other words, the vessel expands only at its embouchure, and the depth of the expanded part decreases in proportion with the advance of the diastole. In opake *Bursariæ*, we see at this time only the contractile vesicle produced out in various directions into short funnel-shaped processes. By degrees these processes entirely disappear, the contractile vesicle having expanded to its original volume. We now see again how, from the fully expanded contractile vesicle, the whole of the vessels run out in the cortical layer, in all directions, as slender streaks; in opake specimens, only the contractile reservoir is visible.

The processes above described are those usually observed when a suitable specimen is placed so that it cannot move, or only move very little, upon the slider. If, however, a *Bursaria* is compressed somewhat more with the covering-glass, or if the water on the slider is almost all evaporated, some other peculiar phænomena present themselves, not only in the contractile vesicle, but in the vessels. The last diastole coming perfectly to rest, and nothing unusual being observed, except that the reservoir is more elongated, with the systole appear suddenly two contractile vesicles instead of one; that is, a portion of the surrounding substance makes its way across the middle of the contractile vesicle while it is contracting, and thus divides it into two parts. Each of these two new reservoirs has its own systole and diastole. In most cases their contractions do not occur at the same moment. Each is in connexion with those vessels which opened into it before the separation. The vessels exhibit the same play as if there were but one uninjured contractile vesicle. Sometimes the two reservoirs reunite into a single one. I saw this happen during a diastole which occurred exactly simultaneously in both: they advanced near together, projected out points toward each other, which came in contact and formed a dumb-bell-shaped reservoir, and this was rapidly converted into a globular vesicle, which contracted and expanded as at the origin.

Von Siebold has already observed in *Phialina vermicularis*, *Bursaria cordiformis*, &c., "that in strong contractions of the whole body, a largish round pulsating space was drawn out longitudinally, constricted in the middle, and at length was separated into two smaller round spaces,—exactly as occurs when a drop of oil is separated into two portions." During the above-described alterations in the contractile vesicles, alterations ordinarily take place in the vessels also. Thus expansions appear in them at points lying very distant from the contractile reservoirs. These enlargements are not however subject to rhythmical disappearance and reappearance, but are permanent; they are filled with the same colourless fluid as the contractile vesicles, and are mostly globular or ellipsoidal. If such enlargements of the vessels are seen in specimens which, from unfavourable optical conditions, do not display the vessels themselves, they may be taken for vacuoles (in Dujardin's sense). Their connexion with the vessels, and their mode of origin, which is readily accessible to observation, prove that they are totally distinct from the vacuoles in the interior of the body, part of which contain nutrient substance, while part do not.

I have not succeeded in any case in isolating a membrane of the contractile reservoir or of the vessels. I find no trace of cilia in the interior of the vascular system. This alone suffices to distinguish essentially those Infusoria furnished with vessels, from the *Distoma*-embryo in which G. R. Wagener has discovered ciliated vessels.

Different hypotheses have been put forth in explanation of the function of the contractile vesicles. There is a detailed account of these in Claparède's paper on *Actinophrys**. Claparède rightly explains the contractile vesicles as organs of the circulation. As to the direction in which the fluid flows in the vessels, nothing can be directly observed in most cases, since we cannot perceive in the fluid any solid corpuscles at all similar to the blood-corpuscles of other animals. Is it a perfect circulation? or does the fluid flow back again in the same vessel in which it has been propelled forward by the contractile vesicle? or are the contents of the contractile vesicles constantly expelled externally? The last view has been set up by Oscar Schmidt. He states that he has seen the place of exit in the genera *Bursaria* and *Paramecium*. Claparède is opposed to this, since,

* Ann. and Mag. Nat. Hist. ser. 2, xv. p. 211.

in the most minute examination, he was unable to discover that the contents of the contractile vesicle were expelled externally in the systole. *Actinophrys* is better suited to the settlement of this question than a ciliated Infusorium. I have many times sought for currents in the fluid surrounding *Actinophrys Sol* and *A. Eichhornii*, when the fluid contained masses of fine globules immediately in front of the projection of the contractile reservoir; but I have never seen, any more than Claparède, any corresponding displacement when the vesicle contracted. In *Bursaria leucas*, *B. Vorticella*, *Paramecium Aurelia* and *P. Chrysalis*, I obtained the following results:—The contraction takes place exactly in the manner described by Schmidt; the vesicle contracts from the interior of the animalcule towards a point lying near the surface, and it expands on the entrance of the fluid in such a manner, that it increases in diameter gradually from the surface of the animalcule inwards toward the centre. But does this teach us what Schmidt concludes from it, that the reservoir expels its contents outwardly every time when it contracts toward the outside, and becomes filled from without when it expands toward the interior? If the contractile reservoir is attached by that part turned toward the surface of the animalcule, to the internal surface of the cortical substance, while the portion projecting into the interior of the body is free in the soft medullary mass,—will not the contraction take place from within outwardly, and the expansion from without inward, whether the fluid flow inwards or outwards? In *Actinophrys*, sometimes in *Arcella vulgaris*, and in *Urostyla grandis*, a totally different import must be attributed to the contractile reservoir, if Schmidt's criterion be valid; for here the reservoir does not contract toward the surface, but toward the interior of the body, and forms an elevation on the surface when it becomes filled, as described minutely in *Actinophrys* by both Von Siebold and Claparède. But it is not on this alone that Schmidt rests his opinion: he asserts that he has observed also an actual external orifice of the contractile vesicle. I must admit that *Bursaria Vorticella* has a distinct orifice at the hinder part of the body, and this exactly at the place to which the contractile vesicle contracts until it vanishes. But regarding this orifice which I saw, only so much is established, that it is the anal orifice which Ehrenberg has already described. I have seen the emergence of remains of devoured substances, of loricæ of Bacillariæ, of fine undeterminable granules, &c., from this very hole, so frequently, that there can be no doubt on this point; and it is even not rare for a corpuscle to slip out from the anal orifice during the diastole,—that is to say, at the very time when, according to Schmidt, the fluid should flow in from the outside. I found the *Bursaria* just named during spring and summer in standing water near Tempelhof; it agrees in the main with Ehrenberg's *Bursaria Vorticella.* The buccal orifice is situated as in *Bursaria truncatella,* in which however I did n ot observe any contractile vesicle at the posterior end of the body. The specimens of *B. truncatella* I observed were all about $\frac{1}{3}$rd of a line or more long, those of *B. Vorticella* at most $\frac{1}{9}$th of a line. The latter is in any case not a *Leucophrys*; therefore, in case Ehrenberg considers his *Bursaria Vorticella* a *Leucophrys,* it is a different animalcule from the latter. I was equally unable to satisfy myself of the correctness of Schmidt's view in the *Paramecia.* When a specimen of *Paramecium Aurelia* lies so that the contractile vesicle, either the anterior or posterior, is seen at the margin, it appears, under certain circumstances, as though a short canal ran directly out through the integument of the animalcule; but in reality it only runs into the integument, and turns round toward the side of the body directed away from the eye. I found the same in *Paramecium Chrysalis* also; it was always one of the rays of the contractile vesicle which presented to Schmidt the appearance of an external orifice. The same is the case in *Bursaria flava,* where I could always trace the curvature of the vessel toward the opposite side of the body most distinctly. F. Stein strongly questions the external opening of the contractile vesicle in the *Vorticellæ.* Hence it is clear, that the explanation of the contractile vesicles as part of a water-vascular system is unproven.

Is it however established, on the other hand, that the contractile reservoirs pour back their contents again into the parenchyma whence they receive it, as Von Siebold says? And if this is the case, how does it happen? Everything indicates most strongly that the contractile vesicles are filled out of the vessels during the diastole. We see how, during this process, the swollen part of the vessels near their embouchure gradually or suddenly return to their smallest diameter, as the stellate figure vanishes. And I have observed a part of a vessel inflated with the fluid, originating at the extreme end of the animalcule, traverse the whole distance up to the contractile vesicle during a single diastole. This phænomenon may be supposed to show that the absorbed fluid which had inflated the vessel into a globule, flowed during the said period into the contractile reservoir.

But if there is a fair presumption that the contractile vesicles are filled out of the vessels, the above observations teach us nothing whatever on the question as to where the fluid flows during the systole.

I have hitherto only become acquainted with one fact relating to this point. In *Bursaria Vorticella* we may detect the following fact: as soon as the contractile vesicle which lies at the posterior end of the body has contracted, we may observe at the margins of the animalcule, in its usual position of swimming, that two long narrow cavities originate, filled with transparent colourless fluid, and these stretch from opposite the mouth as far as the region of the contractile vesicle. They both gradually enlarge, and thus approach near to the anal point; here they meet, lose their often very irregular form, and change into the globular: the remaining contents of the body are displaced upwards by this; and then these globular reservoirs contract until they vanish, without it being perceptible where the fluid has been driven to; after some time the narrow light streaks reappear, and the process is repeated in the way above-described. The afferent canals, therefore, are not filled at the commencement of the systole. But must this not be so much the more expected, if the fluid flowed back in the same path as it came in, the vanishing of the contractile vesicle taking place much more rapidly than its production?

I have never yet found in any Infusorium special canals in which the fluid is seen to flow back into the body during the systole, and which would give the means of a perfect circulation.

The facts stated in this paper were first made public at the meeting of the Berlin "Naturforschende Freunde," June 19, 1855.

XXIX.—*New British* Arthoniæ.

By the Rev. W. A. Leighton, B.A., F.B.S.E.

[With a Plate.]

Since the publication of my Monograph of British *Graphideæ*, the following species of *Arthonia*, new to our flora, have occurred to my notice.

1. *Arthonia glaucomaria*, Nyl. Thallus none; ardellæ hymenicolar, sessile, round; disk black, flattened, more or less convex, dull; sporidia in asci, eight, oblong, 1- 2- 3-septate.

Arthonia glaucomaria, Nyl. Nouv. Class. Lich. (2 Mém.) in Mém. Soc. Sc. Nat. Cherbourg, 3. 189 (1855); Syn. Arthoniarum in Mém. Soc. Sc. Nat. Cherbourg, 4. 98; Leight. Lich. Brit. Exsic. 247!

Parasitic on the apothecia of *Lecanora glaucoma*, Ach.

Haughmond Hill! Caer Caradoc! and Long Mynd! Shropshire. Barmouth! N. Wales. Cliffrigg, Cleveland, Yorkshire!

Thallus undistinguishable from that of the matrix. *Ardellæ* round, very variable in size, either single, or several arising as elevated rounded spots on different portions of the surface of the hymenium of *Lec. glaucoma,* ultimately becoming confluent, and entirely covering it, thus rendering it abortive, and giving it the general appearance of a black disk with a white irregular wavy thalloid margin. *Disk* roughish, somewhat flattened or more or less convex, without any margin, of an opake brownish-black. A vertical section shows the parasite occupying the upper portion of the hymenium, obliterating all traces of the paraphyses and asci of *L. glaucoma,* and leaving its pale yellow hypothecium alone free. *Hymenium* of a pale brown colour, with numerous obovate or pyriform asci imbedded in a compact mass without any appearance of paraphyses. Iodine turns the *Arthonia* of a deeper brown, but the hypothecium of *L. glaucoma* of a blue colour. *Sporidia* in asci, eight, oblong, normally with three septa, frequently with two only, and sometimes with only one; the cells either empty or filled with minute rounded granules, colourless or pale yellow.

Our specimens were identified by Dr. Nylander*.

PLATE XI. fig. 1. Thallus of *L. glaucoma* with the *Arthonia* on the apothecia: nat. size. Fig. 2. The same, magnified. Fig. 3. Vertical section of apothecium of *L. glaucoma,* showing *Arthonia glaucomaria* parasitic in the upper portion of hymenium. Fig. 4. Ascus and sporidia of *A. glaucomaria,* magnified. Fig. 5. Sporidia, more highly magnified.

2. *Arthonia vinosa,* Leight. Thallus thin, membranous, smooth, pale brown, subdeterminate; ardellæ sessile, irregularly roundish; disk deep vinous red, convex, dull; sporidia in asci, eight, large, obovate, uniseptate.

Arthonia vinosa, Leight. Lich. Brit. Exsic. 224! (1856).

On oaks: Newton Wood! Stagdale! and Oggeray Gill! Cleveland, Yorkshire, *Mr. W. Mudd.* Nesscliffe Hill, Shropshire!

Thallus forming irregular patches of greater or less extent, and of various form, of a cheerful pale brownish hue varying in intensity, on the bark of oaks. *Ardellæ* minute, variable in size, roundish, oblong and irregular in form, single or confluent, more or less raised or convex, especially on older barks, whilst on younger barks they are scarcely raised and almost flat. On

* Dr. Nylander in his Syn. Arthoniarum quoted above, says of his *A. parasemoides,* which he states to occur on the apothecia of *Lecidea parasema,* Ach., and also on *Lecanora glaucoma,* Ach., "ex Anglia eandem misit rev. Leighton." I know not to what plant he refers. He characterizes *A. parasemoides* thus: "Thallus nullus, apothecia parasitica hymenicola atra convexiuscula, intus albida vel nigricantia; sporæ 6–8næ ovoideæ 1–3-septatæ, gelatina hym. iodo sordide rubescens."

older barks the ardellæ have a watery stain or shading off around them of a pale brown colour, especially conspicuous on specimens with a paler tinted thallus, and on those which are whitened over with (? *Lepraria alba*). *Disk* of a rich deep brown or vinous red colour, in old age becoming blackish, without margin. A vertical section showed the obovate asci imbedded in a dense and compact almost fleshy brown mass in which no paraphyses were conspicuous. *Sporidia* in asci, eight, obovate, colourless or of a pale yellow, margined, with a single septum, the upper cell rather larger and broader than the lower one, either empty or filled with comparatively large round granules.

Differs from *A. lurida*, Ach. (Leight. Brit. Graph. p. 57. fig. 38, and Leight. Lich. Brit. Exsic. 17 !), to which its general aspect has some resemblance, in the sporidia being double the size of those of that species.

PLATE XI. fig. 6. Thallus and ardellæ of nat. size. Fig. 7. Whitened thallus and ardellæ with surrounding watery stain, nat. size. Fig. 8. Thallus and ardellæ, magnified. Fig. 9. Vertical section of ardella. Fig. 10. Sporidia, magnified.

3. *Arthonia aspersa*, Leight. Thallus thin, membranous, smooth, indeterminate, greyish-green; ardellæ minute, sessile, various in form; disk black, flattened, more or less convex, dull; sporidia in asci, eight, small, obovate, 3-septate, upper cell largest.

Arthonia aspersa, Leight. Lich. Brit. Exsic. 248 ! (1856).

On holly: Hobhole, Baysdale, Cleveland, Yorkshire ! *Mr. W. Mudd.*

Thallus very thin, spreading indeterminately, of a pale opake greyish-green. *Ardellæ* minute, very numerous and crowded as if copiously sprinkled, distinct or confluent, very variable in size and form, sometimes mere specks, roundish, oblong, ovate, angular or of irregular wavy outline. *Disk* more or less raised, convex or flattened, without any margin, opake black, smoothish. A vertical section shows the *hymenium* to consist of a dark brown compact mass destitute of any distinct paraphyses, with numerous round or very broadly obovate asci imbedded in it. *Sporidia* in asci, eight, obovate, pale yellow, margined, 3-septate, the upper cell considerably the larger, occupying nearly one-half of the sporidium, the septa being confined to the lower portion.

Differs from *A. Swartziana*, Ach. (Leight. Brit. Graph. p. 54. fig. 33; Leight. Lich. Brit. Exsic. 70 !), in the sporidia being only half the size of those of that species and in the different arrangement of the septa.

For the two last plants I am indebted to Mr. W. Mudd of

Cleveland Lodge, Yorkshire, whose indefatigable researches in his neighbourhood have supplied me with many Lichens hitherto unknown to our flora.

PLATE XI. fig. 11. Thallus and ardellæ, nat. size. Fig. 12. The same, magnified. Fig. 13. Vertical section of ardella. Fig. 14. Ascus and sporidia. Fig. 15. Sporidia, highly magnified. Fig. 16. Scale of $\frac{1}{1000}$ of an inch, magnified equally with the sporidia in figs. 5, 10 & 15, to show their real size.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

April 3, 1856.—Sir Philip de Malpas Grey Egerton, Bart., V.P., in the Chair.

"On the Diœcious Character of the Rotifera." By Philip H. Gosse.

Professor Ehrenberg, in his descriptions of this class of animals, assumed them to be in every case hermaphrodite. His conclusions remained unchallenged till 1848, when Mr. Brightwell discovered the separate sexes of *Asplanchna Brightwellii*. The author of this memoir soon afterwards discovered a second species of the same genus (*A. priodonta*) with a like diœcious character; and more recently Dr. Leydig has added a third (*A. Sieboldii*), which does not differ in this respect from its congeners.

Dr. Leydig plausibly conjectures that *Enteroplea* of Ehrenberg is the male sex of *Hydatina*, that *Notommata granularis* is the male of *N. Brachionus*, and that *Diglena granularis* of Weisse is the male of *D. Catellina*.

The author of the present memoir has ascertained from his own observations that the sexes are separate also in *Brachionus Pala*, *B. rubens*, *B. amphiceros*, *B. angularis*, *B. Bakeri*, *B. Dorcas*, *B. Mülleri*, *Synchæta tremula*, *Polyarthra platyptera*, *Sacculus viridis*, and *Melicerta ringens*. The males of these species, which are here described in detail, differ so greatly from the females in form, size, and structure, that they could not have been supposed to belong to the same genera, or even families, if their parentage had not been distinctly determined.

One of the most remarkable characters of male Rotifera is the absolute and universal atrophy of the digestive system. No mastax, jaws, œsophagus, stomach, or intestines occur in any example of any species. Another peculiarity is the great disparity between the sexes. In every observed case the male is inferior in size and in organization to the female.

The muscular system is well developed in the males of *Hydatina*, *Asplanchna*, and *Brach. Mülleri*. The frontal cilia are in general greatly developed in this sex, the result of which is seen in the energy and rapidity of its locomotion. In most instances the great occipital ganglion is distinct, with a red eye seated on it; and the latter is almost always present, even where the ganglion cannot be defined. The lateral convoluted threads appear in *Hydatina, Asplanchna*, and *Brach. Dorcas*; and in *Aspl. Brightwellii* they are accompanied by tremulous tags, and by a contractile bladder.

Irregular masses of opake substance are almost constantly present in male Rotifera. This substance Dr. Leydig considers a urinary concretion.

In all cases the abdominal cavity is occupied by a capacious sperm-sac, from which spermatozoa are forced out by pressure. The outlet of the sperm-sac is by a thick, protrusile, and retractile penis. In those species which possess a foot, the intromittent organ is soldered to its dorsal side, and is often so greatly developed that the foot itself appears as an appendage. The penis is protruded by eversion; and is then seen to be a thick column with the extremity truncate and ciliated. The sexual coitus has been witnessed by the author in several instances.

For a parallel to the curious facts thus established, the author considers we must look to the Crustacea. The *Hectocotylus* of certain Mollusca is scarcely an analogous case; nor are those Entozoa in which the males are organically united to the females.

In the Crustacea, however, many examples occur of a sexual difference which may be compared with that of the subjects of this memoir. In the genera *Bopyrus, Phryxus,* and *Ione,* the males are notably smaller than the females, very diverse in form, and in some respects inferior in structure. In the *Siphonostoma,* "the males are extremely small, and do not *in the least* resemble the females" (Baird); though those of different genera bear a strong resemblance *inter se*, even where the females are very dissimilar. So low is their grade of organization, that Burmeister has attempted to prove the minute males to be embryonic forms. Finally, in the Cirripedia, Mr. Darwin has proved the existence of males in the genera *Ibla* and *Scalpellum,* which are very minute as compared with their females, excessively abnormal in form, and in some respects in an embryonic condition, though unquestionably mature, as shown by their spermatozoa. And, what is still more interesting, there is, in these male Cirripedia, "no vestige of a mouth, or masticatory organs, or stomach." The same observer describes the internal structure as "a pulpy mass with numerous oil-globules;" and the sperm-vesicle as "a pear-shaped bag at the very bottom of the sack-formed animal containing either pulpy matter, or a great mass of spermatozoa,"—terms which might have been employed in describing some of the male *Brachioni*.

In all these analogies, the author finds additional reasons for assigning to the Rotifera a zoological rank among the Articulata.

June 19, 1856.—The Lord Wrottesley, President, in the Chair.

"Researches on the Foraminifera."—Part II. By William B. Carpenter, M.D., F.R.S., F.G.S.

In the pursuance of his plan of minutely examining certain typical forms of Foraminifera, for the purpose of elucidating their history as living beings, and of determining the value of the characters they present to the systematist, the author in this memoir details the results of his investigations on the genera *Orbiculina*, *Alveolina*, *Cycloclypeus*, and *Heterostegina*.

The genus *Orbiculina* has long been known, through its prevalence in the West Indian seas, which causes its shells to abound in the shore-sands of many of the islands of that region. These shells present great varieties of form, and have been ranked under three distinct species; but M. d'Orbigny has correctly inferred, from a comparison of a large number of specimens, that their diversities of form are partly attributable to differences in the stage of growth, and partly to individual variation, so that all the *Orbiculinæ* of Cuba, the Antilles, &c., are referable to but one specific type. Of the essential features of its structure, however, he would seem to be quite ignorant; since he ranges *Orbiculina* in a distinct order from *Orbitolites*, to which it is very closely allied. This alliance was first pointed out by Prof. Williamson, whose account of the structure of Orbiculina, though defective and erroneous in certain points, is nevertheless correct in the main.

The author has had the opportunity of examining not merely a considerable number of West Indian specimens, but also a set of specimens peculiarly remarkable for their high development, which form part of Mr. Cuming's Philippine collection. Many of these present the form of flattened disks, marked with concentric circles, and having one or more rows of pores at their edges, not distinguishable, save by their prominent central nuclei, from certain forms of Orbitolites formerly described. The similarity is equally great in their internal structure; so that, if a marginal fragment only were submitted to examination, it would not be possible to say with certainty whether it belonged to an *Orbitolites* or an *Orbiculina*. The distinguishing character of the latter is derived from its early mode of growth, which is uniformly *spiral*; and from the circumstance that each of the first three or four turns of the spire not merely surrounds, but invests its predecessor, thereby producing an excess in the thickness of the earlier over that of the later-formed portion, which gives rise to the central protuberance already mentioned. The transition from the spiral to the cyclical mode of increase is effected (just as it is in those individuals of Orbitolites which begin life upon the spiral type) by the opening-out of the mouth of the spire, which extends itself on either side around the previously-formed body, until its two divisions meet on the opposite side, where they coalesce so as to constitute a complete annulus. This transition may take place at any period of growth after the completion of the first four or five turns of the spire; so that we sometimes meet with small specimens which have already become discoidal and taken-on the cyclical plan of growth, whilst we occasionally meet with full-grown specimens which retain the spiral form, and show no tendency whatever towards the assumption of the cyclical plan of growth. These facts obviously point to the very subordinate value of *plan of growth* as a distinctive character.

The author next proceeds to a like investigation of the genus

Alveolina, which he shows to bear a very marked resemblance to Orbitolites and Orbiculina, in the simple concretionary texture of the shell, in the freedom of communication everywhere existing among the chambers, in the mutual relations of these to each other, and in their mode of communication with the exterior; whilst its plan of growth is very different, the axis round which the spiral turns being greatly elongated, and every additional whorl of the spire producing a much greater augmentation of its length than of its diameter. There is obviously a close *physiological* relationship between this genus and the preceding, since the condition of each individual segment of the sarcode-body must be essentially the same in each; and it is merely in the mode in which these segments are multiplied,—a character which we have seen not to be constant in different parts even of the same specimens of Orbitolites and Orbiculina,—that it differs from them.

A marked contrast to Orbitolites and Orbiculina in all their physiological characters, coexisting with an agreement in their respective plans of growth, is presented by the genera *Cycloclypeus* and *Heterostegina*; the former of which, like Orbitolites, is cyclical from the beginning, its chambers being formed in successive annuli round a central cell; whilst the latter, like Orbiculina, is spiral in the first instance, but tends, as age advances, to assume the discoidal shape and cyclical plan of growth. The genus *Cycloclypeus* is a new one, founded by the author upon specimens dredged-up by Sir E. Belcher off the coast of Borneo. These are the largest Foraminifera at present known to exist; the diameter of some of them being not less than $2\frac{1}{4}$ inches. The genus *Heterostegina* was formed by M. d'Orbigny; but he seems only to have been acquainted with young specimens, and has altogether misapprehended its true characters and relations. A fragment of the flattened spire of Heterostegina could scarcely be distinguished from a marginal portion of the disk of Cycloclypeus; so close is the conformity between the two, as regards the form and relations of the chambers, their mode of communication, and the structure of their shelly envelope. Each chamber, as in Nummulites, has its own proper wall, so that the partition between the adjacent chambers, whether of the same row or of different rows, is double; and between its two lamellæ there is interposed an additional stratum of shell that belongs to neither. This additional stratum is thin, in the septa dividing adjacent chambers of the same row; but it is much thicker, and forms a much more complete separation, in the septa intervening between different rows. It is traversed by a canal-system, analogous to that existing in Nummulites; which the author believes to be occupied in the living state by threads of sarcode, and to be specially destined for the nutrition of the 'intermediate skeleton' formed by the aggregate of these interposed lamellæ. The chamber is covered-in above and below by successive layers of a minutely-tubular and peculiarly-compact shell-substance, resembling dentine in its general aspect; certain parts of this, however, are non-tubular, and form cones, of which the bases appear on the surface as minute rounded tubercles. The adjacent chambers of the same row do not seem to communicate with each other; but each chamber communicates with two chambers of the previously-formed row, and, in like manner, with two of the subsequently-formed row, by narrow passages, the number and position of which are by no means constant. These passages seem to afford the principal means whereby the segments of the sarcode-body occupying the inner chambers, can be nourished from the exterior; but it is by no means impossible that the tubuli of the shelly laminæ that invest the chambers above and below, may also be subservient to this purpose, since, however numerous may be the laminæ, the tubuli are continued through them all from the cavity of the chamber to the external surface.

The almost entire separation of the segments of the sarcode-body in these two genera, the investment of each of them with its own proper envelope of shell, the minutely-tubular structure and firm consistence of the shell-substance, and the interposition of the intermediate skeleton with its canal-system, are features that place them in such marked contrast with Orbitolites and Orbiculina, that, notwithstanding their conformity to those two genera in their respective plans of growth, it is scarcely possible for them to be more widely removed in everything that relates to their respective physiological conditions.

From a comparison of the five genera whose structure has been thus elucidated, the author deduces the conclusion that, in this class, external form, which depends exclusively on plan of growth, affords no clue whatever to internal structure; and that the latter alone, as the exponent of the physiological condition of the animal, can afford the basis of a natural classification.

BOTANICAL SOCIETY OF EDINBURGH.

July 10th, 1856.—Professor Balfour, President, in the Chair.

In taking the Chair, Professor Balfour stated that the painful duty devolved upon him of recording the death of the President, Colonel Madden, which took place suddenly and unexpectedly from rupture of the aorta soon after last meeting of the Society. "We all, I am sure (he said), deeply deplore the loss of one who took a warm interest in our proceedings. His amiable deportment and gentlemanly manner endeared him to all of us, and we rejoiced to see one who had spent a large portion of his life in the active service of the East India Company devoting his time and leisure to the prosecution of science. During his residence in India he was a careful observer, and made many interesting remarks on the flora of the country. He sent home the seeds of many valuable plants, which have flowered in Glasnevin and in other gardens. When he came to settle in Edinburgh, he joined the Royal and Botanical Societies, of both of which he became a very active member. He was elected a councillor of the Royal Society, and took a marked interest in its proceedings. He particularly took charge of the scientific additions which it was agreed to make to its library. To the Transactions of the Botanical Society he contributed an excellent paper on the occurrence of Palms and Bamboos high on the Himalaya, and it is to be hoped that the paper which was read from him at our last meeting will be in such a state as to allow of its publication.

"I have also to report the death of Mr. William Gourlie of Glasgow, who was connected with our Society from its commencement, and aided it much by his exertions. He was a zealous naturalist, and had made a large and valuable collection of plants, which it is hoped will not be lost to science. From his mercantile position in Glasgow, he was able to render important service to this Society and to botanists on many occasions, and he was always ready and willing to do everything in his power for the promotion of science. He set an example of zeal to the mercantile men of the western metropolis, and his labours promised to be instrumental in infusing a taste for science among the community of Glasgow. When the Meeting of the British Association took place in Glasgow in September 1855, he acted as local Secretary. The labour which he underwent, not merely during the Meeting, but for months before, was extraordinary. He spared no pains to render the Meeting creditable to Glasgow, and the arrangements which he made called forth commendation from all. About the time of the Meeting, symptoms of disease of the bones in the face appeared. He endured at first great suffering, which he bore with much fortitude and resignation; and, after a protracted illness, he sunk in the course of last week. He has been taken away in the midst of his usefulness, and at the very time when he seemed to be gaining the highest eminence in his native city. The place which he occupied will not be easily supplied. Let us hope that his enthusiastic love of science, and his noble exertions in the cause of botany, will be the means of stimulating his townsmen to follow his steps; and that, while they are prosecuting their commercial speculations, they will not think it beneath their notice to devote some of their time to science, which was to him in his season of recreation a source of high enjoyment, and which secured for him many friends in all parts of the world. Though dead, may he yet speak to them!"

Professor Balfour read a note from Mr. Babington in reference to Mr. Cock's statement made at a recent meeting, that *Hypericum anglicum* does not grow at Falmouth. Mr. Babington has seen specimens at Falmouth, collected by Mr. Polwhele, and *H. hircinum* grows there also.

The following paper was read:—

1. "A brief Account of the General Botanical Features of a Hill District in Western India, with the results of a Series of Observations in connection with Vegetable Climatology," by John Kenneth Wilson, Esq.

The hill, or rather mountainous district, upon which I am about to make a few observations, is situated upon an immense mountain-chain which lies parallel with the coast of Western India, and which extends from the Province of Candeish in the north, to Cape

Comorin in the south. This mountain-chain is designated the Western Ghauts. It is situated between isothermal lines which deviate little from their parallels of latitude, and the points of intersection which they form with the meridian. The Ghauts extend over an immense area, included between the parallels of 21° of north and 8° of south latitude.

The particular portion of this district to which I am about to call attention is denominated the Mahabaleshwar Hill district. In this district is situated the source of the river Krishna. Near the head of this river is placed a small Brahmin village named Mahabaleshwar, and a large number of bungalows occupied by European residents. The site of the European bungalows is 17° 56′ north latitude, and 73° 30′ east longitude. The Mahabaleshwar district has been long and deservedly a favourite resort of invalids; the climate being cold, bracing, and elastic, and the scenery around magnificent. The hills of the district rise abruptly by means of terraced trappean steps on their western side from the Province of the Concan, and on their eastern side from the Province of the Deccan. Their general elevation above the level of the sea is 4500 feet, and their highest attainment 4700 feet. Their elevation is much more abrupt and precipitous on their western aspect than on their eastern; the suddenness of their elevation on the western side freely exposing them to the influence of the sea breeze. The hills from top to bottom are trappean and highly quartzose. They are extremely eccentric in their formation, being characterized by great diversity of outline; precipices, ravines, chasms, scarps, woods, and waterfalls abounding on their surface. They are well supplied with water which permeates their surface from streamlets which traverse them in all directions.

In some of the districts at the foot of the hills, I observed the soil increasing from the disintegration of the trap rock, and the native agriculturists selecting for their cereal crops those localities where the greatest amount of disintegration was going on. On the summit of the table-lands, the soil consists of red clay formed by the disintegration of the laterite, a species of cellular ferruginous claystone, which overlies the secondary trap formation, and which constitutes the surface-rock. The soil is very abundant on the lower levels, where it forms a highly productive brown mould, owing to its intermixture with decayed vegetable matter and the debris of the trap rocks; but upon the higher levels the soil is much more scanty and of a redder colour; the rock below it generally existing in the form of superficial or detached masses, hardened and blackened by oxidation from exposure to the air.

On the plains at the base of the hills rest those plants which require the hottest climate, such as the Palms, Banyans, and oleaginous shrubs; the vegetation in this locality being tropical, and similar to that which characterizes the plains of India generally; but upon proceeding from the plains to a more elevated position, a vegetation of a different nature presents itself. The withered grass and scanty stripes of Cocoa-nut trees, and groves of Palms, that afford very inadequate shelter from the scorching rays of a tropical sun, are exchanged for a vegetation of surpassing beauty, richness, and variety, standing out in marked and vivid relief upon the fantastic terraces and mural cliffs of the surrounding rocks; and consisting of a certain intermixture of temperate with tropical genera, the predominating genera being tropical.

The vegetation is not distributed in equal parallel lines as regards altitude, except when regarded *en masse*, as I frequently found species of genera whose proper habitat was on the hill portions of the district, spreading, extending, and flourishing in the plains during the cold season—the plains being at this season cooled down to a temperature in which they could exist; while again, during the hot season I observed plants whose proper habitat was in the plains, spreading, and diverging into the hill districts. It is probable also that species of tropical hill genera reach not only a much higher altitude, but likewise a much higher latitude, than their representatives on the plains, owing to the less extensive range of the thermometer, greater amount of moisture, and less free radiation, which they possess in their more elevated position.

At the base of the hills, as at that of almost all the other mountains in India, the ground is covered with jungle, at first thin and open, and then becoming marginal, and well-nigh impervious, consisting of shrubs, trees, and high grasses, intermixed with an immense quantity of miscellaneous underwood. The amount of carbonic acid exhaled in the jungle during darkness is enormous; this amount is fostered by the rank and luxuriant vegetation, and by the older vegetation in progress of decay; but fevers are not so prevalent among the inhabitants in this as in other jungle districts, and the approach to the hills is at all times safe, owing to the jungle being cleared in the neighbourhood of the roads. In some parts, at a distance from the roads, it grows, however, so thick, and so thoroughly interwoven with enormous creepers and thorny parasites, as to be rendered perfectly impenetrable. Among the jungle trees, I observed as typical of this district the occurrence of *Grewia Asiatica, Combretum ovalifolium, Nauclea Cadamba, Carissa Carandas, Grislea tomentosa,* and also of several species of *Celastrus, Zizyphus, Cordia,* and *Sterculia.*

When mentioning the occurrence of the *Sterculiaceæ,* I may state that in the Province of the Concan I had an opportunity of examining that rare tree, the *Adansonia digitata,* with its immense stem, large flower, and enormous fruit. There is every reason to believe, as Roxburgh has shown, that this tree, although indigenous in Africa, is yet an exotic an India. It is one of the largest trees in the world, and is supposed to exceed any other in longevity. In several specimens which I examined, I never could find the occurrence of any such annular rings as would be necessary to prove the very great longevity generally attributed to this tree. Professor Lindley has in a most excellent manner shown the true value of calculations regarding the age of this tree. The natives use the pulp of the fruit, which affords a pleasant acid, as a medicine, and as the basis of a sort of sherbet, very grateful to patients suffering from febrile complaints. The young leaves are eaten as food, and the fibres of the wood are put to a variety of useful purposes.

The humid vapoury atmosphere which pervades the jungle shades, under the massive bowers of foliage so gigantic, is most favourable to the growth and spread of Fungi, Lichens, and other Cellulares; accordingly, in this locality they abound everywhere.

In some portions of land cleared of jungle by the native agriculturists, I observed many fruit-trees flourishing in cultivation, such as the Mango (*Mangifera Indica*), Custard Apple (*Anona squamosa*), Plantain (*Musa paradisiaca*), Pomegranate (*Punica granatum*), &c. In several small plots of cultivated ground, likewise recovered from the jungle, I observed Rice, Sugar Cane, Bamboo, and other useful plants, growing and flourishing in apparent abundance, and associated with cereal grains, such as *Holcus Sorghum* (joaree) and *Holcus spicatus* (bajree).

On ascending the mountain slopes, and after emerging from the jungle, the vegetation again becomes changed. At first the change is slow, but at length it becomes well marked and decided. The underwood becomes less abundant, and the trees stand forth in more solitary grandeur and in greater relief, the varied colouring of our autumnal foliage being absent among them, but this absence being more than compensated for by the richness of their verdure, the contrast of their forms, and the gracefulness of their proportions. Mosses of various descriptions and beautiful Lichens clothe the rocks, while Grasses of great variety and fantastic appearance are met with in abundance. Arums and Euphorbias now become prevalent. In addition to the rarer trees and shrubs already enumerated as occurring in the jungle, I observed as typical of this district—which district may be designated that of the slopes—the presence of the *Bridelia montana*, *Pentaptera paniculata*, and *P. tomentosa*.

In continuing in an altitudinal direction, the ascent of the hills becomes suddenly very abrupt, the trap rock being now thrown up in most places into immense terraces, crowned by table-lands, and flanked by high and precipitous cliffs. On these table-lands forest trees are generally absent; but forest trees occur here and there. The whole surface of the table-lands is, however, strewn over with large tree shrubs and plants of great variety. The *Calyptranthes caryophyllifolia* or Jambool tree is very characteristic of this district. The *Olea dioica*, *Terminalia Chebula*, *Symplocos racemosa*, *Memecylon ramiflorum*, and the Water-tree or Oomber (*Ficus glomerata*) occur very frequently. *Urtica pulcherrima*, *Rubus rugosus*, a species of *Salix* (the *tetrasperma* of Roxburgh), *Eriolæna Hookeriana*, and *Pygeum acuminatum* occur here and there.

[To be continued.]

ZOOLOGICAL SOCIETY.

November 27th, 1855.—Dr. Gray, F.R.S., in the Chair.

Note on the Genus Legriocinclus, Lesson, and its synonyms. By Philip Lutley Sclater, M.A. etc.

In his last published work on natural history, entitled 'Description des Mammifères et Oiseaux,' which is part of the series known as

'Complèment aux œuvres de Buffon,' M. Lesson has elevated to generic rank by the name of *Legriocinclus*, a bird previously described in the 'Annales des Sciences Naturelles' (ix. p. 168, anno 1838) as *Petrodroma mexicana*. While lately in Paris I was favoured by Prince Charles Bonaparte with a sight of several volumes of very beautiful coloured drawings of birds and other animals of which M. Lesson in his lifetime had published descriptions only. M. Lesson's descriptions, as is well known, are so short and often so inaccurate as to render identification of the originals almost impossible; and these drawings are therefore very valuable, and, as they are to be disposed of, will, it is to be hoped, pass into the possession of some public institution, where access to them may always be had. Among them is a plate of the so-called *Legriocinclus*, which, there is no difficulty in perceiving at a glance, is a member of Lafresnaye's genus *Ramphocinclus*, and so closely resembling the *R. brachyurus*, the type of that genus, as to leave little doubt that the two *generic* names are coequal. But if Lesson's locality is correct (Vera Cruz), which, however, I am hardly inclined to believe, the *Legriocinclus mexicanus* may possibly be a new species of this peculiar form—hitherto considered as confined to the Antilles, but thus extended geographically to the mainland.

Three species of *Ramphocinclus* only are given by Lafresnaye in his article in the 'Revue Zoologique' (1843, p. 67). Of the first of these—the type of the genus—*R. brachyurus* (*Turdus brachyurus*, Vieill. Nouv. Dict. xx. 255, et Enc. Méth. p. 655), the Paris Museum contains several fine examples from the islands of St. Lucia and Guadaloupe. Vieillot says his bird was from Martinique, which is very probable, as that island is situate between the other two.

Upon reading attentively Lafresnaye's description of his second species of the genus, *R. tremulus*, I think there can be little doubt that, if not absolutely identical with, it is at all events a very close ally of the bird which Mr. Gould described as long ago as 1835, under the name of *Stenorhynchus ruficauda*. There are two specimens of this bird in the British Museum, from the island of Nevis.

Stenorhynchus, having been previously employed in Zoology, was changed by Mr. G. R. Gray in 1840 to *Cinclocerthia*.

Prince Bonaparte, in his 'Conspectus' (p. 223), has somehow or other confounded the third species of this same genus along with *Campylorhynchus scolopaceus* of Spix, which is quite a different form and is the type of the wren-like genus *Campylorhynchus*, and *Thryothorus longirostris* of Vieillot, which he likewise quotes as synonymous, is, I believe, a true *Thryothorus*. Again, *Zoothera cinclops* of the same work (p. 253), since generified into *Cinclops* (*Cinclops melanoleucus* of Mr. G. R. Gray's lately published List of Genera), seems to be nothing more than a bird of this genus—probably *R. brachyurus*, though it is dangerous to draw positive conclusions from so meagre a description.

Under these circumstances I propose to reduce into one group, or at all events to place in close juxtaposition, the following six generic terms, some of which have hitherto been arranged in widely different families :—

1. Stenorhynchus, Gould (1835), P. Z. S. p. 186.
2. Cinclocerthia, G. R. Gray (1840), List of Gen. p. 22.
3. Ramphocinclus, Lafr. (1843), Rev. Zool. p. 66.
4. Herminierus, Lesson, (ubi?)
5. Legriocinclus, Lesson (1847), Descr. d. Mamm. et Ois. p. 278.
6. Cinclops, Bp. (1854), Notes Ornithologiques, p. 25.

Of these, Mr. G. R. Gray's name *Cinclocerthia* is the oldest that can be adopted.

Note.—Since writing the above, I have carefully examined the two specimens of *Cinclocerthia ruficauda* in the British Museum. They seem to agree in every respect with Lafresnaye's description of *Ramphocinclus tremulus*, and, as the islands of Nevis and Guadaloupe are so near, I think we may reasonably conclude that these two birds are not specifically distinct. The rectrices are twelve in number, and not ten, as Mr. Gould supposed (P. Z. S. 1835, p. 186) might be the case.

The three species of this group ought therefore apparently to stand as follows:—1. Cinclocerthia ruficauda (*Stenorhynchus ruficaudus*, Gould; *C. ruficauda*, G. R. Gray; *Ramphocinclus tremulus*, Lafr.). 2. Cinclocerthia gutturalis (*Ramphocinclus gutturalis*, Lafr.); and, 3. Cinclocerthia brachyura (*Turdus brachyurus*, Vieill.; *Ramphocinclus brachyurus*, Lafr.; *Zoothera cinclops* et *Cinclops melanoleucus*, Bp.).

Notice of some new species of Birds. By Frederic Moore, Assist. Mus. East India Company.

Genus Otocoris, Bonaparte.

Otocoris longirostris, Gould, MSS.

Allied in colour to *O. penicillata*, and in the markings of the head and breast, but differs in its larger size, considerably more lengthened bill, wings and tail, and thicker toes; and in the feathers of the back being broadly centred with brown.

Length $7\frac{3}{4}$ inches; of wing 5 inches; tail $3\frac{3}{4}$ths; bill to frontal plumes $\frac{6}{10}$ths; to gape $\frac{3}{4}$ths; tarsus $\frac{10}{12}$ths; middle toe and claw $\frac{8}{12}$ths; hind ditto $\frac{7}{10}$ths of an inch.

Hab. Neighbourhood of Agra. In Mr. Gould's Collection.

Genus Emberiza, Linn.

Emberiza stracheyi, Moore.

Affined to *E. Cia*, but differs in having the markings about the head more broadly developed, and of a deeper black colour, forming three well-defined black bars, as seen laterally; the throat and sides of neck being whiter, and ashy on the front of the neck only, the breast and the rest of the under-parts being uniform bright rufous-brown, which colour is also prominent on the back, and especially on the scapulars, rump and upper tail-coverts.

Length 6 inches; of wing $3\frac{2}{8}$ths; tail 3; tarsus $\frac{3}{4}$ths of an inch.

Hab. Kumaon. In Mus. East India Company.

EMBERIZA CASTANEICEPS, Gould, MSS.

Also affined to *E. Cia.* Crown and ear-coverts deep chestnut-brown; superciliary streak, base of upper mandible, throat, front and sides of neck ashy white; behind the ears and nape ashy; a spot before the eye and streak from base of lower mandible down the sides of the throat black; back, scapulars and rump rufous-brown, the two former having blackish centres to the feathers; wings dusky black, the feathers margined with rufous-brown; tail dusky black, the two centre feathers broadly margined with rufous-brown, the two outer tipped obliquely with white for nearly the whole length; breast and flanks rufous-brown, and paling towards the centre of the belly; upper mandible dark-horn, lower paler.

Length $5\frac{1}{2}$ inches; wing $2\frac{7}{8}$ths; tail $2\frac{5}{8}$ths; tarsus $\frac{3}{4}$ of an inch.

Hab. Kintang in China. In Mus. East India Comp., J. Gould, Esq.

Genus PROPASSER, Hodgson, Gray's Zool. Misc. p. 84 (1844); P. Z. S. 1845, p. 36.

PHŒNICOSPIZA, Blyth, J. A. S. Beng. xxiii. p. 213 (1854).

PROPASSER THURA.

Carpodacus Thura, Bonaparte et Schlegel, Monogr. des Loxiens, t. 23. Bonap. Consp. Gen. Av. p. 531 (male).

Propasser rhodopeplus, part. Hodgson.

Hab. Nepal. In Mus. East India Comp. Brit. Mus., J. Gould, Esq.

This species may be distinguished from the true *P. rhodopeplus,* by its rather smaller and a trifle more pyrrhuline bill; the colour of the male above being hair-brown, the feathers centred with blackish, and the lesser range of wing-coverts *only* being crimson-tipped; the under-parts, rump and upper tail-coverts, cheeks, forehead, and superciliary streak are pale silvery-crimson, the end of the latter and the centre of the belly being pure white; the crimson feathers of the head and throat being centred also with white, and the crimson colour being deepest at the base of the bill; whereas, in *P. rhodopeplus* the male above is dark crimson-brown, and has *both* ranges of wing-coverts *and the tertiaries* pale crimson-tipped. The female of *P. Thura* (which is now for the first time described) may be distinguished from the same sex of *P. rhodopeplus* by being paler above and having paler centres to the feathers; the colour of the under-parts being considerably more uniform; having also but faint centres to the feathers. *P. rhodopeplus* is a trifle larger than *P. Thura.*

The Prince Charles Lucien Bonaparte has compared these specimens, and his Highness also verifies their distinctness.

PROPASSER PULCHERRIMUS, Hodgson.

Propasser pulcherrimus, Hodgson, Gray's Zool. Misc. (1844), p. 85.

Hab. Himalaya. In Mus. East India Comp., Brit. Mus., J. Gould, Esq.

The male differs from *P. rhodochrous* in having the forehead, superciliary streak, cheeks, throat, and under-parts, with the rump, of a paler or more silvery-crimson colour, being in some lights very silvery; the upper parts, with the crown, are dusky-brown with pale crimson-tinged edges to each feather. The female differs from the same sex of *P. rhodochrous* in having the under-parts dusky white, instead of rufescent, and the colours above are also less rufescent.

The size is the same as that of *P. rhodochrous*, excepting that in *P. pulcherrimus* the wing is longer in both sexes.

Remarks.—Both sexes of this species and *P. rhodochrous* were sent from Nepal by B. H. Hodgson, Esq., under the name of *pulcherrimus*, which name, upon examining his original drawings in the British Museum, we find refers to the true *rhodochrous* and not to the present species; but, as that indefatigable naturalist applied the name to both birds, we deem it but correct to retain it for the present bird.

Genus LINOTA, Bonaparte.

CANNABINA, Brehm.

LINOTA BREVIROSTRIS, Gould.

Linota brevirostris, Gould, Bonap. Geogr. et Comp. List of B. p. 34 (1838).

? *Fringilla bella*, Hempr. et Ehrenberg, Mus. Berol.

Hab. Erzeroum and Afghanistan. In Mus. East India Comp. et J. Gould, Esq.

Allied to *L. montium*, but distinguished from that species by its lighter colour, and the male having the pink colour on the rump paler; the axillaries and the basal edge of the inner web of the primaries and secondaries pure white; the tail being margined on the whole outer and broadly on the inner web also with pure white; the primaries and secondaries above are also broadly margined exteriorly with white. The female is also paler and broadly edged as in the male with white.

Length 5 inches; of wing $3\frac{7}{8}$ths; of tail $2\frac{5}{8}$ths; centre feathers $\frac{1}{2}$ inch less; bill to frontal plumes $\frac{3}{10}$ths; to gape $\frac{1}{2}$ an inch; tarsus $\frac{6}{10}$ths; centre toe and claw $\frac{5}{8}$ths; and hind ditto $\frac{1}{2}$ an inch.

Remark.—Cabanis in Catal. Birds Mus. Heine, p. 161, states that "the bill of *F. bella*, of Hempr. and Ehrenb., is a trifle larger than in *L. cannabina*, Linn., but in colour almost agrees with *L. fringillirostris*, Bonap. et Schlegel, Monog. Loxiens, t. 49. p. 45.

NEW GENUS OF FISH-SCALED LIZARDS (SCISSOSARÆ), FROM NEW GUINEA. BY J. E. GRAY, Ph.D. F.R.S., ETC. ETC.

The Lizard which I have the pleasure of bringing before the Society this evening, was presented to the British Museum, with other most interesting and novel specimens, by Mr. John MacGillivray, who accompanied H.M.S. Herald as naturalist during her voyage in the Australasian seas.

CORUCIA.

Head broad, flat-topped; nostrils ovate, oblique, simple, not prolonged behind, on the middle of the lower part of the nasal shields; supranasal shields none; rostral square; internasal one, large, 8-sided, broader behind; frontal-nasal two, moderate, band-like, transverse; lateral-frontal one, small, subtrigonal, nearly equal-sided; frontal-parietals two, rhombic, contiguous at the angle; interparietal one, rhombic, elongate; eyebrows covered with band-like shields; lower eyelid with a series of larger opake scales; temple covered with large shields; ears large, simple, edged in front.

Body fusiform, compressed; scales, 6-sided, smooth, with 3, 5 or 7 grooves, seen through the skin, of chin and underside of the body thinner, smooth.

Legs strong; toes five, cylindrical, elongate, unequal, with a series of band-like shields beneath; claws strong, curved.

Tail elongate, tapering, rather compressed, scales of upper surface like those of the back, but rather larger, with a central series of broad hexangular shields beneath.

Hab. Australasia.

This genus belongs to the same section in the Museum Catalogue as *Ateuchoglossus*, characterized by the simple nostril and scaled opake lower eyelids. It differs from that genus in the smoothness of the scales, the shielded underside of the tail and several other characters.

CORUCIA ZEBRATA.

Pale yellowish-white (in spirits); back with irregular blackish-brown cross-bands; upper part of limbs and tail blackish, varied; head dark-brown.

Hab. New Guinea, the Island of San Christoval, *John MacGillivray, Esq.*, two adult and young specimens.

Length of adult nearly 2 feet.

December 11, 1855.—Dr. Gray, F.R.S., in the Chair.

DESCRIPTION OF TWO NEW SPECIES OF ACTINIA, FROM THE SOUTH COAST OF DEVON. BY E. W. H. HOLDSWORTH.

Among various species of *Actinia* collected by me in July last, on the south coast of Devon, two appear to be undescribed, and although of small size, are of some interest as being additions to the fast increasing list of our native zoophytes.

They were found on the rocks near the entrance to Dartmouth harbour, a part of our western coast, which, from its steep rugged character and its luxuriant growth of sea-weeds, presents a fruitful hunting-ground for those in search of marine productions.

The first that I have to notice may be thus characterized:—

Body smooth and cylindrical when fully extended, from half to three-quarters of an inch in height, but very much flattened when contracted; tentacula in four rows, moderately long, slender, and slightly tapering towards the tips, their length regularly diminishing from those of the inner circle outwards. The entire animal has a pale transparent appearance, and the only trace of decided colour about it is found in a narrow dark blue line surrounding the base of each tentaculum, and extending a little in the direction of the mouth, but soon becoming indistinct. Very delicate white lines are at times visible on the surface of the body, but these are probably only the edges of the membranous septa seen through the transparent skin. When this animal is at all roughly handled, the long seminal filaments are thrown out from the mouth in great profusion. This little Anemone approaches very closely in many respects the *Act. candida* of Mr. Gosse, and I am indebted to that gentleman for his ready assistance in determining the differences between them. *Act. candida* may be distinguished by its possessing fewer tentacles, by the colour of the body being of a more opake white, and especially by the narrow lines surrounding each tentaculum being of a reddish-purple tint, and enlarging into a conspicuous spot on each side of its base. In their habits and general appearance they are very much alike, and had I obtained only one example of the pale species, I should hardly have ventured to consider it more than a variety. Ten specimens, however, were taken from different places, and did not vary except in size; they were found on the exposed surface of perpendicular rocks at about half-tide mark, and when out of the water and contracted, were very difficult to distinguish, owing to their great transparency. I propose for this species the name of *pallida*.

It has been my custom, after any expeditions in search of *Actiniæ*, to bring home one or two plants of *Laminaria digitata*, in order to examine at my leisure the various forms of animal life commonly met with among their tangled roots; and it was on one of these plants I found, in company with minute *Ophiocomæ*, green *Nereides* and numerous other animals, the beautifully marked Anemone that I have now to describe.

It has the following characters:—

Body elongate, cylindrical, about three-quarters of an inch in length when extended, the upper half covered with numerous pale perforated warts, increasing in number as they approach the top, and from which the white filaments are protruded when the animal is irritated. Tentacula in five rows. Colour of the body a dark orange, becoming paler towards the base. This species is chiefly remarkable for the beauty of its oral disk, which for colouring and elegance of marking will bear comparison with that of any of the larger kinds. The external half of the disk is of a rich purplish-brown, changing into a light orange tint towards the mouth, the pink tumid lips of which are frequently conspicuous; from near the centre diverge ten or twelve pairs of yellow bands slightly separating as they proceed outwards, and at their extremities partially surrounding the bases of the tentacula, according to the following arrangement. Taking a small segment of the disk, the first tentacle may be said to arise from the space between two pairs of bands, the second being situated within the pair; the band bifurcates near its extremity, and encloses the third tentacle; these branches again divide and form a similar enclosure for the arms of the fourth row: beyond these is a set of very short tentacula; these, as far as I have been able to examine them, are not connected with the yellow bands, but their small size and the difficulty of seeing their entire length when the animal is expanded, render it almost impossible to describe their exact appearance. On the surface of the disk a cream-coloured spot is situated near the base of each tentacle of the first and second rows, those connected with the inner series being farther removed from them than those of the second; the alternation of light and shade produced by this arrangement gives a battlemented appearance to the disk, and adds considerably to the general effect. The tentacula rapidly diminish in size from those of the inner row outwards; they are dark brown at the bases, becoming paler towards the tips, and are encircled by three well-defined white rings, of which the basal ones are very distinct. Several examples of this species were obtained at extreme low water-mark, from a large mass of detached rocks known as the Mewstone, near the entrance to Dartmouth harbour. They were met with on two or three occasions, but were always found nestling among the roots of *Laminaria digitata*.

A few weeks since, part of a plant of *Laminaria* was sent to me from Devon, and among the roots I found six specimens of an *Actinia* that closely resembled the one just described, excepting that the brown on the tentacula and certain parts of the disk was replaced by various shades of red. These animals differ so little, except in the general colour of the disk and appendages, that until I have an opportunity of examining some more specimens, I must consider the red one as only a variety of the other, and as such I would provisionally describe it. This uncertainty obliges me to depart from the old-established rule of giving the specific name from some marked character in the animal, and I must therefore propose the more general title of *ornata* for the brown species, and suggest that of *rubida* for the red one, should it on future examination prove to be distinct, which I am inclined to think is probable.

MISCELLANEOUS.

OBITUARY NOTICE.—WILLIAM YARRELL.

The list of British zoologists has just lost one of its best and brightest ornaments in the person of William Yarrell, who died suddenly at Yarmouth on Monday the 1st of September. Mr. Yarrell was born in June 1784, in Duke Street, St. James's, where his father carried on the business of a newspaper agent: this business was afterwards continued by the son in Ryder Street until nearly the time of his decease.

On the 3rd of August last, as he was returning from church, he was seized by a giddiness and unsteadiness of foot, which proved to be caused by incipient paralysis. From this he had pretty nearly recovered, only complaining of a slight "woolliness" in his brain, when on the Saturday before his death he went to Yarmouth with an invalid friend. On Sunday night he was attacked by a difficulty of breathing, which continually increased until about half-past twelve, when he tranquilly departed from this world.

Early in life Mr. Yarrell was celebrated as a keen and successful sportsman, but during this sporting phase of his existence neither neglected the management of his business, nor, what is of more importance to us, the cultivation of his innate taste for natural history, for he was busily engaged in forming collections illustrative of the natural history of this country, especially of its Birds and Fishes, and in making notes of their habits, which stood him in good stead when at the mature age of forty he began to write upon his favourite science. His first paper, containing "Notices of the occurrence of some rare British Birds observed during the years 1823, 1824 and 1825," was published in the 'Zoological Journal' in the latter year. From this time he seems gradually to have relinquished the gun and the rod for the pen, and his communications subsequently appeared pretty frequently in the periodical above mentioned, in 'Loudon's Magazine of Natural History,' and in this Journal. He also contributed valuable papers to the Transactions of the Royal, Linnæan, and Zoological Societies; but the works upon which his fame chiefly rests, and those with which the English student at all events will principally connect the name of Yarrell, are the admirable Histories of British Birds and Fishes, published in a style of such unrivalled excellence by Mr. Van Voorst. In these works we find accuracy of scientific research, combined with a plain but agreeable mode of communicating information on the details of the natural history of particular species, such as has rarely been equalled; and these Histories of British Birds and Fishes will always remain of the highest value to the investigator of the natural history of these islands.

Mr. Yarrell was elected a Fellow of the Linnæan Society in 1825, and for some years before his death he was a Vice-President and the Treasurer of that Society. He was also one of the founders of the Zoological Society, and a constant attendant at its meetings; and for many years he was the Treasurer of the Entomological Society.

Whilst thus distinguished in the scientific world, Mr. Yarrell's social qualities endeared him highly to his acquaintances. His more intimate friends always spoke of him in terms of affectionate regard, and even those who knew him superficially could never be insensible to the kindliness of his nature. To quote the words of a writer in the 'Athenæum,' who evidently knew him well, "His judgment was clear and sound, his appreciation of the value of facts and of evidence most accurate, his advice always practical and thoughtful. His truthfulness and simple-heartedness were even childlike, his temper gentle, his heart loving and affectionate, and he was liberal and charitable almost to the verge of imprudence. A kindlier spirit never lived."

AMPHIOXUS LANCEOLATUS.

To the Editors of the Annals of Natural History.

Falmouth, September 23, 1856.

GENTLEMEN,—The "*Amphioxus lanceolatus*," Yarrell, was found in dredger's refuse from Gwyllyn Vase Bay on Friday last, by Mr. Henry Bastian of this town. Length one inch and one-sixteenth; breadth in the middle one-eighth of an inch; of a lanceolate form, tapering to each extremity, riband-like, transparent as crystal; mouth circular, produced, armed with long slender cirrhi, crenated laterally; when these are reflexed, the passage to the oral aperture is considerably increased in length and diameter, and the water, with its crustacea, &c., has ready ingress, assisted by the ciliary current. The animal closes the aperture by contracting and crossing the free extremities of the cirrhi. It swims rapidly with a wriggling or snake-like motion for a few seconds, and then suddenly settles down at the bottom of the vessel, where it remains motionless, lying flat on its side, with the mouth open to its fullest extent (to all appearance dead), for thirty or forty minutes, or longer if not disturbed. Two days after its capture, I put into the vessel (of water) a quantity of shell-sand, which at first appeared to excite it very much, for it swam with increased velocity for a second or two, and then suddenly disappeared under the bed of sand formed at the bottom of the glass.

Fifty minutes after this occurrence, I was pleased to see one-third of the body projecting in a vertical direction from the surface of the sand, its mouth open, and the cirrhi slightly reflected at their extremities; but on agitating the water with a piece of straw, the body was partially drawn in, and on repeating the annoyance it disappeared altogether.

This morning the body was completely covered (over) with the sand, but the open mouth could be seen just above the surface of it—awaiting its prey (?). I consider it a scarce fish in our neighbourhood, not a rare one. Its rarity arises from the naturalist being ignorant of its habitats, and selecting ground for his dredging operations incompatible with the movements of the fish. Dr. Vigurs's fish (1851) carried ova. Mr. Bastian's is a young one.

I am, Gentlemen, your obedient Servant,

W. P. COCKS.

Description of a newly discovered Tanager of the genus Buarremon. By PHILIP LUTLEY SCLATER, M.A. &c.

Through the kindness of Sir William Jardine I am enabled to describe a specimen of a very distinct species of *Buarremon*, which Professor Jameson of Quito has lately transmitted to this country. It was obtained by him during a recent expedition into the eastern Cordillera of the Andes near Quito at an elevation of 6000 feet above the sea-level. In form and size it is similar to *B. pallidinuchus*, but the style of coloration is different and more nearly resembles that of *B. schistaceus*. Sir William Jardine has named it *leucopterus*, from the conspicuous white spot on the wing. The area of the genus *Buarremon* appears to extend along the Andean range from Bolivia into Southern Mexico, the vicinity of Bogota being perhaps the principal *sedes* or *focus*, where no less than seven or eight species occur. The present bird may be characterized as follows :—

Buarremon leucopterus.

B. schistacescenti-niger, alis caudaque obscurioribus ; pileo ochraceo-rufo ; macula utrinque anteoculari et speculo alari conspicuo cum toto corpore subtus albis ; lateribus in cinereum trahentibus ; capitis lateribus nigris ; tectricibus alarum inferioribus albis ; rostro pedibusque nigris.

Long. tota 6·2 ; alæ 2·8 ; caudæ 2·7.

Hab. in rep. Equatoriana (*Jameson*).—*Proc. Zool. Soc.* Nov. 27, 1855.

METEOROLOGICAL OBSERVATIONS FOR AUG. 1856.

Chiswick.—August 1, 2. Slight haze : very hot. 3. Hot and sultry. 4. Overcast : very hot. 5. Cloudless and hot. 6. Cloudy : slight haze : very fine. 7. Clear : hot and sultry. 8. Cloudy : overcast : very fine : rain. 9. Slight rain. 10. Cloudy and fine. 11. Very fine : cloudy : rain. 12. Cloudy : very fine. 13. Very hot : heavy rain at night. 14. Cloudy and fine : rain. 15. Cloudy and fine. 16. Very fine : thunder, lightning and rain at night. 17. Slight rain at half-past eight A.M. : excessively heavy rain commenced, nearly an inch fell in one hour : cloudy at night. 18. Cloudy. 19. Overcast : rain. 20. Foggy : overcast : heavy rain at night. 21. Densely clouded : boisterous, with heavy clouds and showers. 22. Partially overcast : cloudy : very fine. 23. Fine. 24. Cloudy and fine. 25. Slight showers. 26. Very fine. 27. Uniformly overcast : very fine. 28. Cloudy and fine : rain. 29. Very fine. 30. Slight fog : very fine. 31. Very fine : rain at night.

Mean temperature of the month	63°·40
Mean temperature of Aug. 1855	00 ·00
Mean temperature of Aug. for the last thirty years	61 ·97
Average amount of rain in Aug.	2·413 inches.

Boston.—Aug. 1—3. Fine. 4. Cloudy. 5, 6. Fine. 7. Fine : thunder, lightning and rain A.M. and P.M. 8. Fine. 9. Cloudy : rain A.M. and P.M. 10. Cloudy. 11, 12. Fine. 13. Cloudy. 14. Cloudy : rain A.M. 15, 16. Fine. 17. Rain A.M. and P.M. 18. Cloudy : rain A.M. and P.M. 19. Cloudy. 20. Cloudy : rain A.M. and P.M. 21. Rain A.M. and P.M. 22. Cloudy : rain A.M. 23. Cloudy. 24. Rain. 25. Cloudy. 26. Cloudy : rain P.M. 27. Cloudy : rain A.M. 28. Cloudy : rain A.M. and P.M. 29—31. Cloudy.

Sandwick Manse, Orkney.—Aug. 1. Drizzle A.M. : fog P.M. 2. Clear, fine A.M. : clear P.M. 3. Bright A.M. : cloudy P.M. 4. Bright A.M. : clear, fine, aurora P.M. 5, 6. Bright A.M. : clear, fine P.M. 7. Bright A.M. : cloudy, fine P.M. 8. Cloudy A.M. and P.M. 9. Cloudy A.M. : cloudy, fine P.M. 10. Bright A.M. : cloudy P.M. 11. Drops A.M. : drizzle P.M. 12. Bright A.M. : thunder-showers P.M. 13. Clear A.M. : bright P.M. 14. Bright A.M. : vapour, fine P.M. 15. Damp A.M. : drizzle P.M. 16. Damp A.M. : clear P.M. 17—22. Cloudy A.M. and P.M. 23. Cloudy A.M. : cloudy, drops P.M. 24. Bright A.M. : cloudy P.M. 25. Rain A.M. : showers P.M. 26. Showers A.M. : drizzle, showers P.M. 27. Cloudy A.M. and P.M. 28. Rain A.M. : drops P.M. 29. Showers A.M. : drops P.M. 30. Clear A.M. : cloudy P.M. 31. Rain A.M. : clear, aurora P.M.

Mean temperature of Aug. for previous twenty-nine years ...	55°·03
Mean temperature of this month	53 ·22
Mean temperature of Aug. 1855	56 ·10
Average quantity of rain in Aug. for previous sixteen years ...	3·01 inches.

Meteorological Observations made by Mr. Thompson *at the Garden of the Horticultural Society at* Chiswick, *near London;* *by* Mr. Veall, *at* Boston; *and by the* Rev. C. Clouston, *at Sandwick Manse*, Orkney.

Days of Month.	Barometer.					Thermometer.					Wind.			Rain.		
	Chiswick.		Boston.	Orkney, Sandwick.		Chiswick.		Boston.	Orkney, Sandwick.		Chiswick.	Boston.	Orkney, Sandwick.	Chiswick.	Boston.	Orkney, Sandwick.
1856. Aug.	Max.	Min.	8¾ a.m.	9¼ a.m.	8½ p.m.	Max.	Min.	8¾ a.m.	9¼ a.m.	8½ p.m.	1 p.m.					
1.	30·149	30·093	29·60	30·03	30·09	88	56	72	61	56	e.	s.	w.	....	....	·09
2.	30·052	30·029	29·50	30·13	30·17	92	52	72	62½	56	e.	ne.	e.	....	....	....
3.	30·066	30·022	29·51	30·17	30·17	89	55	70	58	54	se.	ne.	e.	....	....	....
4.	30·181	30·117	29·64	30·21	30·27	87	44	65	57	54	e.	ne.	se.	....	....	....
5.	30·216	30·190	29·70	30·26	30·23	84	44	67·5	58	53	ne.	ne.	ese.	....	....	....
6.	30·171	30·046	29·66	30·17	30·07	78	41	64	65	53	e.	ne.	ne.	....	....	....
7.	30·009	29·874	29·44	30·00	29·90	88	42	67	56	52	sw.	w.	ne.	....	....	....
☽ 8.	29·718	29·640	29·20	29·83	29·83	80	54	66	53½	48	sw.	s.	ne.	·08	·22	....
9.	29·808	29·750	29·23	29·86	29·92	75	55	67	52½	48	sw.	w.	ne.	·10	....	....
10.	29·841	29·774	29·26	29·94	29·96	84	54	72	55	49	se.	w.	e.	....	·53	....
11.	29·831	29·787	29·22	29·80	29·61	87	56	69	53½	55½	sw.	ssw.	se.	·12	....	·11
12.	29·960	29·910	29·33	29·67	29·76	80	47	70	63½	60	sw.	ssw.	calm	....	....	·28
13.	29·959	29·888	29·42	29·81	29·73	85	50	69	64	57	s.	ssw.	se.	·66	....	·01
14.	29·899	29·749	29·27	29·67	29·59	75	54	64	64½	54	sw.	sw.	se.	·06	....	....
15.	29·978	29·911	29·30	29·60	29·72	75	40	65·5	56½	55	sw.	sw.	w.	....	·12	·04
○ 16.	29·945	29·674	29·43	29·87	29·95	78	55	64	53½	46	se.	calm	nne.	·22	....	·01
17.	29·533	29·422	29·17	29·94	29·92	70	56	62	50½	48½	ne.	ne.	ne.	1·12	....	....
18.	29·430	29·406	29·07	29·87	29·84	62	52	56	52	49	ne.	nne.	nne.	....	·73	....
19.	29·619	29·426	29·08	29·84	29·84	67	55	62	50	48	ne.	nne.	nne.	·29	·19	....
20.	29·553	29·316	29·17	29·84	29·83	67	56	66	49½	48½	se.	nne.	ne.	·45	....	....
21.	29·400	29·255	28·83	29·77	29·82	68	49	64·5	51½	50½	s.	s.	nne.	·24	·66	....
☾ 22.	29·984	29·574	29·16	29·88	29·97	68	39	61	53	50	n.	n.	calm	....	·51	....
23.	30·128	30·085	29·60	29·99	29·78	66	46	56	53	52	n.	n.	se.	....	....	·03
24.	30·090	30·040	29·50	29·71	29·70	69	54	62	55	52	sw.	s.	wsw.	·02	....	·01
25.	29·983	29·812	29·38	29·36	29·28	66	52	66·5	55½	54	sw.	sw.	wsw.	·02	....	·29
26.	29·929	29·901	29·36	29·69	29·78	76	55	61	52½	45	w.	nw.	n.	....	....	·05
27.	29·824	29·755	29·22	29·77	29·75	77	52	64·5	51	44½	w.	w.	sse.	....	·02	....
28.	29·846	29·773	29·32	29·56	29·42	71	53	59	53	50	sw.	sw.	calm	·07	·04	·12
29.	30·144	29·888	29·30	29·69	29·98	76	40	64	50½	49	sw.	w.	nw.	....	·06	·18
● 30.	30·151	29·967	29·66	29·99	29·75	74	54	58·5	53	50½	s.	s.	se.	....	....	....
31.	29·931	29·874	29·40	29·60	29·67	77	40	60	52½	51½	sw.	w.	w.	·05	....	·18

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SECOND SERIES.]

No. 107. NOVEMBER 1856.

XXX.—*A Notice of some New Genera and Species of British Hydroid Zoophytes* *. By Joshua Alder, Esq.

[With three Plates.]

Having had occasion lately to examine the zoophytes of the coasts of Northumberland and Durham for the purpose of drawing up a local Catalogue for the Tyneside Naturalists' Field Club, I have been so fortunate as to meet with several undescribed species, some of which have not been before observed, and others have been misunderstood or passed over as varieties. The species here described belong to the **Anthozoa Hydroida** of Johnston.

Family **Corynidæ**.

Vorticlava, nov. gen.

Polype linear-cylindrical or clavate, soft, naked, affixed at the base, solitary? Head terminal; tentacles in two rows, stout, dissimilar, the upper row capitate.

Vorticlava humilis, n. sp. Pl. XII. figs. 1–4.

Body white, semitransparent, nearly of equal thickness throughout; upper tentacles five, short and stout; lower tentacles ten, about three times the length of the upper.

Length of body $\frac{2}{10}$ inch.

On *Corallina officinalis*, in a rock-pool between tide-marks, Cullercoats.

* Read at the late Meeting of the British Association for the Advancement of Science at Cheltenham. Four new species of *Polyzoa*, forming a part of the communication then read, have been published in the 17th Number of the Journal of Microscopical Science.

Only one specimen has yet occurred to me of this very interesting little zoophyte, which may readily escape observation on account of its diminutive size. It was observed on a branch of *Corallina officinalis* that had remained for a while in a glass of sea-water, in the autumn of 1853. The pools where it was obtained have been searched several times since for additional specimens, but without success. I am happy, however, to find that the species was also found by Mr. Busk, in the same year, at Felixstowe in Suffolk. The Cullercoats specimen, which lived with me several days, showed little animation, holding itself always in a curved position as represented in fig. 2. The mouth is tubular and prominent. The upper tentacles, which surround the mouth, are short and generally curved inwards; their enlarged heads showing, when highly magnified, a congeries of little tubercles, which probably contain thread cells. The lower tentacles form a radiating circle near the base of the head.

Mr. Peach has described, in the 'Annals of Natural History' for August last, the change of a zoophyte somewhat similar to this into a naked-eyed Medusa. That gentleman's observations led him to conclude that the change was a complete metamorphosis, and not a reproduction by gemmation as is usually the case, though the exact point of transition does not appear to have been observed.

Names given to genera in this family must be considered provisional and subject to revision, should the Zoophytes afterwards prove to be the transition-state of something already known. At present this genus has as good a claim to recognition as *Clava* and some of its nearest allies.

Family **Tubulariadæ.**

Eudendrium confertum, n. sp. Pl. XII. figs. 5–8.

Polype white or pale flesh-coloured, with a longish ovate head, surrounded by a single row of tentacles. *Polypary* consisting of short crowded stems rising from a common base; they are tubular, yellowish horn-coloured, strongly wrinkled across but not annulated, slightly branched, and expanding a little towards the apertures: base a densely reticulated and closely adhering crust, the interstices filled up by a membrane.

Height $\frac{1}{4}$ to $\frac{1}{2}$ inch.

On old shells of *Buccinum undatum* and *Fusus antiquus* from deep water, Cullercoats.

This little zoophyte appears to have been first noticed by Dr. Johnston, though he had subsequently overlooked or forgotten it, as when I sent him a description of a specimen got at

Cullercoats in 1854, he wrote me that it was not anything he was acquainted with. I have since, however, found in his Catalogue of the Zoophytes of North Durham, published in the 'Transactions of the Newcastle Natural History Society,' mention made of a zoophyte, which is undoubtedly the same as this, and the description is so characteristic that I cannot do better than adopt it. "I have observed," he says, "a small *Tubularia* which invests old specimens of *Murex antiquus* with a dense beard-like coat, and may, possibly, be a species distinct from the above (*T. ramosa*). It is only the quarter of an inch in height, slender, horny, wrinkled, slightly and irregularly branched, the branches without rings at the origins: polypes white, furnished with a single series of obtuse tentacula, that do not seem to exceed ten in number. In this respect it agrees with *T. ramosa* as characterized by Dr. Fleming, but differs from the specimens which I have seen, and also from Ellis's figure of it, in which the tentacula are much more numerous." The incrusting base, which Dr. Johnston does not appear to have examined, forbids our considering it to be the young of *Eudendrium ramosum*. The basal ramifications are corneous and more solid than the ascending stems, rather broad, flat and undulating in outline, forming a dense network, the spaces between the larger reticulations being nearly filled up with smaller ones, and the whole, in old specimens, appear to be united by a membrane. The number of tentacles is not very constant, varying with age, and occasionally reaching sixteen, but ten is the more usual number. The mouth is conical when at rest, but varies much in form, sometimes expanding to a flat disk, with a wide aperture, similar to what is occasionally seen in *Hydractinia echinata*, to the polype of which this bears a strong resemblance.

I have lately met with specimens, apparently of this species, more branched than the form above described, and showing at the top of the tube, a cup-like expansion, similar to what is represented by Van Beneden in his *E. ramosum*: the cup, though continuous with the tube, is more membranous and soon falls off. The species may therefore possibly be the same with that so well described by Van Beneden, but is not the *T. ramosa* of Linnæus, of which Ellis's figures must be taken to represent the type.

Eudendrium capillare, n. sp. Pl. XII. figs. 9–12.

Polypary minute, very slender, thread-like, a little branched, transparent, pale horn-coloured, smooth, excepting two or three faint rings near the origin of each branch. *Polypes* terminal on the upper branches, vase- or pear-shaped, with a single row of eighteen or twenty long, slender tentacles: reproductive capsules on separate short branches near the lower part of the stem on clustered or verticillate pedicles, two or three capsules in linear series on each pedicle.

Height $\frac{1}{2}$ inch.

Parasitical on *Antennularia ramosa*, from Embleton Bay, Northumberland, *R. Embleton, Esq.*

The peculiarity of this elegant and graceful little zoophyte is that the reproductive capsules are on separate branches from the polypes; the latter always terminating the upper branches, while the former are on branches near the lower part of the stem. The moniliform mode of arrangement of the capsules on the pedicles is similar to what is seen in *E. ramosum*, where, however, they are in union with the polypes, arranged round the base of the tentacles. A more near approach to the mode of arrangement in *E. capillare* may be found in Cavolini's *Sertolara racemosa* (*Eudendrium racemosum*), which has two kinds of reproductive capsules, one set of which are arranged in moniliform series on umbels very closely resembling those of our species. According to Krohn (as quoted by Professor Owen), these capsules, in the Mediterranean species, are found to contain spermatozoa, and this may possibly be the case in the present instance.

For a knowledge of this new species I am indebted to Mr. Embleton, who kindly sent it to me along with some other very interesting species collected in Embleton Bay. It was fortunately preserved in spirits, so that the characters of the animal could be distinctly made out; otherwise it might readily be taken for a *Coryne*.

Family **Sertulariadæ**.

Sertularia tricuspidata, n. sp. Pl. XIII. figs. 1, 2.

Stem slender, alternately branched, twisted at intervals, and jointed above each cell: cells alternate, rather distant, smooth, exactly cylindrical, a little bent outwards, with a three-toothed rim; ovicapsules strongly ribbed across, with a narrow funnel-shaped aperture.

Height 1 to 2 inches.

On zoophytes from deep water on the Northumberland coast.

Without a careful examination of its characters, this species might be passed over as a small variety of *S. polyzonias*, from which it differs in the slenderness of its proportions, in the shape of the cells, and especially in their three-toothed apertures. Mr. Busk has pointed out to me that there is a species very nearly resembling this found in the South Seas—the *S. Johnstoni* of Gray, of which he has kindly sent me a specimen from New

Zealand. Like our species it is tridentate; but on a careful comparison of the two, I find that the southern form differs from ours in the following particulars. It is of smaller size and more compact mode of growth; the cells are more closely set, smaller, shorter, broader at the base, and attached for a greater part of their length, besides having some rib-like thickenings of the walls, which are not to be found in the northern species. There are likewise occasionally two or three cells together without a joint. The ovicapsules are very similar, but the aperture is not so much produced, and is conical, not funnel-shaped. Upon the whole I think there can be little doubt that the two species are distinct. The form is at least new to the British seas.

The cells of this species do not bulge out below as in *S. polyzonias*, and the capsules are narrower and much more strongly and regularly ribbed across, with a funnel-shaped aperture, having a smooth, everted rim.

Sertularia tenella, n. sp. Pl. XIII. figs. 3–6.

Sertularia rugosa, var., Johnst. Brit. Zooph. 62. f. 8 *c*.

Minute, creeping, throwing up short unbranched or slightly branched stems, which are slender, zigzagged, and jointed above each cell: cells alternate, rather distant, elongate, barrel-shaped, finely wrinkled across; the aperture erect, patent, squared and four-toothed.

Length $\frac{1}{2}$ to 1 inch.

Parasitical on *Plumularia falcata* and other zoophytes, but not common.

This pretty little species is smaller and more delicate in all its proportions than *S. rugosa*, with which it has hitherto been confounded. The cells are more erect, narrower, and more closely and regularly ribbed or wrinkled across; the wrinkles generally rising a little opposite each angle; they are six or seven in this species—in *S. rugosa* three or four. The aperture is erect, patent, and conspicuously squared and four-toothed: in *S. rugosa* the aperture is much less prominent, and is always bent outwards. The stem of *S. tenella* is slender, seldom exceeding half an inch in length, and most frequently unbranched: it is waved or zigzag, bearing a cell at each angle: opposite each cell there is a joint, above which the cell is much constricted and slightly ringed or twisted. The cells are more distant than in *S. rugosa*, in this respect resembling *S. polyzonias*, but are more slender and elongated than in either species; they are thin, delicately wrinkled transversely and produced a good deal at the top. The aperture is closed by a quadripartite operculum, opening in segments as in *Campanularia syringa*, but here the segments are fewer, corresponding with the angles of the mouth. *S. rugosa* has a similar operculum. The ovicapsules, for a knowledge of which I am indebted to the Rev. T. Hincks, scarcely differ from those of *S. polyzonias* and *S. rugosa*, but are perhaps a little more produced at the top. The polypes appear to be yellow or orange-coloured. Specimens of *S. tenella* occur in which the creeping fibre throws up only single cells on short foot-stalks throughout its course. In this form it might be taken for a *Campanularia*.

Family **Campanulariadæ**.

Campanularia volubilis. Pl. XIII. fig. 7.

Sertularia volubilis, Linn. Syst. Nat. 12th ed. 1311 ; Ellis, Brit. Corall. 24. t. 14. f. *a* A.

Stem creeping, sometimes giving off shoots in a free state, generally spirally twisted; pedicles rather longish, spirally twisted, and not ringed at the base; a single spherical ring below each cell; cells generally rather narrow and deep, with about ten shallow blunt denticles round the margin: ovicapsules rising on short pedicles from the creeping stem, oblong flask-shaped, smooth, with a long narrow neck.

Height about $\frac{1}{10}$th inch.

On *Plumularia falcata*, *Sertularia fallax*, and other zoophytes: frequent.

Three or four species have hitherto been confounded under the name of *Camp. volubilis.* It therefore becomes necessary to redescribe and discriminate them, and to ascertain, if possible, to which the Linnæan appellation properly belongs. Unfortunately the description of that author is very imperfect, but as he quotes the excellent figures of Ellis, with which his description, as far as it goes, corresponds, these may be fairly taken as representing the true *C. volubilis.* The distinguishing character of the species there represented is the spirally twisted stem; and Ellis remarks in his description, that "at the bottom of each [cup], where they join the stalk, the microscope discovers to us a very minute spherule or little ball, as in some drinking glasses." With these characters the species here described perfectly agrees. I have for some time been satisfied that this was distinct from the *C. volubilis* of Johnston and other modern British authors, but it was not until lately that I was so fortunate as to meet with its ovicapsules, the peculiar form of which will, I think, remove all doubt on the subject. This species is almost equally common on our coast with that described by Dr. Johnston (which

I propose calling *C. Johnstoni*), but on account of its usually inhabiting deeper water, it is not so generally met with. They may, however, be occasionally found mixed together on the same zoophyte, particularly on the stem of *Plumularia falcata*; but when their peculiar characters are known, they can readily be distinguished from each other. *C. volubilis*, as here distinguished, is scarcely more than half the size of *C. Johnstoni*, and has the cells usually narrower and more cylindrical, with the crenations of the margins blunter and shallower. But the best distinguishing character is in the pedicle, which in this species is always spirally twisted throughout, though becoming less marked towards the top, where a single spherule supports the cup. The creeping stem is generally, but not always, twisted when attached; but when, as is often the case, it becomes free, its spirally twisted character is beautifully displayed, and it has the appearance of a minute transparent cord, with a club-shaped termination. The pedicles and cells arising from the free part of the stem are always shorter than where it is attached, and more nearly resemble Ellis's figure. The ovicapsules are oblong flask-shaped, smooth, compressed laterally and produced into a very long and narrow neck; they arise from the creeping stem by a short pedicle of two whorls.

Campanularia Johnstoni. Pl. XIII. fig. 8.

Camp. volubilis, Johnst. Brit. Zooph. 107, woodcut 18; Couch, Cornish Fauna, 40. t. 2. f. 1; Gosse, Ramb. Dev. Coast, 296. t. 18.

Stem creeping, plain; pedicles long, with numerous close-set rings at the base, and more or less ringed at the top; the middle part usually plain; cells deep and rather large, with ten or twelve strong denticles round the rim: ovicapsules nearly sessile on the creeping stem, ovate oblong, strongly plicated transversely and truncated at top.
Height $1\frac{1}{2}$ tenth.

On sea-weeds, zoophytes, and shells, from between tide-marks to deep water: common.

This species is of more robust growth than the last, with the cells larger and more strongly denticulated; they are also wider, but this character is rather variable in both species. The pedicles are longer and stouter, and have always numerous close-set rings at the base, and also several rings at the top: the middle part is variable, sometimes partially or even wholly ringed, but more frequently plain*. The creeping fibre is always plain, and

* It is important in this genus to distinguish between rings and spiral ridges.

seldom if ever detached. The ovicapsules are large, ovate or subcylindrical, more or less elongated, with a truncated top, and very strongly plicated transversely; they rise from the creeping stem by scarcely perceptible pedicles. (Mr. Gosse has represented a spur at the bottom which I have not observed.) It may be a question for future solution, whether this species is ever branched. I have found branched specimens from deep water very much resembling this, with a ringed base and strongly denticulated cup, which I believe to be the young of *Laomedea dichotoma β*, Johnst. (*Sert. longissima*, Pallas), having once found an example a little more advanced, with the ovicapsules of that species. In Ellis and Solander's 'Zoophytes,' however, a figure is given of a branched specimen under the name of *Sertularia volubilis*, with vesicles resembling *C. Johnstoni*.

Campanularia Hincksii. Pl. XIII. fig. 9.

Camp. volubilis, var., Hincks in Ann. Nat. Hist. 2nd ser. vol. xi. p. 180.

Stem creeping, plain; pedicles long, nearly smooth, with two or three slight spiral twists at the base, and two or three spherical rings at the top, one of which is within the cup: cells rather long, with parallel sides, wrinkled or lineated longitudinally; marginal denticles ten, of a squared or castellated form, a little indented at top.

Height $1\frac{1}{2}$ to 2 tenths.

On shells and zoophytes from deep water: rather rare.

This species differs from the two former in the castellated form of the rim, and also in the shape of the cup, which is broad at the base and lineated longitudinally; the spherical ring within the cup is also a distinguishing character. The pedicle is long and quite smooth, with the exception of one or two rings at its junction with the cell, and a slight spiral twisting at the base. In this respect it differs from the *C. volubilis* of Van Beneden, the cells of which, though differing in shape, have a somewhat similar castellated rim, but the pedicle is short and strongly annulated throughout. This latter will probably constitute a fourth species. The *C. Hincksii* was first noticed by Mr. Hincks, who described it in the 'Ann. Nat. Hist.' for March 1853, as a curious variety of *C. volubilis*, from specimens sent him by Mr. Templar from the West of England. I have since met with it sparingly from deep water on the Northumberland coast. Mr. Hincks informs me that in his specimen the ovicapsules were apparently smooth, but from their imperfect state of preservation, this character was not satisfactorily made out. My specimens are without capsules.

Campanularia gracillima, n. sp. Pl. XIV. figs. 5, 6.

Stem erect, compound, subunilaterally branched; cells very slender, long, tubular, thin, set on loosely twisted pedicles of about two whorls: aperture entire.

Height 1 inch.

On shells and zoophytes from deep water, Northumberland coast: occasionally.

This is a critical species, greatly resembling *C. dumosa*, from which it can only be distinguished by comparative characters, though its general appearance and habit at once strike the eye as something distinct. It is much smaller than *C. dumosa*, thinner in texture and more flexuose when fresh, with narrower cells, set on longer pedicles. The stem is erect, and generally compounded of two or three tubes, diminishing to one at the ends of the branches. It is a good deal branched, the branches often rising more from one side of the stem than the other. The cells are long, very slender, thin and transparent, with a smooth rim; they are set on pedicles, about one-fourth the length of the cells, loosely twisted and making about two turns; they generally rise at a less angle from the stem than in *C. dumosa*, and are more fragile, being very apt to fall off when dry. The cells of *C. dumosa*, on the contrary, are more persistent than in any other species of the genus. *C. gracillima* appears usually to assume the erect form; only in one instance have I observed it creeping over the surface of a shell near the base of the ascending stem.

A *Campanularia* from Bass's Straits, of which Mr. Busk has sent me a drawing, is very similar to this, if not identical.

Genus Grammaria, *Stimpson.*

"Polypidom rectilinear, elongated, cylindrical, composed of aggregated tubes, generally without branches, which, when they occur, are of the same character as that from which they spring. Cells arranged on all sides in more or less regular and equidistant longitudinal rows, giving the section of the stem a star-like appearance."—*Stimpson**.

G. ramosa, n. sp. Pl. XIV. figs. 1–4.

Polypary stout, horn-coloured, irregularly branched, the branches rising from a constricted base: cells cylindrical, bending outwards to a distance nearly equalling the width of the stem, with an even margin, behind which they are frequently annulated with one or two lines of growth; they are

* Synopsis of the Marine Invertebrata of Grand Manan, p. 9. t. 1. f. 3.

set in about four longitudinal rows, the adjoining cells alternating, and the opposite cells nearly on a line with each other.

Height 1 to 2 inches.

From the deep-water fishing-boats, on the coasts of Northumberland and Durham: rather rare.

This species comes very close to the *Grammaria robusta* of Stimpson, of which it may possibly be a variety, the principal difference being that the British form is constantly branched, while the American species is linear and straight. The genus is new to Europe, and does not appear to differ much from the *Salacia* of Lamouroux founded on an Australian species.

EXPLANATION OF PLATES XII., XIII., XIV.

Plate XII.

Figs. 1, 2. *Vorticlava humilis*, natural size and magnified.
Fig. 3. A tentacle of the lower row much enlarged.
Fig. 4. Ditto of the upper row ditto.
Figs. 5, 6. *Eudendrium confertum*, natural size and magnified.
Fig. 7. A polypary of the same, magnified.
Fig. 8. A tentacle contracted and very highly magnified.
Figs. 9, 10. *Eudendrium capillare*, natural size and magnified.
Fig. 11. A polype of the same, more highly magnified.
Fig. 12. Reproductive capsule (sperm-capsule?), more highly magnified.

Plate XIII.

Figs. 1, 2. *Sertularia tricuspidata*, natural size and magnified.
Figs. 3, 4. —— *tenella*, natural size and magnified.
Fig. 5. Ovicapsule of the same.
Fig. 6. A polype-cell showing the operculum.
Fig. 7. *Campanularia volubilis*, highly magnified.
Fig. 8. —— *Johnstoni*, ditto.
Fig. 9. —— *Hincksii*, ditto.

Plate XIV.

Fig. 1. *Grammaria ramosa*, natural size.
Fig. 2. Another specimen magnified.
Fig. 3. A portion of the same more highly magnified.
Fig. 4. A section of the stem of the same.
Fig. 5. *Campanularia gracillima*, nat. size.
Fig. 6. A portion of the same, magnified.

XXXI.—*The Vegetable Individual, in its relation to Species.* By Dr. Alexander Braun, Professor of Botany in the University of Berlin, &c.* Translated by Chas. Francis Stone, B.A.

[Concluded from vol. xvi. p. 354.]

While thus, on the one hand, all the facts seem to unite in establishing the individual nature of the shoot, on comparing shoots in their qualitative relations, phænomena are brought to view which seem to contradict such a view of its individuality. The higher departments of the animal kingdom usually present as individuals, representatives of the specific type agreeing in all essential respects, though, perhaps, not perfectly identical. The fact of the separation of the sexes was all that modified this view; and here, indeed, the essence of the species does seem to be divided between two different individuals. Attempts have not been wanting to obviate this contradiction by the Platonic doctrine of the original unity of the sexes, by the assertion of Paracelsus†; that, in fact, the two together must be regarded as the one real individual—and such like.

This contradiction to the usual view of what constitutes the individual is shown in a far higher degree by *qualitative* comparisons of vegetable shoots, not merely of the same species, but also of the same stock. Thus we see, *e. g.* in *Equisetum arvense* (Field Horsetail), shoots totally different in aspect proceeding from the same root-stock; in early spring they are pale, discoloured, unbranched, terminating with a strobilaceous-like fructification; later, green and foliaceous ones appear, verticillately ramified. Investigations into subterranean vegetation show even other varieties of shoot-formation, viz. offsets dwindling down to a point, and club-shaped buds which, at a later period, drop off of themselves. The Colt's-foot (*Tussilago Farfara*) presents similar phænomena, in early spring putting forth leafless shoots, with asparagus-like scales terminating with yellow capitula, which in summer are followed by others bearing leaves. The flowers in the little capitula of the first present a third variety of shoots in their lateral branchlets. Even in common life we distinguish leaf-buds from flower-buds, on many trees. Let us consider this relation in the Cherry-tree, for example. On the same branch we find, on the one hand, buds which develope into branches bearing leaves, without producing flowers; on the other hand, some bearing only little squamate leaves on the shortened

* Reprinted from Silliman's American Journal for January 1856.

† "For this ye must know: man without woman is not a whole; only with woman is he a whole. That is as much as to say: both together make man, and neither alone."

axis, from whose axils the flowers rise and form a third kind of shoot.

On examining closer into the real origin of these differences, we find their ground to be a partition of the different steps of the metamorphosis (of the formations) among different shoots. True, there are many plants which go through the whole series of formations, from the inferior* and the foliaceous formations up to flower and fruit; but the cases are very numerous in which this does not take place, and in which the single shoot is not able to produce all the formations. Thus there are shoots which are only able to realize the lower steps, and never attain to flowers and fruit; while others overleap all the inferior degrees and commence immediately with the formation of flowers. Hence, on the one hand, we see the metamorphosis interrupted, a stoppage taking place at a determinate step; on the other, the metamorphosis attained by passing over the intermediate steps. Still more remarkable are the cases in which the retardation is not merely an interruption at a determinate step, but appears as a real retrogression in the metamorphosis, whereby an alternate rise and fall—an oscillation—usually takes place, which may at last pass over in victorious progress to the formation of flower and fruit; though in most instances it prevents the shoot in question from ever attaining its end. *Helleborus niger* is an example of the first case; for after many years of inferior- and foliaceous-leaf formation, at last it attains superior leaves and fruit by overleaping the formation of foliaceous-leaves which until then had prevented its further progress†. Many of our trees with true foliage present examples of the second case. Their branches commence with bud-scales (inferior-leaves), the succeeding foliaceous branch ends with a terminal bud (thus falling back to inferior-leaf formation), and in the next period of vegetation they rise again to foliaceous-leaf formation ‡,—as in

* On the terminology of the leaf-formations, see Wydler, Bot. Zeit. 1844, 36tes Stück, and A. Braun, Verjüngung, p. 66. (Henfrey's Transl. Ray Soc. 1853, p. 62.)

† Analogous cases occur in the branches in *Æsculus* and many Maples which attain to flowers. Among herbaceous plants *Anemone nemorosa* and *Asarum Europæum* also belong here, and especially remarkable is the Tulip, the plants of which, not yet ripe for flowering, annually develope one single foliaceous leaf, followed by a central bud hidden in the middle of the bulb and composed of several inferior-leaves. This bud preserves this position in bulbs deep in the ground, but in those nearer the surface it is, as it were, led out of the centre of the bulb, and sinks deeper into the earth, causing an indentation of the surrounding base of the preceding leaf in form like a spur, boring through the old bulb and penetrating vertically into the ground, and at the same time sinking itself into a deeper stratum with the spur;—an arrangement explained, but not with sufficient clearness, by Henry in Nov. Act. Nat. Cur. vol. xxi. p. 275. t. 16 & 17.

‡ In such librations, of course, the formation of the flower can only be

the Oak, Beech and Poplar. A similar oscillation between inferior-leaf formation and foliaceous-leaf formation, keeping pace with the change of season, is seen in the creeping main-shoot of *Adoxa,* and in the stock of *Hepatica nobilis,* creeping close to the soil, with its short internodes, and which in so far deserves its French name (*la fille avant la mère*) as its flowers, which unfold before the foliage, do not belong to the same individual as the foliage, but are produced laterally as a "daughter generation" from the axils of the inferior-leaves of the maternal stem *. A similar phænomenon, only in a higher degree (a rising and falling between foliaceous- and superior-leaf formation), is presented by those plants whose inflorescence ends in a foliaceous coma, as is remarkably the case in the Pine-Apple, and also in the New Holland species of *Melaleuca* and *Callistemon,* whose crowded, brush-like inflorescence (*i. e.* the region covered with superior-leaves and bearing the flowers in the axils of these) returns and forms foliaceous-leaves, and in the following year again attains an inflorescence.

While every leaf-formation may bring the progress of the metamorphosis on a single shoot to a consummation, it is conceivable that one shoot may be allowed to each step for itself alone. Thus, there are shoots which represent inferior-leaf formation alone; *e.g.* the root-stock of *Paris quadrifolia,* the tuberiferous branches of the rhizoma of the Potato†; and there

attained by particular branches, deviating in character from the rest,—the catkins which pass over leaf-formation advancing from the inferior-leaves immediately to the superior-leaves out of whose axils the flowers are emitted.

* The same obtains in *Galanthus nivalis,* in which every annual generation consists of one inferior leaf, one foliaceous-leaf with a vagina, and one without a vagina, which follow each other in simple alternation, in a distichous arrangement. The flower, as a branch, is emitted from the axil of the second foliaceous-leaf, while the direct continuation of the shoot returns again to inferior-leaf formation. In striking contrast to the extremely simple relations of this plant we find *Oxalis tetraphylla* and other species of that genus, in which the subterraneous main-stem also presents an alternation of inferior-leaf formation and foliaceous-leaf formation, advancing with the change of season, but conjoined with a rare abundance of leaves and a complicated phyllotaxis. The number of the inferior-leaves amounts to several hundreds; and transverse sections of the bulbs, which last through the winter and are formed by the close approximation of these leaves, form some of the prettiest specimens of phyllotaxis, showing 21-15 arrangement through easily computable 8-, 13- and 21-ranked oblique spirals. The number of the foliaceous-leaves is not so large; they develope in the summer, and form an 8- to 13-leaved rosette, out of which the axillary inflorescences issue, with their long peduncles.

† In case (as sometimes occurs) the tuber does not pass through this formation and advance to foliaceous-leaf formation. The tuber is the thickened apex of the inferior-leaf shoot. Cf. the figure by Turpin, Mém. du Mus. d'Hist. Nat. t. 19. pl. 2.

are some which are endowed with the foliaceous-leaf formation only, as the primary axis of many species of *Veronica*, the sterile leafy branches of several *Euphorbiæ*, as well as the leafy branches of those woody growths which have no bud-scales and no terminal inflorescence (e. g. *Rhamnus Frangula*). Cases of pure superior-leaved shoots may be seen in the peduncles of *Veronica Chamædrys, officinalis*, &c., in the (always lateral) spike-bearing scapes of *Plantago*, and the racemes of *Convallaria majalis*, which shoot out of the axil of the highest lower-leaf as branches. Even the leaf-formation belonging to the flower can be divided among different shoots, and thus the flowers may be produced piecemeal, so to say; as is the case in all diœcious plants, where the two most essential formations of the flower (the stamens and pistils) are found, not in the same flower, but in two separate ones. Even the less essential parts of the flower, the sepals and the petals, may occur separated from the other particular shootlets; as may be seen in the neutral flowers in the coma of the spike of *Muscari comosum* and in the ray-flowers of the cyme of *Viburnum Opulus*. The destitution of the shoot may be carried so far as to cause it to produce but one single leaf, or one single formation (whether from the sphere of the plant-stock, or from that of the leaves); in which case the individual represents only one single organ; as, for instance, in the branches which form the axis of the inflorescence in *Vicia monantha* and other Leguminosæ with racemes reduced to one flower, bearing one single superior-leaf, from whose axil the flower proceeds. The male flower of *Euphorbia* is a peduncle whose flower consists of one single stamen*. Must we, now, still regard as individuals, these

* The genuine cases will be of rare occurrence if we look at the cases which belong here rigorously, that is, if we take into account the dwarfed foliaceous formations which may possibly exist, suppressed or scarcely discernible. The male flower of *Euphorbia* itself properly belongs here only in appearance, as two small scales (inferior-leaves) occur, more or less developed, at the base of the peduncle. The small involucre of the male flower proceeds to develope itself out of one of these scales. (Cf. Wydler, Linnæa, 1843, p. 409.) Another example of a one-leaved shoot (though a spurious one) is presented in the Californian *Pinus monophyllos* (Fremont), whose lateral branchlets bear a fascicle of needle-shaped leaves reduced to one single needle: but this, as well as the pair of such leaves of our ordinary Pines, is preceded by a vagina composed of several bud-scales. Perhaps another deception is played upon us in this case, for the perfectly round form of this needle excites the suspicion that it may be composed of two which have grown together through their whole length. The seed-bearing fruit-scales of the cone of *Abietinæ*, which are placed in the axils of the scales, also appear to be one-leaved shoots; but the series of changes which these scales present in cones of *Pinus Larix* which have completed their growth, proves that these fruit-scales are composed of two concrete leaves. The spurious axis of the Grape is a concatenation of alternating

shoots, so partially endowed, and the last-named so destitute? Certainly. For if the individual can fall short, though ever so little, of the perfect realization of the specific idea, then there are no limits to its imperfection and destitution; for, after all, the realization of this vegetable Idea by the different members of the vegetable kingdom is precisely similar to the realization of the species by its single individuals. To be sure, our idea of a plant implies that it shall manifest its life in a series of successive formations, that it shall put forth its leaves, flowers and fruit by successive steps; and yet there are plants which produce no leaves and no fruit (the Cryptogamia); again, there are others which hasten on to form flower and fruit with various intermissions of the regular steps, as is especially the case with the ugly parasites destitute of that green foliage which elsewhere is so characteristic a product of the vegetable world*. One of these (the *Hydnora*†, which preys upon the root of the South African *Euphorbiæ*) seems entirely devoid of all the foliage which is usually formed before the flower. Hence, therefore, in general we cannot necessarily regard individuals as perfect representatives of the specific idea, and hence, too, we cannot regard them as representations invariably identical in their realizations. Individuals appear rather as living attempts, by which the Idea is more or less attained, and is thus realized with various modifications. From this point of view even the differences in indi-

one- and two-leaved leaf-shoots, if we do not count the one or two little dwarfed superior-leaves, which in most cases are perceptible on the apex of the single shoot which finally forms a cirrhus. *Ophioglossum* presents a genuine case of a one-leaved shoot. The spike of this plant is a single fertile leaf, standing in the axil of the sterile one, and hence belonging to a lateral axis, of which however nothing is perceptible but this leaf. (Cf. Schnitzlein, Icon. fam. nat. Heft ii. t. 32.) The utriculus of *Carex* is the solitary leaf of an axis which in its normal condition developes no farther, and out of which, as the axillary formation of the utriculus, the female flower is emitted. And the so-called neutral flower of *Panicum*, and the allied Grasses, is a shootlet which developes nothing but one leaf (the bract of the flower).

* *Orobanche*, *Lathræa*, *Monotropa*, *Cynomorium*, all of which agree in the inferior-leaf formation passing immediately into superior-leaf formation, and thus the formation of foliaceous-leaves is omitted. In the celebrated *Rafflesia* the immense flower is preceded by bud-scales only, which must be considered as the inferior-leaf formation. The same occurs in *Frostia*, which preys upon the branches of arborescent *Leguminosæ*, and which resembles a mere flower so much, that one might doubt whether it is merely a monstrous papilionaceous flower or a real parasite. (Cf. Endlicher, Gen. Plant. p. 76; and Guillemin, Nouv. Ann. des Sc. Nat. ii. t. 1; and as to parasites in general, Unger, Annalen d. Wiener Museums, part 2.)

† E. Meyer, Nov. Act. Acad. L. C. Nat. Cur. xvi. 2. p. 771. t. 58 & 59, and R. Brown, On the female flower and fruit of *Rafflesia* and *Hydnora*, 1844, pl. 6–9.

viduals, as pointed out by the doctrine of shoots, within the limits of vegetable species, will no longer surprise us; on the contrary, it will open to us a deeper insight into that independence presented to us even in the life of nature, in the realization of the internal problems of the creation.

But here, too, as is so variously the case in nature, the regulative law is admirably united to the free configuration; for what gives a peculiar interest to the differences among shoots in the same species is the regular reciprocal relation among the shoots, as they reciprocally complete each other by their very one-sidedness, and thus form a higher whole. In this respect the qualitative difference of shoots bears a certain relation to their origin, that is, to the order of ramification to which they belong. And as the formation of shoots, as was shown, is a process of propagation, we see here, in the history of the development of the species, propagation taking the place of individual development. A second individual takes up the thread of reproduction which the preceding one was unable to carry any farther. Thus, what we are accustomed to see elsewhere attained in the individual, is here reached by the generation in a more or less strictly determined cycle;—in other words, where the single shoot is incapable, a determinate succession of shoot-series arises to bring the internal problem of its existence to a consummation,—to complete the metamorphosis into flower and fruit. This remarkable phænomenon,—which is a very frequent one in the vegetable kingdom, and is one of the essential characteristics of many of the most important families of plants, *e. g.* the Grasses, *Synanthereæ, Labiatifloreæ, Cruciferæ, Leguminosæ,* &c.,—is the same as that which in the animal kingdom (in whose lower orders it reappears) was, we cannot say discovered, but brought to a clearer comprehension not long since by the Norwegian naturalist Sars*, completed and confirmed by Von Siebold's investigations into the history of the development of *Medusa aurita* †, and soon after substantiated in its universality by the Dane, Steenstrup, under the name of "alternation of generation," or propagation and development by alternate series of generations ‡. Single cases of alternation of generation had been already carefully observed §; but they were too much in opposition to the

* In Wiegmann's Archiv, 1844, where the observations published in the author's earlier works, on the adolescent states of *Medusa*, are completed and concluded.

† Beiträge zur Naturgesch. der wirbellosen Thiere. Danzig, 1839.

‡ Ueber d. Generationswechsel, übersetzt von Lorenzen, Copenhagen, 1842.

§ Bonnet's industrious observations, the first that were made, of the alternating mode of reproduction of *Aphis*, published in his 'Traité de usual mode of reproduction to be understood in their true meaning. It was attempted to reconcile them with the customary mode by an unnatural interpretation, which regarded them as subversive exceptions to the general rule; while on the contrary almost all later works* bring to light a multitude of unexpected facts which take their places naturally under the law of alternation of generation as now known, and substantiate the pertinent words of Goethe with which Steenstrup opens his Memoir: "Nature keeps on her course, and what seems an exception is in rule." It was Sars, however, who first gave the answer to the riddle, the key to the newly opened domain, when he said of the course of development of *Medusa,* that here "it was not the individual, but the generation, which underwent the metamorphosis†." This was the true point of view; for Steenstrup dwelt too exclusively on the physiological side, the functional relations, of the alternating generations. Steenstrup, in fact,

l'Insectologie' in 1745, though made in 1740, belong here. Also Chamisso's correct observations of alternation of generation in *Salpæ*, described in his Memoir, De Animalibus quibusdam e classe Vermium Linnæana, Fasc. 1, 1819. Fragments in regard to the alternation of generation of *Trematoda* were known (but as such they did seem very enigmatical) by Bojanus's Beschreibung d. königsgelben Würmer (the "nurses" of *Trematoda* according to Steenstrup) aus welchen Cercarien (the larvæ of the final generation) herauskommen (Isis, 1818), and by von Bauer's important work on *Cercariæ* and the related *Bucephalus* (Beiträge zur Kenntniss d. niederen Thiere, Act. Nat. Cur. vol. xiii. 1827).

* Of the later works, by which the field of alternation of generation has been extended, I will adduce in particular: Sars, Fauna litoralis Norvegiæ, 1846, in which the sections especially important in relation to alternation of generation are those on *Syncoryna*, *Podocoryna*, *Perigonimus*, *Cytais*, as well as on *Agalmopsis*, *Diphyes*, and *Salpa*.—Van Beneden, Recherches sur l'Embryogénie des Tubulaires (1844); Mém. sur les *Campanulaires* de la côte d'Ostende (1845, in the Mém. de l'Acad. Roy. de Bruxelles, t. xvii.); Recherches sur l'Anat., la Physiol. et le Dével. des *Bryozoaires* (Mém. de l'Acad. Roy. de Br. t. xviii.).—Dujardin, Sur le Dével. des Méduses et des Polypes hydraires (Ann. des Sc. Nat. Nov. 1845).—Krohn, Bemerkungen über die Geschlechtsverhältnisse d. Sertularinen (in Müller's Archiv, 1843, p. 174); Ueber d. Fortpfl. u. Entw. der Biphoren (Froriep's neue Notizen, No. 868, 1846).—Busch, Beob. über Anat. u. Entw. d. Infusorien (Arch. f. Naturgesch. xv. p. 92). How great an importance must be attributed to the discovery of alternation of generation in dispelling the darkness which until then settled on the history of the life and development of *Entozoa*, may be seen in particular in Siebold's pregnant communications in R. Wagner's Handwörterbuch d. Physiologie, p. 640 (Article: Parasiten).

† Sars, *l. c.* p. 29. This assertion, of course, must not be understood as if the particular generation did not come in for its part of a metamorphosis. Sars' view is most beautifully corroborated by a comparison with plants; as in plants the metamorphosis of the individual itself is connected with the formation which leads to the completion of new parts, which in their turn have their own subordinate metamorphosis.

considered that the significance of alternation of generation consisted in its being an organic nursing of the brood connected with particular generations, for which reason he termed the individuals of *these* generations "nurses;"—a mode of viewing the subject, which, with all Steenstrup's pregnant elaboration of his idea, and with all the analogies he pointed out between it and the well-known phænomena of nursing the brood by particular individuals among bees, wasps, ants and termites, does not seize the *essential* point of the phænomenon of alternation of generations*. R. Leuckart† conceives alternation of generation from a more comprehensive physiological point of view, in connexion with the totality of all the other phænomena of the formation of different individuals, whether it occurs in a different or in the same generation; regarding all these phænomena from the point of view of a division, not merely of the generic task, but of the vital task in general, among certain individuals; considering it as a polymorphism determined by a division of labour. But even this view must lead to the morphological one; for the division of labour is determined by the organic development, while this itself obtains its peculiar character from the determinate step of the metamorphosis at which the development ceases;—and this is just what is so unmistakable in the phænomena of alternation of generation in plants. Hence as a typical phænomenon of development, as a metamorphosis of generation, alternation of generation (as well as the metamorphosis of the individual) presents analogies with the graduated series in the animal and vegetable kingdoms, and the organic scale of the creation, in general;—a point to which

* Steenstrup's explanation is most correct in regard to the history of the development of *Distoma*, whose nurses and grand-nurses are at last utricles entirely filled with the brood, and forming mere receptacles of the brood. Its application is less happy to those cases where the transition from the preparatory generations to the final generation takes place through *external* shoot- or bud-formation, as in *Sertulariæ*, *Campanulariæ*, and *Corynæ*, whose nurses forming the polype-stem can continue to live even after the concluding generations, comparable to the flower in plants, separate or wither off. Hence the vital activity of the preparatory generations is not exhausted in the production of the brood. Steenstrup's view, accordingly, would only be correct if non-sexual brood-production (by internal or external shoot-formation or by division) and alternation of generation were *correlative* conditions of each other. But this is not the case, as reproduction by shoots takes place without any alternation of generation in a great number of animals (*Ascidia, Bryozoa, Madrepora*), and by division as well (*Astræa, Annulata, Infusoria*). These cases are comparable to the occurrence of *unessential* branches in plants; while alternation of generation represents the succession of *essential* shoots.

† Ueber d. Polymorphismus d. Indiv. od. d. Ersch. der Arbeitstheilung in d. Natur. Ein Beitrag z. Lehre v. Generationsw. (1851).

Carus* called attention, and Reichert, his predecessor, as well.

The difficulties which the qualitative differences of shoots of one and the same species seem to present to our conception of shoots as individuals, will be entirely obviated if we can demonstrate that a partial outfit and equipment of individuals, perfectly analogous to those found among plants, are likewise found in the animal kingdom, where in most cases there is less doubt as to what is an individual,—if we can show that in both kingdoms, and in a similar manner, a polymorphism of individuals occurs which depends upon a division of the steps of development and of the vital problem of the species among individual members, whether of the same generation (divisions of generation), or of different generations cyclically succeeding each other (alternation of generation).

Let us first compare the phænomena of alternation of generation (or, as it should be called, *cyclical succession of generations*) in both kingdoms†. As is the case in the alternation

* Zur näheren Kenntniss. d. Generationsw. (1849); and, Einige Wörte üb. Metam. u. Generationsw. (von Siebold u. Kölliker, Zeitschr. f. wiss. Zool. iii. 1851, p. 359).

† These remarks on alternation of generation in plants, do not depend, as one might perhaps be disposed to think, upon a zoological doctrine fancifully applied to plants. But I recognized the phænomenon as the same, and I treated of it in my papers, if not under the same name, still in the same meaning, before my attention was called to the occurrence of this phænomenon in the animal kingdom by Steenstrup's work. As soon as the doctrine of the shoot as the vegetable individual was assumed in all its consequences, a determinate succession of generations emitted one from the other necessarily appeared to be the ground of the flower's first making its appearance in many plants in a determinate degree of ramification, and of the occurrence of a determinate succession of steps in the series of axes up to this goal, caused by a peculiar partition of the leaf-formations. Hereby the essential shoot-succession, which is the one which represents alternation of generation, was accurately distinguished from the unessential one. Twenty years ago, or more, C. Schimper distinguished between essential and unessential shoots, denominating the first (in a wider sense of the word) "Ableger" [off-sets], the latter "Ausleger" [out-sets]. In the 'Versammlung d. Naturforscher' in Mayence in the autumn of 1842, I made a communication on this subject, and at the same time in particular I called attention to the frequent importance of the characteristics involved in these relations when applied to improving the differentiation and grouping of species. Of this communication a report appeared in the 'Flora' for 1842, p. 962, though, indeed, somewhat distorted by inaccuracies. Wydler treated the same subject in the 'Bot. Zeit.' 1844, St. 37, under the heading "Achsenzahl der Gewächse," and gives a compendium of examples, in which, however, much appears which needs qualification. As Wydler informs us, Aug. de St. Hilaire is said to have turned his attention to ascertaining the number of essential axes in plants; however, I find nothing in the place referred to in the 'Leçons de Botanique' but the distinction between determinate and indeterminate growth, which has been known since

of generation of animals, a twofold reproduction appears in plants: sexual and non-sexual. Disregarding for the present the various relations of alternation of generation among the Cryptogamia, we find sexual reproduction (in animals by fertilized ova,—in plants by fertilized seeds) always vested in the generation which concludes the cycle of generations. That the consideration of this generation as the concluding one is not arbitrary, is shown by comparing it with the usual course of the metamorphosis; for the concluding generation is invested with the concluding formations of the metamorphosis (flower and fruit), in the same way in fact as in the animal the complete development of the organs of generation occurs at the summit of the individual metamorphosis. The preceding (preparatory) generations, which Steenstrup calls "nurses," on the contrary invariably produce their brood by non-sexual reproduction: in the animal kingdom this takes place, now through germ-granules which develope in the interior of the body (as the nurses of *Distoma*), now by a process of division in the posterior part of the body (the nurse of the *Medusæ*, the *Tape-worm*), or finally by external, persistent or deciduous, shoot-formations (*Corynæ*, *Campanulariæ*, *Sertulariæ*, &c.). Among Phanerogamia the last is the only kind occurring subservient to alternations of generation.

In animals, as in plants, the number of the generations in which the cycle of alternation of generation is completed, is for the most part a determinate one. *Medusæ*, *Salpæ*, *Corynæ*, and *Tubulariæ* conclude this cycle in the second generation: according to Steenstrup's showing, *Distoma pacificum* has a trimembral alternation of generation, and the family stock of *Pennatula* seems also to be formed by a trimembral succession of shoots. *Campanularia* has a quadrimembral cycle, in which however the two first generations are of the same character. Among *Sertulariæ*, cycles of still more numerous members appear to occur: eight to ten generations form the annual cycle of generation of

Joachim Jung's time, and was brought forward especially by Rœper and applied by him to classifying inflorescences. It is exemplified, in that place, by creeping stems, upright root-stocks, and by bulbs; and the section on indeterminate stems is unluckily exemplified by wrong cases, viz. *Scirpus palustris*, *Primula officinalis*, and *Menyanthes*, to which indeterminate main-shoots are falsely ascribed.—Steenstrup also lays down an alternation of generation in plants, in the concluding remarks in his work quoted above, as well as in his later book, 'Ueber das Vorkommen des Hermaphroditismus in der Natur' (On the Phænomenon of Hermaphroditism in Nature), though in an entirely different manner from mine as here given; for he compares the single leaves of the plant with the individual in animals,—a mode of viewing the subject in regard to which I have already expressed my opinion in the Introduction.

Aphides, though, excepting the last one, they are all similar and not even determinate as to number.

To these examples from the animal kingdom much more numerous ones from the vegetable kingdom might be added, though I will only adduce a few of them here. Most *Labiatifloræ, Synanthereæ, Grasses, Polygaleæ, Primulaceæ,* the *Dictamnus, Iris, Galanthus nivalis,* &c., have a bimembral alternation of generation in different ways, according to the partition of the formations. In *Paris,* for example, the first generation takes the lowest grade: it presents a subterranean inferior-leaf shoot (rhizoma), which never leaves the darkness of the earth, only reaching the world of light, towards which all plants strive, in its posterity, viz. in the quadrifoliate and unifloral lateral shoots which it sends up. The first generation of *Viola odorata* and allied species forms foliage proper; still, the main axis tarries close to the earth, and the second generations (the lateral flowers) scarcely rise above the foliage. In *Lysimachia nummularia* the main-shoot, a rooting leaf-stem, creeps along the surface of the ground, growing indefinitely, and terminating only in the (essential) lateral branches by its golden-yellow flowers. The main-shoot rises perpendicularly, forms foliage proper, and passes on to superior-leaf formation in many species of *Veronica,* e. g. *V. acinifolia,* producing its flowers as a second generation out of the axils of the leaves. The same holds good in regard to *Orobanche ramosa,* which fixes itself and preys upon the root of Hemp, though its main-shoot has no green leaves. A very remarkable bimembral alternation of generation is shown by *Adoxa,* now so famous, its name to the contrary notwithstanding*. The main-shoot creeps along the ground, oscillating with the seasons between leaf and inferior-leaf formation,—at every return of the latter stretching out like a runner and boring into the earth. Flowers and fruit, frustrated by the invariable retrogression of the main-shoot, are produced by the aspiring perpendicular branches, after a pair of small leaves on the scape, and several insignificant superior leaves, out of whose axils the lateral flowers are emitted as unessential shoots of the third degree. *Hepatica* presents a similar division of the formations among the two generations of shoots; but the main-shoot, rejuvenated from year to year and alternating between inferior-leaf and leaf formation, is short and upright. The branches with their single flowers, forming the second generation, arise in the axils of the scale-like inferior-leaves. A bimembral succession of shoots occurs in *Convallaria Polygonatum,* the genus *Aloe,* all species of *Plantago,*

* E. g. *Adoxa moschatellina,* which derives its name from *δόξα* (fame). The relations of growth in this plant have been correctly described by Wydler, Bot. Zeit. 1844, p. 657.

Veronica officinalis, Chamædrys, &c., *Viola sylvatica, Lysimachia thyrsifolia, Alyssum saxatile,* and some other *Cruciferæ, Echeveria coccinea,* all the species of *Melilotus, Medicago, Galega,* in *Pisum,* and many other leguminous plants, and in *Succisa pratensis, Anacyclus, Pyrethrum, Polygonum, Bistorta,* &c. A familiar example occurs in *Secale*: its spiciferous culm forms the shoot of the first degree, the lateral spikelets which compose the spike itself are those of the second*, and the florets in the axils of the superior leaves (paleæ) of these spikelets are the shoots of the third degree, *i. e.* the third generation of the cycle. A quadrimembral succession of shoots occurs in *Trifolium montanum, Hedysarum coronarium,* and in several of the New Holland phyllodineous *Acaciæ.* Several species of *Carex,* e. g. *C. maxima* and *leptostachys,* have a trimembral succession of shoots up to the male flower and a five-membral one up to the female.

If we were to reckon the similar generations which are reared one above the other until the tree gains strength enough to perfect its flowers, in many trees without terminal buds, as in the Willow, or the Lime†, we might find a number of generations equal or even much superior to that presented by *Aphis.*

Besides the generation *essential* to itself, and by which it gives existence to the next grade in the cycle, every generation may have still another unessential reproduction, which only extends the same grade. As above we distinguished between essential and unessential shoots, so here accordingly we must distinguish an essential succession of generations,—the true alternation of generation,—and an unessential one. Very often both occur in the same species of plants. A fine example of this is shown in *Lysimachia nummularia,* from whose creeping and rooting leaf-axis are emitted not only peduncles, but here and there a new creeping leaf-axis exactly repeating the original one (except as to the two early-lost cotyledons): and from the undetermined leaf-bearing main-axis of *Tropæolum minus* are emitted in regular alternation three lateral flowers at a time, and then again one (unessential) leaf-shoot. In *Cardamine amara* the first generation (the stem bearing foliaceous and superior leaves) is repeated in a twofold manner, by lateral branches from the cauline leaves, and by creepers from axils of the root-leaves. Similar relations obtain in *Mentha* and a large number of other plants. This same phænomenon is repeated in the animal kingdom. The polype-like nurses of the *Medusa* increase as such (according to Sars and Von Siebold) by lateral buds and runners. *Syncorynæ*

* *Secale,* in fact, has no terminal spicule; neither has *Triticum monococcum,* while the other cultivated species of *Triticum* have.

† I have described the Grape in reference to this subject in another place (Verjüngung, p. 49) [Henfrey's Transl. *op. cit.* p. 46].

are spadix-polypi, which represent trees by their formation of unessential branches, emitting finally from every branch and from the middle stock a whorl of individuals of the second (and last) degree. *Campanulariæ* and *Sertulariæ* put forth runners from the bases of the main-individual, which again shoot up and become new main-stems, or new stems emerge out of them; and perhaps the ramifications of *Bucephalus* (which according to Steenstrup's supposition is the larva of *Aspidogaster conchila*), as represented by Baer in Nov. Act. Acad. Nat. Cur. xiii. 2, belong here.

In our qualitative comparison of shoots, it was shown how the shoot may be limited to a few leaves, or even to a single one; in like manner the animal individual, in the division of *rôle* which occurs in alternation of generation, may become the representative of one single organ, of one single function. Thus the females of *Coryne squamata* are hardly anything more than egg-stocks, and the males than sperm-stocks*. The members of the *Tape-worm*, which are so many individuals of the final generation, hardly represent anything more than hermaphrodite sexual apparatus. As an analogous example in the vegetable kingdom perhaps the *Willow* † may be compared to the *Coryne*; here too the shoots of the last degree are nothing but naked unisexual apparatus of reproduction. In *Potamogeton* ‡, on the contrary, they are hermaphrodite, as in the Tape-worm. The construction of many of the lower animals, which when considered as individual animals seem to be the strangest monsters, becomes more intelligible as soon as they are regarded from this point of view,—as soon as we make up our minds to regard the supposed individuals as a family stock, and its parts (formerly held to be mere organs, and which, physiologically considered, are really nothing more) as individuals. In particular this is true of *Physophora*, *Stephanomia* and *Agalmopsis*.

In many cases we find alternation of generation connected with division of generation, that is, the appearance of heterogeneous individuals in one and the same generation. Just as is the case in animal and vegetable forms without alternation of generation, so, where it is connected with alternation of generation, division of generation relates principally to the sexual functions; and a glance at the animal kingdom shows us relations of alternation of generation complicated by division per-

* Hence Rathke regards the male individuals as mere testicles. Cf. Wiegm. Archiv, 1844, p. 155, and Steenstrup, Hermaphr. tab. 1. f. 17–20.

† The two stamens in the Willow, and the floriferous bud as well, are preceded by only two very small bracts, which grow together and form a little scale.

‡ The flowers of *Potamogeton* are branches which bear only stamens and carpels.

fectly similar to those which occur in the vegetable kingdom. In animals which go through an alternation of generation, the individuals of the preparatory generations are non-sexual; still they may nevertheless have a determinate importance in relation to the completion of the race which is to form their posterity. When in fact the final generation does not consist of hermaphrodite individuals, as obtains, for instance, in the Tape-worm, various alternations are conceivable: the final individuals of both sexes can be nourished by the same nurse, and hence the sexual division will first take place in the second, or generally speaking, in the last generation; or, different nurses may nourish the two sexes, so that a division of generation will occur even at the degree of nurse-formation. If in the last case the nurses are not single ones, but even then form *per se* a family stock, then on the same stock we may either have male-bearing and female-bearing nurses together, or these two kinds of nurses may be divided among different stocks, according as the division of generation occurs in a determinate later generation, or is present already in the first. Although as yet the observations of these relations by no means form an unbroken chain*, still this much is certain, that in animals, in the same way as in plants, both monœcious and diœcious forms occur; and hence there are families partly bisexual, partly unisexual. *Corynæ, Tubulariæ, Campanulariæ,* and probably all *Sertulariæ* (hence, doubtless, the greater part of *Hydroids*), also *Veretillum, Cynomorium,* according to Steenstrup, Krohn, and other observers, are diœcious, whether they form small simple stocks, as *Coryne squamata,* or small ramified trees, as *Syncorynæ, Campanulariæ*†, &c. On the other hand, the *Siphonophora,* according to Milne-Edwards's description of *Stephanomia*‡ (and judging from Sars' description of *Agalmopsis*), are monœcious family stocks; *Hydræ* are also monœcious§. To enter any further into these relations as they occur in the lower animals would lead us too far from our subject; but it may be in place to give some details as to

* Thus, *e. g.*, as far as I know, it remains to be shown whether the single nurses of *Medusæ* produce *Medusæ* of both sexes, or, as is most probable, only those of the same sex. In *Aphis* also this point still needs to be more accurately determined.

† Steenstrup, Hermaphr. pp. 66, 67, 72.

‡ Ann. des Sc. Nat. 1841, p. 217. pl. 7–10.

§ The later investigations into the *Siphonophora* by Huxley, Edin. Phil. Journ. 1852, Kölliker, Zeitschr. f. wiss. Zool. 1852, and Leuckart, Zool. Untersuch. Heft 1, 1853, corroborate the monœcious relations of these wonderful creatures as regards most of their genera, *e.g. Agalma, Agalmopsis, Stephanomia* (*Apolemia*), *Physophora,* and the other closely related genera. Busch's researches into the group of *Diphyidæ* have proved them to be diœcious, and the same obtains in the related genus *Epibulia.* (Later note.)

the manifold relations under which sexual division of generation occurs in plants.

Diœcious relations may occur without alternation of generation when, in fact, the flower has a terminal inflorescence and no branches, or only unessential ones,—when, therefore, as it is usually expressed, it is "uniaxial," as *e. g.* in *Rubus Chamæmorus, Lychnis,* and *Viscum.* Much more frequently, however, division of the sexes occurs in plants which at the same time have a cyclical succession of shoots (alternation of generation),—a succession which each of the two heterogeneous stocks passes through independently, and not always *pari passu.* This is a circumstance which must not be neglected in considering the differences of *habitus* in male and female flowers. Thus, in *Mercurialis* the female plant bears flowers even on the second axis; in the male plant, however,—if I do not misunderstand the inflorescence (a spike composed of small glomerules),—this first occurs on the third. In *Carex dioica, vice versâ,* the male plant flowers in the second line and the female in the third*. In other diœcious plants, on the other hand, the male and female flowers appear in the corresponding generation: *e.g.* in the second, *Stratiotes, Empetrum,* and *Taxus*; in the third, *Salix, Populus, Myrica, Cannabis*; in the fourth, *Phœnix.* In Hemp, the extremely heterogeneous appearance of the inflorescence of the male and female plants does not depend upon a division of the flowers of the two sexes among different axes, but upon the production of numerous unessential peduncles in the male inflorescence†.

Monœcism necessarily presupposes a succession of shoots (alternation of generation); in the simplest case at least for one of the two sexes, as both cannot be united in the same terminal flower; but, *vice versâ,* both may easily appear in determinate (equal or unequal) degrees of ramification. The most important circumstance to be considered in monœcious relations, consists in both the sexes (*i. e.* the shoots which bear them) occurring either subordinately or coordinately‡, for one either arises out of

* The second axis, which is a complete dwarf or a mere bristly spine, bears the so-called 'urceolus,' in the axil of which the female flower is placed, as the third member of the succession of generations.

† The female flowers are placed at the sides of the primary branches as branches of the second degree. In the same place where one single flower occurs in the female plant, a furcately ramified inflorescence is found in the male, produced by branching out of the two bracts of the original flower.

‡ Both these cases doubtless occur in the animal kingdom; the first probably in *Alcyonella,* where the stock is said to be composed partly of males and partly of females. As the stock is here formed by individuals continually shooting out of each other, one sex must shoot out of the

the other, or they both spring from a common mother-stem. In the first case, the female flower usually belongs to the earlier, the male to the later (subordinate) generation; the male flower-shoot springing from the female*, as *e. g.* in *Euphorbia*, *Ricinus* and *Poterium*, in which the female flower terminates the main axis, and the male occurs as a lateral shoot†. In *Buxus* the female flower occurs as the second, the male as the third axis; in many species of *Phyllanthus* (e. g. *Ph. niruri*), the female as the third, the male as the fourth; in *Xylophylla*, the female (on the margins of the spurious leaves) as the fourth, the male arising from the bracts of the female flower (as in *Phyllanthus*) as the fifth. In *Momordica*, *Ecbalium*, *Cephalanthera*, and some other *Cucurbitaceæ*, the female flower, placed in the axils of the foliaceous leaves of the main-stem, belongs to the third axis, and the male to the fourth; for the third axis, which here arises from the base of the peduncle of the female flower as main axis of the racemose male inflorescence, is a superior leaf-shoot. In the other cases,—in which the succession of shoots, in order to arrive at the two kinds of flowers, separates into two coordinate lines,—both kinds of flowers may appear either immediately in the first generation after this separation, or, since here again preparatory generations are intercalated, in a later one. Further, the number of the generations (axes) in the two lines arising from the division, may be either equal or unequal. A few examples may serve to explain the manifold cases which thus occur. In *Musa*, *Myriophyllum* and *Sagittaria*, the coordinate male and female flowers appear in the first generation after the separation, and in the whole as a second system of axes. Here the female flowers stand in the lower, the male in the upper part of the spicate or racemose inflorescence. The contrary holds true of *Cucurbita* and the monœcious *Bryoniæ*‡; for here

other. The second case occurs in *Agalmopsis* (according to Sars), where partly female (seminal vesicles) and partly male individuals grow out of the same main-stem.

* The opposite case seems to occur very rarely or not at all. A monstrosity, which for some reasons might be adduced here, is found in *Larix Europæa* and *Picea alba*, in which transitions of the amentaceous male flowers into female cones occur, where the fruit-scales are emitted from the axils of stamens which are often only slightly abnormal.

† As in all the examples adduced, the unessential aggrandizement of the inflorescence must be disregarded, which occurs in *Ricinus* and *Poterium* in the form of lateral female flowers emitted beneath the terminal female flower.

‡ *Bryonia* has apparently axillary racemes; but a more careful investigation shows that they do not spring immediately out of the axil of the foliaceous leaf, but (as secondary branches) out of the peduncle of a single flower standing directly in the axil of the leaf which exactly corresponds to the flower in *Cucurbita*.

the earlier flowers, which appear in the axils of the foliaceous leaves, are male; while the later ones, which appear on the further continuations of the stems, are female. *Arum** has below female, in the middle male, and above again female flowers, though these last are dwarfed and sterile. Likewise in the first generation after the separation, but in the whole as the third system of axes, we find both kinds of flowers in *Pachysandra* and *Acalypha*, and here again, as is usually the case in indeterminate spicate inflorescences of mixed sexes, the female flower is in the lower, the male in the upper part of the inflorescence. The same obtains in monœcious Palms with axillary spadices; though here the flowers appear in ramified spikes from the fourth system of axes. When the flowers make their appearance in the second generation after the division, they cannot easily be united in the same inflorescence, and special male and female inflorescences will arise. Thus, *e. g.*, in *Platanus, Liquidambar* and *Sparganium*, in which the female inflorescences occur on the lower part of the main-shoot, and the male in the upper; likewise in *Quercus* and *Fagus*, though here, *vice versâ*, the male inflorescences are the lower, and the female the upper. Finally, if the division of the succession of shoots is an unequal one in the separated lines of generation leading to the two kinds of flowers, *i. e.* if the number of essential axes is unequal, it is greater sometimes for one sex and sometimes for the other. In the Walnut (*Juglans*) it is the male flower which attains the higher degree of ramification; in *Xanthium*, and the species of *Carex* with separated male and female spikes, it is, on the contrary, the female flower†.

Other dimorphisms or even polymorphisms of the flowers, more or less independent of sex, occur when the sexes appear in the two different lines of generation; for even among flowers of the same sex, whether hermaphrodite, male, or female, differences often reveal themselves of a very striking character, which are generally coordinate according to fixed laws of division of generation. Thus, in all *Primulæ*, and in several *Labiatæ*, two kinds of hermaphrodite flowers occur, in a state of diœcious

* The inflorescence in *Arum* is terminal, as well as that in *Calla*.

† In species of *Carex* with terminal male and lateral female spikes, the male flower belongs to the first generation after the division, and the female to the third. In most of the species where the shootlet which bears the inflorescences is a continuation of the main axis of the plant, the male flowers represent in general the second generation and the female the fourth; in those species, on the other hand, which have a shortened main axis, which forms a mere rosette of leaves whence the shootlets bearing the inflorescences proceed as branches, the male flower is the third system of axes, and the female the fifth; as *e. g.* in *C. maxima, leptostachys* and *pilosa*.

separation; one with a large corolla and strongly developed stamens (*forma brevistyla*), the other with a small corolla and strongly developed pistils (*forma longistyla*). According to C. Schimper's observations* both forms occur at times in *Labiatæ* even on the same stock and in the same inflorescence, *e. g.* in *Dracocephalum Moldavicum*. Many species of *Viola* also produce two kinds of hermaphrodite flowers on the same stock; early ones of the usual form, and late ones without petals. In *Viola mirabilis* the first arise directly out of the main-stem (as branches of the first degree) and are mostly sterile, while the latter spring from the foliaceous branches (as branches of the second degree) and are fertile. In *Impatiens*, sterile flowers with perfect corollas and apetalous fertile ones occur in the same raceme. The cases in which normally formed above-ground and abnormally formed under-ground flowers appear, belong here; the latter have their corolla developed slightly or not at all, and are merely female, and, *par excellence*, fertile. If both kinds of flowers are fertile, the subterranean fruit differs from that borne above the soil; such cases are found especially in the family of *Leguminosæ, e. g.* in several species of *Lathyrus* and *Vicia*, in *Amphicarpæa*, and *Arachis*†; and also in the very remarkable Abyssinian Convolvulaceous plant, *Hygrocharis Abyssinica*‡. Among the most striking cases of dimorphous flower-formation are those described by Jussieu § in *Gaudichaudia, Camarea*, and other *Malpighiaceæ*. Here, besides the flowers conjoined in racemes or in corymbs, and formed according to the common type of the family, other apetalous flowers occur, standing alone and hidden in the axils of the leaves. Besides the normally formed glandulose corolla, they have only one stamen and two carpels. In several cases the dimorphism of the flowers is confined to the formation of the fruit alone, as *e. g.* in some species of *Æthionema* (especially *Æ. heterocarpum*, Gay), which in the same raceme bear partly dehiscent silicles with two cells and several seeds, and partly one-celled and one-seeded indehiscent silicles. *Ceratocapnos*‖, a North African genus of *Fumariaceæ*, bears in the lower part of the spike oval, ribbed, one-seeded nutlets, and in

* Communicated in the Versamml. d. Natur. zu Wiesb. in Sept. 1852.

† For details, *vide* Treviranus, Bot. Zeit. 1853, p. 393.

‡ Hochstetter, in Schimp. Iter Abyss. Nos. 572 & 1701. The same plant is called *Nephrophyllum Abyssinicum* by Richard, Tent. Flor. Abyss. and figured in pl. 76. The two kinds of flowers are emitted from the axils of the foliaceous leaves of the same creeping stem; those provided with corolla, stamens and pistil stand upright; the others without corolla and stamens bend down to the ground on their long peduncles.

§ Adr. de Jussieu, Monographie des Malpighiacées (1843).

‖ Durieu, Explor. scient. de l'Algérie, pl. 78. Endlicher, Gen. Plant., Suppl. iv. p. 32.

the upper part, lanceolate two-valved and two-seeded siliques. Polymorphism of flowers and fruit occurs in the most heterogeneous manner in the family of *Compositæ*; I will only refer to *Zinnia, Dimorphotheca, Heterotheca, Thrincia, Geropogon, Crupina*; and especially to *Calendula*, where the hermaphrodite blossoms of the ray produce three different forms of fruit, so that, including the male flowers of the disk, the capitulum presents four different forms of flower-shoots (belonging to the same generation). As somewhat similar cases in the animal kingdom, the instances of dimorphal insects, of which there are several, might be adduced*.

A separation of the series of generations into several distinct lines occurs in fact not only as regards the flower, but also, though less frequently, even among the inferior formations of the plant; this is especially the case where a particular lateral line is allotted to the leaf as well as to the flower. The true Pines afford the best known example of this. Their fascicles of needle-shaped leaves are nothing but foliaceous branches of circumscribed growth †, which lie outside of the line which leads to the two kinds of flowers, while they are essential, as the leaf-formation appears on them alone ‡. Here the generation splits up into three kinds of essential and coordinate shoots: 1st, the small leaf-shoots, which, after some few inferior-leaves forming the vagina, bear two, three, or five foliaceous leaves; 2nd, the male flowers, or small shoots, which are provided with stamens only; 3rd, female inflorescence, shoots with superior-leaves (the integumentary scales of the strobile) in whose axils the fruit-scales of the cone are formed, belonging to a further system of axes. In the animal kingdom cases analogous to these occur in monœcious *Siphonophora*, especially in *Stephanomia* and *Agalmopsis*, where even more than three kinds of coordinate individuals are emitted from the main axis: in particular motory individuals (the so-called *Swimming-bells*), nurses, the proboscis-like formations or imbibing tubes, and as already mentioned, two kinds of sexual individuals.

The differences of shoots thus far considered depend princi-

* The first in several species of *Dyticus* (*D. marginalis, circumcinctus, Lapponicus, Rœselii*, according to Erichson, Gen. *Dyticeorum*, 1832, p. 31); the last in *Aphis Quercus*, according to Bonnet.

† That the fascicles of leaves in *Pinus* are branches, is proved by the phænomenon of percrescence, which is not unfrequent, especially in young Pines.

‡ The main-stem, as well as all the elongated branches essentially resembling the stem, bear only leaf-scales, which may be best compared to bud-scales, and ascribed to the inferior-leaf formation. It is only in early youth (in the first and second years) that the main-stem itself bears needle-shaped leaves.

pally upon this: one portion represents exclusively the vegetative formation, or a certain part thereof; the others represent the degrees of formation which belong exclusively or principally to the sphere of fructification. Hence, in regard to the division of functions, to one portion the functions of nutrition are allotted, to the others those of generation. For this reason the different kinds of shoots of such a partial character must unite in a determinate succession, and complete each other; and even those which we have designated as unessential are of importance in enriching, preserving, and increasing the plant-stock. Finally, we have still to consider those shoot-formations which properly do not belong either to the essential or the unessential succession of shoots, but rather to an *aberrant* formation; as they neither conduce to the perfection of any of the common steps of the metamorphosis, nor perform any essential physiological function in the plant, but at the best are only of some service as organs of defence, support, or adherence. These are the shoots which take the form of thorns, bristles, hooks and tendrils, which for the most part owe their peculiar abnormal character to an entire suppression of the leaf-formation, and a final induration of the point of vegetation: these seem to be the last, terminal or lateral members of the generation, abortive in every respect. Not unfrequently they form the last ramification of paniculate and dichotomous inflorescences, like terminal flowerless peduncles, as *e.g.* in *Teloxys* (*Chenopodium aristatum*, L.), *Acroglochin*, and in a very peculiar form, branching and complicated by aculeate or setiform leaf-formations, in *Pupalia, Desmochæta, Digera* and *Cometes**; also in *Scleropus*, where they take the form of short, thick, cartilaginous stalks, with two converging leaf-apicules. Among the Grasses they are known under the form of bristles in *Setaria*. In many Rhamnaceous and Sapindaceous plants (*Helinus, Cardiospermum*) they appear as small cirrhi; not as the last sterile ramifications of the inflorescence, but on the contrary as the first, followed by other fertile peduncles. They often occur in the axils of foliaceous leaves; and wherever they make their appearance they naturally arrest the further succession of shoots, when they have neither of the two leaves at their origin, out of whose axil an additional shoot may be developed. This is the case in *Passiflora*, whose flower

* The plumose tails which form the "envelope" of *Cometes* are the last branches of the dichotomous inflorescence, accompanied by similar accessory (secondary and tertiary) branchlets. All these numerous sterile branchlets are elongated and beset with setiform leaflets arranged in spiral order ($\frac{2}{5}$), commencing with two similar anterior leaves. The direction of the phyllotaxis in all these branchlets follows the law of furcate inflorescence.

arises from the axil of a leaf situated at the side of the base of the tendril. The thorns of *Ononis, Elæagnus* and *Maclura** present the same phænomenon. In other cases the succession of generation thus arrested by the aculeate shoot is restored by secondary formations; when, with the thorn, a second shoot follows out of the axil, which in some cases may form a leaf-shoot, and in others a flower-shoot. This happens in *Gleditschia*, in several *Acaciæ* (e. g. *A. pulchella*), in *Prinsepia utilis*†, the Lemon, the Egyptian *Balanites, Duranta, Bougainvillea* and *Randia*, in which the secondary shoot arises close under the spine; while in *Celastrus pyracanthus*‡ and *Europæus*, as well as *Pisonia aculeata*§, the secondary shoot occurs above the thorn. In *Uncaria pilosa*|| and *Strychnos spinosa*, pairs of leaves with axillary thorns alternate with pairs which have peduncles in their axils.

Have even these phænomena of extreme alienation of the individual (as they occur in the thorns and hardened shoots of plants) analogous forms in the animal kingdom? Yes, I believe they have! I believe I may assert that in the animal kingdom itself there are individuals which occur as mere fixed claws, pincers, scourges, tactile and predial filaments, &c.—individuals which perform neither functions of nutrition nor of reproduction in the society to which they belong, but which probably merely assist in seizing the food, or lend a helping hand in defending the community. The cases which I have here in mind are of frequent occurrence among Bryozoa, and especially in the group of *Cellariæ*. Individuals in the form of horns (which usually conclude the series of complete cell-inhabiting individuals) occur, *e.g.* in *Eucratea cornuta*¶ and *Cordierii***; in another form (reminding us of *Teloxys*), as forked terminal spines, in *Vesicularia spinosa*††. Moveable individuals, representing mere weapons, in form like a bird's beak, a crab's claw, or a pincers, appear in *Acamarchis avicularia* ‡‡ and *flustroides*§§, *Retepora cellulosa, Scrupocellaria scruposa*|||| and many others. In the last-

* Here belongs also the curious hook of *Uncinia*, which is also visible, though less developed, in many species of *Carex*. The utriculus is a leaf at the base of this spine.

† Royle, Illustr. of the Bot. of Himal. pl. 38. fig. 1.

‡ Boissier, Voy. bot. en Espagne, t. 38.

§ Rheede, Hort. Malab. vii. t. 17.

|| Wallich, Plant. As. Rar. t. 170.

¶ Ellis, *op. cit.* pl. 21. f. 10 (*Cellaria cornuta*); M.-Edw., Ann. d. Sc. Nat. (1838) t. 8. f. 2 (*Crisidia cornuta*).

** Descrip. de l'Egypte, Polypes, t. 13. f. 3.

†† Van Beneden, Rech. sur les Bryozoaires, t. 4. f. c.

‡‡ Van Beneden, *l.c.* t. 6. f. 1–8 (*Cellularia avicularia*, Pall. *Crisia avicularia*, Lamx.).

§§ Ellis, *op. cit.* pl. 38. f. 7.

|||| Van Beneden, *l. c.* t. 5. f. 8–16 (*Cellaria scruposa*, Auct.).

named *Cellariæ*, besides the claw-individuals, there are also scourge-individuals, which Van Beneden himself compared to the cirrhi in plants, and which even Leuckart * acknowledges to be individuals. Besides the 'Swimming-bells' evidently resembling *Medusæ*, the peculiar retractile predial filaments of the *Siphonophora* doubtless belong here also; they are remarkable for a purplish-red swelling on or under the apex, and they shoot out singly as branches from the stalk of the nutritive individual (imbibing-tubes), and themselves bear a series of similarly formed filaments as secondary branches. They are found with unimportant departures from this form, especially in *Physophora* †, *Diphyes* ‡, and *Agalmopsis*. In the last-named genus, according to Sars §, they have even three modifications: the spadiciferous terminal piece ends in a long simple filament, or in a short two-parted one, or without any filament at all. In *Stephanomia* ‖ numerous filaments, called tentacles, arise out of the stalk of the nutritive animals (the so-called proboscis-formed organs) without such coloured swellings, which in the same manner may also be regarded merely as individuals with a very incomplete outfit of organs ¶.

After having in the foregoing review regarded all lateral shoots which spring from the main axis of the plant as real individuals, however unimportant a fraction of the total specific character they may realize, it will hardly be deemed surprising if we finally apply this mode of view to the *branches of the root* and to *adventitious shoots*. It is only possible for the main-shoot to develope freely both the points of vegetation of the axis; yet

* Polymorphism. p. 17.

† Philippi, Müller's Archiv, 1843, taf. 5.

‡ Sars, Fauna lit. Norv. tab. 7.

§ *Ib.* tab. 5.

‖ Milne-Edwards, Ann. d. Sc. Nat. 1841, pl. 7–10.

¶ Since Sars observed the separation of the Medusa-like sexual individuals in *Agalmopsis*, the view that *Siphonophora* are composite animal stocks has gained ground more and more among zoologists. But this mode of viewing the subject was for the first time carried out (after a fashion) consistently in Leuckart's latest work on strange animal forms (Zool. Unters., erstes Heft, Siphonophoren, 1853); and this idea had forced itself upon me as early as 1847, when I compared the description of *Diphyes* with *Agalmopsis*, in Sars' Fauna lit. Norv. In the above-named work, Leuckart extends the view which allows individual importance to the parts of the stock of *Siphonophora*, not only to the tentacles and predial filaments, but also to the covercles, which in most of the genera are placed close above the nutritive individual as protective envelopes; these formations, like all the other appendages of individual importance, being emitted from the stem as shootlets, and in the first stages of their formation, resembling the tentacles in particular. Accordingly the *Siphonophora* have not less than *eight* different forms under which the individual may appear on the whole stock. (Later note.) [I have omitted the enumeration of these forms.—Tr.]

even here the lower point remains undeveloped. On the contrary, the lateral shoots, thus far considered, have no lower point of vegetation; for their base is united to the maternal shoot, and hence they are mere developments of the upper point of vegetation. Opposed to these, there are, however, other shoots by which the lower point of vegetation is represented, and which on the other hand have no upper point of vegetation. Among these may be reckoned not only the root-branches which take their rise from the main root, but also all adventitious roots which spring from the stem at determinate or indeterminate places. I must, however, content myself with this general hint, as any attempt to particularize these relations could after all only show the deficiency of the investigations into this subject, and how desirable a more comprehensive work is on root-formation in the vegetable kingdom.

The few points which I have selected out of the inexhaustible field of shoot-formation in the vegetable kingdom may in the mean time suffice to show that the comparison of the vegetable shoot with the animal individual is not far-fetched or arbitrary, but is presented to us by Nature herself. The solution of the difficulties which this mode of conceiving the vegetable individual encounters in the lowest grades of the vegetable kingdom, I must defer to a later day. These difficulties are founded upon the less complete organization of the inferior plants, and at all events cannot invalidate the results gained in considering the higher organizations. We may therefore consider it settled, that although the individual has not exactly the same importance in the vegetable kingdom as in the animal, plants still realize their vital cycle in sections which are not only comparable to the animal individual, but are in fact its complete analogues. What distinguishes plants is the formation of family-stocks (a formation manifested in the highest vegetable representations, and here in the richest fullness),—as ancestral trees organically connected, variously disposed in their ramifications, and comprising numerous generations, rendered reciprocally complete through individuals variously endowed. And this leads us back again to the tree from which we set out; in which even our natural perceptions seemed to discern something more than one common individual, and whose high import scientific research must confirm. Just what at the outset appeared to be an obstacle to our allowing the single shoots of the tree their true significance,—now that we have compared them with alternation of generation in animals, at length proves to be the most conclusive demonstration of the correctness of our first conception. The conception of these so heterogeneous shoots as individuals of one and the same species has led us, in fact, to a more profound and more pregnant conception of individuality, which will no longer seem paradoxical when we perceive it is confirmed even in the highest realms of life—in the sphere of the mental development of the individual. Or are the differences of human individuals in mental endowment and development less important than those which we have seen in the morphological and physiological endowment and development of shoots? Do we not meet with a similar reciprocal completion, a similar division of labour among the individuals of the family, of the state, and of nations, and cannot even the human individual become likewise a mere organ? Do we not see the development of the human race itself bound up with a succession, in which the later generations continue the edifice their predecessors began, like branches depending upon the earlier stocks and nourished by them;—in which generation is added to generation, and cycles to cycles; so that thus, by the ever-renewed labour of the individual, the problem of human life may be ceaselessly aspired to, and at last reach its final accomplishment?*

* The preceding pages were almost all printed when I was fortunately enabled to read Reichert's memoir (Die monogene Fortpflanzung, Dorpat, 1852), upon a subject closely allied to the one here discussed. His work is full of new views of the subject, elaborated with great acuteness. The vegetable individual itself is considered in detail, and the author is thus led to a mode of viewing this subject similar to the Schultz-Schultzenstein-ian doctrine of *anaphyta*—regarding not only the shoot, but even its single parts, the internodes, with their leaves, as series of individuals shooting out of each other, or intimately connected by continuable bud-formation. Since, however, it is implied in the idea of an individual, that it shall somehow be limited by, and distinguishable from (notwithstanding it is connected with), others, it seems to me that even from this point of view Reichert's idea can by no means be carried out. I will not deny that there are still other considerations in the nature of the shoot which it is difficult to reconcile with the idea of the simple individual, and I can only find the ground of this phænomenon in the fact, that the individual appears in its full import in the higher steps of the series of created beings, while in the lower it loses more and more its reality, if I may so say. I must reserve farther remarks on this subject until I treat of the individuality of the lower plants.

[We cannot but think, after all, that this view of Reichert's, &c., which our author rejects, is the legitimate conclusion, to which the very line of argument so completely and ably presented in the preceding pages, when fully carried out, naturally leads. It is merely a question of *degree* of individuality. As yet, perhaps, no sure middle ground has been secured between the two extreme views,—one of which regards all the vegetative offspring of a seed, however numerously multiplied, as philosophically the individual; while the other views the phyton, or in the simplest lower plants, the cell, as philosophically representing the individual,—real individuality being incompletely realized (and with various grades of incompleteness) in all vegetables, and in many animals. The mind is reluctant to accept either of these conclusions, and seeks—thus far in vain—for some stable intermediate view. Of the two extreme views, if forced to the choice, we should incline to prefer the latter.—Asa Gray.]

XXXII.—*On the young state of* Ophiocoma rosula, *and on the Form and Development of the Spines of this Species.* By T. H. Stewart.

[With a Plate.]

On looking over a maundful of trawl-refuse lately, which was obtained by the fishermen from off the Plymouth coast, and principally from near the Eddystone lighthouse, I found fine specimens of *Salicornaria farciminoides,* around the lower portions of many of which a parasitic sponge* was attached. On tearing apart this sponge to look for the form of the spicula, a number of exceedingly small starfishes were found on it. When I first saw them, I fancied that they were young *Ophiocomæ rosulæ,* and subsequent investigation has proved this to be the case; although on looking at them afterwards with a low power (100 diam.) under the microscope, I was, from the very peculiar form of the spines, led to think them a new species of *Ophiocoma.*

It is an interesting and curious fact, that not only have these young starfishes been found in deep water, as at the Eddystone, which is about 30 fathoms, but also in pools left by the receding tide in limestone rocks under the "Hoe," Plymouth, and in this case also crawling on a soft sponge; and I have not hitherto observed them in contact with any harder material.

The fact of their having been found in two such different localities proves that this *Ophiocoma* spawns both in deep and shallow water. It is also remarkable that they should in each case have been found on sponge, and that those from the deep-water locality were never seen to crawl on the Zoophyte, but were found exclusively on the sponge at the base.

They were not stalked, as the late lamented Prof. Edward Forbes fancied the young of the *Ophiocomæ* might be (however, they may have passed this period), but could crawl about at pleasure, though they did not seem to be very active, and seldom moved unless intentionally disturbed, and were crowded chiefly in the corners of the sponge.

None of them, however, when roughly handled, showed any tendency to break off their arms.

The largest of them did not exceed one-eighth of an inch in diameter, including both the rays and disk.

Their appearance when alive, under the low power of a microscope, was a most interesting sight; and by employing the polarizing apparatus, the colours that the various parts, more especially the spines, exhibited, made them tenfold more beautiful.

* On submitting this sponge to Mr. Bowerbank, whose judgement on such subjects is always appreciated, he not only kindly examined it, but also pronounced it to be a new sponge.

The *disk* in this young state is more pentagonal than in the adult animal. It is of a deep yellowish-brown or purple colour, and it was this part that rendered the starfish evident on the sponges.

The entire starfish was very transparent, so that the movements of the stomach and parts within could be distinctly seen under an inch power (100 diam.).

The disk was spinous, but had the spines more irregularly arranged than in the full-grown starfish. The forms of the spines are those depicted in Pl. XV. fig. 4. They were most distinctly seen on the borders of the disk, between the rays, and all of them had a like typical form, though some differed from others on the same starfish in slight particulars, as the length of the stalk bearing three spinules or secondary spines.

The base of these spines is a flattened disk, and somewhat circular in form; immediately above the base is a contraction, and it then shows a perforated structure; the holes producing these perforations are regular and arranged in the central line. The length of the stalk is rather *less* than half the length of the whole spine. The spine then separates into three prongs or spinules, which are rather *more* than half the length of the whole spine.

These spinules in some spread out wider apart than in others, and in one they approached each other again at the tip. All the spines of the disk are of this form, and they retain the same in the adult *O. rosula*, but as a general rule they are rather longer in the stalk.

If the animal be turned on its back, and examined with a power of 100 diameters by transmitted light, the outline of the stomach is seen to be of a pentagonal form, and has *five* lateral attachments to the inner surface of the body, which are situate between the rays. The outline of the stomach is dark and well defined, and appears like lines passing from one point of attachment to the other; it might be taken at first sight for the nervous system, were it not for the fact, that the meeting of the lines where the nervous threads to the rays would be given off, takes place *between* the rays, and not at their base, as would be the case if it were the nervous system.

The contractions of the stomach were very evident; sometimes the orifice was completely closed, and was then central, and the radiating muscular fibres could be detected. At other times it was dilated quite to the lines indicating the outline of the stomach before mentioned, and at another time much to one side.

The dilating muscle possesses a great deal more power than the contracting one, as the motion of the former was considerably quicker effected.

Within the stomach were seen ten attached club-shaped bodies' similar to the membranous tentacula of the arms, which were in constant motion; two were attached between each dark bundle of spines, or oral cluster, which are situated at the mouth of the disk. They seemed to be contractile, and to draw back to the sides of the stomach, assuming a somewhat globular form.

But what I desire more especially to direct attention to are the spines on the rays; these may be said to be of three kinds:— 1st, those which may be termed palmate or basal spines of the ray, or the first set at the part where the ray springs from the disk (fig. 4); 2ndly, the reticulated spines (fig. 5); 3rdly, the hooked spines (fig. 6).

The first set are shaped somewhat like a hand with the fingers spread out, only minus a thumb: as the greater number have only four spinules, or secondary spines, these are longer and more widely separated from each other than in the second set, and consequently the whole spine is broader. It has a broad, thick, and rounded base, and immediately above the base the spine is narrowed, and then becomes wider again so as to form a constriction at this part; and in fact the spine may be divided into three parts,—the base, the body constricted at the lower part, and the spinous extremities.

The palmate portion of the spine is pierced with irregular holes. The entire spine is covered with a delicate membrane, and this connects the spinules, forming a web, thus giving the spine a strong resemblance to the foot of a frog. In other parts of the spine this membrane is closely attached to it; and where the webbing occurs, the two parts covering the upper and lower portions of the spine come in contact, and thus as it were enclose it in a membranous sac. This membrane is destroyed by boiling in caustic potash.

The spines of the *second* set may be said to occupy rather more than the lower two-thirds of the ray on the under side, and almost the whole of the upper. They are more irregular in their form than the last, especially as regards the number, form, and arrangement of the spinules. Their base is not so rounded and the constriction not so well marked as in the first set. In fact, the spine altogether is not so symmetrical and constant in its shape as either of the others, and is evidently in a transition state, for no two of these spines were alike in form, whilst the first or palmate, and the third or hooked, never varied to any marked extent. In the adult animal, the hooked spines still preserve the form that they had in their young condition, though of course they are proportionately larger.

As the second set of spines grow, they become more regular in form, and the spinules, or what are then the rough serrations, are placed at regular distances, and the spine becomes symmetrical, and assumes that beautiful form depicted in fig. 8; and figured by Prof. E. Forbes, who says, "the lightness and beauty of which might serve as a model for the spire of a cathedral."

The most interesting of all these spines are the *third* set, or hooked ones, which occupy the tip and a portion of the under surface of the extremities of the rays. They are not unlike reaping-hooks, only they have a secondary hook below, just at the point of the junction of the handle and blade. They also have a tubercle below this on the *handle*, but this is never formed into a decided hook like the other two above. It was the existence of these hooked spines that led me to fancy the young *O. rosula* a new *Ophiocoma*. But in order to be quite sure on the subject, and not to make new species without careful investigation, I boiled some older *O. rosulæ* in caustic potash; and on examining the result, I found the same hooked spines to be present.

By examining and comparing the spines of these young with those of an adult *O. rosula*, it will be noticed that the hooked ones do not grow in the same proportion as the rest; for in the adult, though they still keep the same form, they are very small in comparison to the other spines, whereas in the young they are of the same size and serve an important office, viz. enabling these young and feeble starfish to gain a firmer hold of the substance on which they crawl, so that they are not drifted off by every slight force to which they are exposed; and indeed I found that while they were alive it required a considerable effort to separate them from their attachment.

It would appear therefore that these hooks are specially provided for the young condition of the starfish, and is another beautiful instance how Nature modifies parts of the body to meet the special requirements of animals under varying circumstances. These hooked spines have the same rounded base and constriction as the others, and they then form the sickle-like termination.

Parallel with this terminal hook in about the middle of the spine another is formed, which is not so long or large as the terminal one; and at an equal distance below this second hook is a little tubercle, which is not developed into a hook, but is perforated with small holes, as also is the base, giving it when only slightly magnified a granular appearance.

I have never found more than two hooks on a single spine, except in one adult animal, where on one of the spines there were three; but the lowest near the base was very rudimentary.

All the spines are covered with the animal membrane before described, and all the spinules are more or less connected together or webbed by it.

Royal College of Surgeons, October 14, 1856.

DESCRIPTION OF PLATE XV.

Fig. 1. The perfect young *O. rosula*, magnified 100 diameters.
Fig. 2. The under surface of disk as seen when alive, magnified 100 diam.
Fig. 3. The spines of young *O. rosula* from the disk.
Fig. 4. Palmate or basal spines of the ray.
Fig. 5. The reticulate spines.
Fig. 6. The hooked spines from the extremity, and a portion of the under surface of the ray.
Fig. 7. The spines of young *O. rosula*, showing animal membrane.
Fig. 8. Perfect spine of adult *O. rosula*, magnified 100 diam.

XXXIII.—*Monograph of the genus* Catops. By Andrew Murray, Edinburgh.

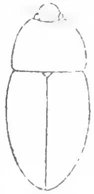
[Continued from p. 318.]

Exotic species.

38. *C. marginicollis*, Lucas.

Catops marginicollis, Lucas, Expl. de l'Algérie, Anim. Art. ii. p. 224. pl. 21. fig. 4.

Fig. 39.



"Capite nigro, granario; thorace subgranario, nigro, ferrugineo marginato, angulis posticis subacuminatis; elytris nigris striatis subtilissimis confertissime punctulatis; corpore infra nigro, subtiliter granario; pedibus antennisque ferrugineis.

"Long. $2\frac{1}{2}$ lin., lat. $1\frac{1}{2}$ lin.

"The head is black, granulated, and scarcely pubescent. The maxillary and labial palpi, as well as the antennæ, are entirely ferruginous. The thorax pubescent, very lightly granulated, black, with the lateral margins ferruginous; it is very gently convex, rounded on the lateral parts, with the angles on each side of the base less projecting, and a little less acuminate than in *C. celer*, Luc. The scutellum is black, granulated. The elytra, of the same colour as the scutellum, pubescent, have a very fine and very dense punctuation; they are striated, and the striæ are sufficiently well marked. All the body below is of a deep brown, and is very finely granulated. The legs are entirely ferruginous*."

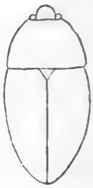
This species was taken by M. Lucas at Oran, in the west of Algeria, under stones, in the end of February.

* Lucas in *loc. cit.*

39. *C. rufipennis*, Lucas.

Catops rufipennis, Luc. Expl. d'Algérie, Anim. Art. ii. p. 224. pl. 21. fig. 3.

Fig. 40.



"Capite nigro, granario; thorace subtilissime granario, nigro, ad latera posticeque rufescente marginato; elytris granariis rufis, ad suturam utrinque unistriatis; corpore infra nigro; pedibus rufis tibiisque fusco-maculatis.

"Long. $2\frac{1}{4}$ lin., lat. 1 lin.

"This is smaller than *C. celer*, from the same country (Algeria), and cannot be confounded with it, on account of the colour of its elytra, which are entirely ferruginous. The head is black, granulated. The maxillary palpi, as well as the labial palpi, are reddish. The antennæ are ferruginous, with the last joints a little brownish. The thorax slightly pubescent, very finely granulated, and tolerably convex; black, margined with ferruginous on the sides and behind; the sides are rounded, as are also the angles on each side of the base. The scutellum is black, pubescent, and very finely granulated. The elytra very pubescent, ferruginous; they are finely granulated, striated, and a sutural stria appears pretty deeply impressed on each side of the suture. The whole body below is black. The legs are of the same colour as the elytra, with the thighs marked with brown, and the tibiæ finely denticulated*."

Met with by M. Lucas on a single occasion, under stones, in the month of January, in the ravines of Djebel Santon, in the neighbourhood of Oran.

40. *C. fungicola*, Kolen.

Catops fungicola, Kolenati, Meletemata Ent. fasc. v. 51.

"Castaneus, nitidus, pubescens, punctulatus; capite brunneo, antennis pedibusque testaceis.

"Long. 0·0025, lat. 0·00133.

"Head blackish-brown, shining, scarcely punctulated; thorax testaceous or chestnut, pubescent, very finely punctulate; elytra convex, chestnut, shining, narrowed behind, rounded, punctulate. Scutellum brown, punctulate.

"Lives in fungi in the woods of Mount Ssarijal, in the province of Elisabethopolis†."

This species is unknown to me, and I place it in this group merely from the colour, none of the characters on which I

* Lucas in *loc. cit.*

† Kolenati in *loc. cit.*

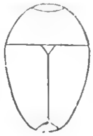
have rested my subdivisions of the genus being mentioned by M. Kolenati.

41. *C. pusillus,* Motsch.

Catops pusillus, Victor Motschoulsky, Bull. Soc. Imp. Mosc. 1840, p. 175.

"Ovalis, cinnamomeus, sericeo-pubescens; thorace transverso, angulis posticis subproductis, lateribus rotundatis; antennis pedibusque dilutioribus pubescentibus.

Fig. 41.



"Long. $\frac{1}{2}$ lin., lat. $\frac{1}{3}$ lin.

"One of the smallest species of *Catops,* and covered with a close golden pubescence. The antennæ are a little pilose, of the length of the head and thorax together, the eighth joint much smaller and shorter than the seventh. The thorax is transverse, rounded on the sides, and when looked at from in front, it appears even a little broader than the elytra; it is cut straight at the base, and has the posterior angles a little projecting backwards. The scutellum is triangular. The elytra are oval, *obliquely emarginate at the extremity towards the suture, with the exterior angle projecting in a point.* On each side of the suture there is an impressed line which reaches a little beyond the half of the elytra. The anterior tibiæ are a very little dilated*."

The emargination of the elytra at the apex of the suture furnishes an easy character for distinguishing this species.

M. Motschoulsky mentions that he took it in spring at Ananur, on the great military route of Georgia, and in the month of August, near Davial, on the same route. It was found under stones, and in the earth, among roots, in obscure places. The specimens which have been recently excluded are often of a testaceous colour.

42. *C. pallidus,* Menetries.

C. pallidus, Menetr. Cat. rais. des Obj. de Zool. rec. dans un Voyage au Caucase, &c., p. 169.

"Oblongo-ovatus, subdepressus, ferrugineus, breviter griseo-pubescens; elytris obsolete punctulatis, apice subacuminatis.

"Long. 2 lin., lat. $1\frac{1}{4}$ lin.

"Found at Bakon†."

The above meagre description is all that we know of this

* Motschoulsky in *loc. cit.* † Menetries in *loc. cit.*

species; it would, however, rather appear to belong to this group.

43. *C. Dauricus*, Motsch.

Catops Dauricus, Motsch. Remarques sur la Collection de Col. Russ. de V. de Motschoulsky in Bulletin de Moscou, vol. xviii. 1845.

"Testaceo-ferrugineus; thorax angustior quam elytra.

"A species remarkable on account of its thorax being much narrower than the elytra, which are of a tolerably broad oval, and acuminate at the extremity. The *facies* approaches nearly the genus *Pteroloma*, but the body wholly removes it. It is of a ferruginous-yellow colour, and is found on the summits of the alps of Hamar-Daban in Mongolia*."

I have not seen this species in nature, and the above description is too short to enable us to form an accurate idea of its form or affinities.

44. *C. basilaris*, Say.

Catops basilaris, Say, Journ. Acad. Philadelphia, iii. 194.

"Niger, brevissima flavescente pubescentia vestitus; elytris brunneis, pallidioribus ad basin.

"Long. $1\frac{1}{2}$ lin.

"Body black, covered with numerous short yellowish hairs; eyes fuscous; antennæ blackish, two basal joints yellowish-white; eighth joint very small, transverse, shortest; the seventh and three terminal joints largest, the latter somewhat piceous; thorax transverse, quadrate, convex, rather narrower before; lateral edge regularly arcuated, basal and anterior edge sub-rectilinear; angles rounded; scutellum triangular; elytra brownish, paler at base; a distinct subsutural impressed line; labrum and palpi pale piceous, beneath blackish piceous; feet dark piceous.

"Found under wood at Engineer Cantonment, on the Missouri†."

I believe it is not known what species Say had in view in describing this. Dr. Leconte, whose knowledge of American entomology is perhaps greater than that possessed by any other naturalist, includes it, in his 'Synopsis of the *Silphales* of America,' among those which were unknown to him. Say's description, I think, seems to point either to an affinity with *C. tristis* or *C. fumatus*, and I place it in this group with doubt.

* Motschoulsky in *loc. cit.* † Say in *loc. cit.*

45. *C. opacus*, Say.

Catops opacus, Say, Journ. Acad. Nat. Sc. Philad. v. 184; Leconte, Syn. Silph. Amer. in Proceedings of Acad. Philad. (1853) 280.

"Ater, punctulatus, subtiliter pubescens; thorace semielliptico, basi late rotundato; elytris obsolete striatis; tibiis calcaribus magnis armatis.

"Long. 2 lin.

Fig. 42.

"New York and Ohio: rare.

"The male has three joints of the anterior tarsi strongly dilated; the middle tarsi are not dilated. The sutural stria of the elytra is deeper than the others*."

46. *C. terminans*, Leconte.

Catops terminans, Lec., Agassiz, Lake Superior, 218; Lec. Synops. Silph. N. Amer. Proc. Acad. Philad. vi. 1853, 282.

"Oblongo-ovalis minus convexus, nigro-piceus, subtiliter pubescens; elytris distinctius rugose punctulatis, stria suturali profunda; thorace breviore, antrorsum valde angustato, angulis posticis vix productis; pedibus fuscis; antennis apice flavis, basi testaceis.

"Long. 1 lin.

Fig. 43.

"Very abundant at the mouth of the Pic river, on the north side of Lake Superior, under dried animal matter. This species is broader and less convex than *C. consobrinus*, and is easily known by the more distinct punctuation, and by the absence of the transverse lines. The thorax is densely and finely punctulate; it is about twice as wide as its length, strongly narrowed in front, rounded on the sides, especially anteriorly, slightly emarginate at apex, truncate at base, and very slightly sinuate at the posterior angles, which are scarcely perceptibly acute. The anterior tarsi of the male, and the first joint of the middle tarsi, are dilated †."

47. *C. monilis*, mihi.

Oblongo-ovalis, fuscus; antennis capite et thorace longioribus, articulo octavo minutissimo, *articulis ante sextum non gradatim crescentibus magnitudine*, fuscis, articulo ultimo et articulis ad basin ferrugineis; thorace leviter, elytris fortiter transverso-strigosis, his stria suturali impressis; pedibus spinosis.

Long. $1\frac{1}{2}$ lin., lat. $\frac{3}{4}$ lin.

Fig. 44.

Oblong-oval, nearly of the same size and form as *C. alpinus*,

* Leconte in *loc. cit.*

† Leconte in *loc. cit.*

brown, a little darker behind and on the middle of the thorax. The antennæ are longer than the head and thorax; the basal joints (first, second, third, fourth and fifth) and the last joint are ferruginous-yellow; the seventh, eighth, ninth and tenth joints blackish-brown; first joint large, and longer than second; second thin and slender, a little longer than third; third, fourth and fifth thin and slender and very short, nearly all of equal length; sixth shorter than these, but rather broader; seventh largest and broadest of the whole; eighth excessively minute; ninth and tenth of equal length and thickness, rather narrower than the seventh, their sides more parallel than is the case in other species; eleventh of the same breadth as the two preceding. Head broad, rugosely punctate; mouth broad, concolorous. Thorax pale on the margins, lightly transversely strigose. Elytra more decidedly transversely strigose, with the suture and a sutural stria somewhat depressed, and indistinct traces of striæ towards the apex. Scutellum equilaterally triangular, somewhat depressed, clothed all over with a concolorous fuscous pubescence; beneath the pubescence the surface is somewhat shining; under side and legs fuscous-brown, paler than above; tibiæ slightly and delicately spinous, middle tibiæ slightly bent.

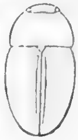
This species has very much the appearance of *alpinus*, but the structure of the antennæ is different. They are longer than in that species. The club also does not gradually increase in thickness from the first joint onwards till it reaches its greatest breadth at the seventh, and then taper away again, as in *alpinus*; the club from the eighth joint to the middle of the last joint is of equal thickness, giving a somewhat moniliform appearance to the club, from which character I have given its name. In *alpinus* the third joint is thicker and longer than the second, while here it is smaller and slenderer. In *alpinus* the fourth, fifth, sixth and seventh joints go on increasing in thickness, while here the third, fourth and fifth form a narrow slender peduncle, all being of nearly equal size; the sixth and eighth joints here are much smaller than in *alpinus*. The pubescence in this species is also darker and duller and more sparing than in *alpinus*.

It was found at Caraccas by M. Sallé, and presented to me by his relative M. Chevrolat.

48. *C. spinipes*, mihi.

Elongato-ovalis, fuscus; antennis capite et thorace vix longioribus, *articulis ante sextum gradatim crescentibus magnitudine*, fuscis, articulis ultimis et primis pallidioribus; thorace leviter et elytris fortiter transverso-strigosis, his stria suturali impressis; pedibus spinosis. Long. 1 lin., lat. ½ lin.

Fig. 45.



A good deal smaller than the preceding (*C. monilis*), to which it has considerable resemblance, but is more elongate in form. The antennæ are not quite so thick; the joints do not continue thin, short and slender from the second to the sixth, but go on increasing in breadth from the second to the seventh; the second and third are nearly of equal length; the fourth and fifth are each shorter than the third, and gradually but slightly increase in breadth; they are all of nearly the same length; the sixth is shorter than the fifth, but not very minute; the seventh is the largest joint in the antenna; the eighth is minute, but not nearly so much so as in *monilis*; the ninth is as broad but shorter than the seventh; the tenth is a little narrower than the ninth, and the eleventh a little narrower than the tenth, otherwise they are nearly of the same size. The antennæ are brown, with the exception of the two first joints which are clear ferruginous, and the three last which become gradually paler to the tip. The head and mouth are broad; the former is rugosely punctate and darker than the rest of the body. The thorax is short, darkest in the middle, transversely rugose. The elytra are very distinctly transversely strigose; there is a sutural stria impressed on them. The scutellum is small, elongate triangular, depressed, and darker than the elytra. The whole body is covered with a dense fuscous pubescence of the same colour throughout, but throwing a reflexion like a lighter band across the elytra towards the apex when viewed in certain lights. The under side is of the same colour as the upper. The legs are paler; they are very distinctly spinose, a character which is found in other species, but which, from being very marked here, I have taken to furnish a suitable name to the species. The middle tibiæ are a little bent. In the males the anterior tarsi are widened, but the middle tarsi are not.

Found at Caraccas by M. Sallé, and presented to me by M. Chevrolat.

Group III.

Mesosternum keeled; middle tarsi alike in both sexes.

1st Subdivision. *Body polished and shining; the elytra not transversely strigose.*

49. *C. lucidus*, Kraatz.

C. lucidus, Kraatz, Stett. Ent. Zeit. xiii. 439. 30.

"Oblongo-ovatus, nigro-piceus, *nitidus*; *antennis pedibusque ferrugineis*; thorace transverso, basi latiore lævi *ad angulos obtusos utrinque distincte sinuato*; elytris flavo-testaceis, apice piceis, passim minus profunde punctatis.

"Long. $1\frac{3}{4}$ lin."

Not having seen this species, I can only reproduce M. Kraatz's description, which is as follows:—

"A new species differing so much from all the species of *Catops* known to me, by its shining glittering upper side and clear yellow elytra, that I cannot class it under any one of Erichson's groups: not only so, but I was not wholly averse to have based a new genus upon it, if in spite of the many differences there was not a form of transition to that of the perfect *Catops* in a species which I possess (the only one hitherto accessible), and a species from Mesopotamia in the Royal Museum (of Berlin) (though in other respects differing little from the *C. lucidus* of this country). The antennæ are nearly of the length of the elytra, entirely of a lively reddish-brown, stout; first joint distinctly longer than the second, and as well as it a little more slender than the remaining joints; third a little stouter than the fourth, nearly as long as the first; fourth, fifth and sixth are reverse cone-shaped, the following joint always somewhat shorter than the preceding; the seventh is equal to the ninth and to the tenth in length, which is the same as the length of the fourth joint, but somewhat stouter; the eighth is somewhat shorter but scarcely more slender than the joints which encompass it; the eleventh is almost of the length of both the preceding, from its base to its last third growing gradually broader, from thence cone-shaped acuminate. The head is black, shining, not punctate; the mouth yellowish-red. The thorax at the base is more than double as broad as long, gradually narrowed from the base towards the front, so that the greatest breadth is before the middle*, gently rounded on the sides; the anterior angles are obtuse, somewhat sloping downwards, the posterior angles likewise obtuse and rounded off; the posterior margin is distinctly sinuate and depressed over the moderately densely finely punctate scutellum, and on each side towards the posterior angles, so that the posterior angles project slightly and are a little reflexed; the upper side is dark pitchy-brown, clearer on the sides and posterior angles, flatly arched, bright shining. The elytra are symmetrical oblong, only feebly narrowed behind, shining pale yellow, brownish towards the scutellum, dark pitchy-brown at the apex, disappearing at some distance, with punctures irregularly arranged in rows and clothed with solitary yellowish hairs; the under side is shining black, not punctured, the last abdominal segment yellow. The legs are lively reddish-brown.

* *Sic in orig.*, viz. "von der Basis an nach vorn allmälig verengt, wodurch die grösste Breite vor der Mitte." It should probably have been, "greatest breadth behind the middle."

"One example from Kuhr, probably found in Dalmatia*."

I am unable to give any description of the species from Mesopotamia above referred to by M. Kraatz.

50. *C. cryptophagoides*, Mannerheim.

Catops cryptophagoides, Mann. Bull. Soc. Imp. Mosc. 1852, pt. 2. p. 333.

"Oblongo-ovatus, convexus, rufo-ferrugineus, nitidus, glaberrimus; antennis extrorsum valde incrassatis pilosis, articulo octavo præcedente multo minore; thorace lævi, antrorsum rotundato, angulis posticis supra elytra rotundato-productis; elytris disperse punctatis, subrugulosis.

"Long. $\frac{2}{3}$ lin., lat. $\frac{1}{3}$ lin.†"

I have not seen this species. M. Pippingsköld collected it in the island of Sitka under a stone.

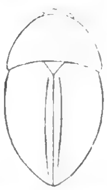
Mannerheim states that in form it comes very near the genus *Colon*, but he rather referred it to *Catops* from the structure of the antennæ, although at the same time differing from both by the polished smoothness of its body. From this indication it should probably rank beside *lucidus*, Kraatz, and I have accordingly placed it in this subdivision.

2nd Subdivision. *Body not polished and shining; elytra transversely strigose.*

51. *C. strigosus*, Kraatz.

Catops strigosus, Kraatz, Stett. Ent. Zeit. xiii. p. 441. 31.

Fig. 46.



Ovatus, rufo-ferrugineus; antennis longioribus, obsolete clavatis, ferrugineis; thorace transverso, angulis posticis fere acuminatis; elytris substriatis, evidenter transversim strigosis, *apice acuminatis*.

Long. $1\frac{1}{2}$ lin.

The antennæ are slender, entirely reddish-brown; first, second and third equal in length; fifth scarcely longer than those on each side of it, half as large as the first joint; seventh somewhat longer and stouter than the foregoing, equal to the ninth and tenth; eighth scarcely half as long and a little thinner than the seventh; eleventh somewhat longer than the tenth, moderately sharply acuminate. The head is red-brown, densely and finely punctate. The thorax is nearly $2\frac{1}{2}$ times as long as broad; at the base it is of the same breadth as the elytra; it is gradually narrowed towards the front, gently rounded on the sides; the

* Kraatz in *loc. cit.*

† Mannerheim in *loc. cit.*

upper side is moderately densely clothed with golden-yellow pubescence, coarsely granulated; the anterior angles are obtuse, sloping downwards; the almost pointed posterior angles project pretty strongly backwards embracing the elytra, so that the posterior margin appears to be strongly sinuated on both sides near the elytra. The elytra are oval, strongly narrowed from the middle towards the apex, each tolerably sharply acuminated, moderately densely and finely pubescent, and deeply transversely strigose, with distinct traces of longitudinal striæ. Under side and legs reddish-brown.

Kraatz says it is of a reddish colour, but the only specimen I have seen was black.

Of the form of the *C. velox*, Spence, approaching most to it, but a little smaller, more acuminate behind, and easily recognizable by its keeled mesosternum; distinguished from the following species by its different form and longer antennæ; and from *C. acicularis*, Kraatz, the only other species of the preceding groups which has transversely wrinkled elytra, by its smaller size and shorter and broader form.

Found in Austria: extremely rare.

52. *C. validus*, Kraatz.

Catops validus, Kraatz, Stett. Ent. Zeit. xiii. 441. 32.

"Oblongo-ovatus, niger, fusco-sericeus; *antennis rufo-piceis, clavatis*; thorace, elytrisque transversim strigosis, apice truncatis.

"Long. $2\frac{1}{2}$ lin.

"This distinct species comes near the following in the form of the body, and only deviates from them by its greater size and the different structure of the antennæ. I confine myself therefore to describing the latter more strictly.

"Antennæ reddish-brown; first joint at least twice as long and half as strong again as the second, somewhat more slender at the base; second very small, at the end nearly as broad as long, somewhat more slender at the base; *third at least three times as long as second*, for the last third part becoming gradually somewhat broader; *fourth equal in length to second*, but somewhat broader; fifth equal to fourth; *sixth somewhat shorter and broader than the eighth*; *seventh somewhat shorter, but just as broad as the ninth*; eleventh distinctly more slender and half as long again as tenth; from the base to the apex conical acuminate, somewhat paler at the tip. Agreeing in other respects with the following species.

"Two examples from Stentz in Hungary are in the Royal Museum, under the name of *C. validus**."

* Kraatz in *loc. cit.*

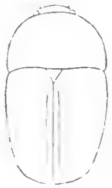
Not having seen this species in nature, I have merely copied the description of Kraatz. In size it is a third larger than the following species; but although that of itself would not be sufficient to constitute it a distinct species, the differences in the structure and proportion of the joints of the antennæ are too great to allow us to hesitate in according it a place as such. The principal differences in these proportions have been printed in italics in the respective descriptions of the antennæ of these species.

53. *C. sericeus*, Fabr.

Catops sericeus, Fabr. Syst. El. ii. 564. 2; Erichs. Käf. d. M. Br. i. 243. 16; Sturm, Deutschl. Fn. xiv. 43. 22. t. 278. f. d. D; Heer, Fn. Helv. i. 384. 21; Redt. Fn. Aust. 143. 1; Kraatz, Stett. Ent. Zeit. xiii. 442. 34; Fairm. & Laboulb. Fn. Ent. Fr. i. 305. 21.
Helops sericeus, Panz. Fn. Germ. 73. 10.
Ptomaphagus truncatus, Illig. Mag. i. 42. 4.
Catops truncatus, Gyll. Ins. Suec. i. 279. 3.
Cholera villosa, Latr. Gen. Crust. et Ins. ii. 29. 5; Spence, Linn. Trans. xi. 152. 12.
Mycetophagus picipes, Kug. Schneid. Mag. 558. 9.
Mordella silphoides, Marsh. Ent. Brit. i. 493. 19.
Var. minor. *Catops sericatus*, Chaud. Bull. de Mosc. 1845, no. 3. 199.

Oblongo-ovatus, niger, fusco-sericeus; antennis brevioribus, nigro-piceis, *ad basin ferrugineis*; thorace elytrisque transversim strigosis, his apice truncatis.
Long. 1–1½ lin.

Fig. 47.



Oval, a little depressed above, of a deep blackish-brown, very silky. Antennæ about as long as the thorax, perceptibly thickened towards the extremity; first joint twice as long as the second; *second and third nearly equal in length and thickness*; *fourth and fifth nearly equal in length, each shorter than second or third*; sixth about the same length as fifth, but decidedly broader, *twice as long as eighth, and not so broad*; seventh a very little longer and much broader than sixth; *eighth less than half as long as seventh, and scarcely less broad*; *ninth and tenth each about the same length as seventh, but broader*; eleventh more slender and half as long again as tenth, and only commencing to be acuminate past its middle; the apex obtuse, reddish-brown, lighter at the base, deeper at the apex. Head black, large, finely punctate. Thorax shining black, finely transversely wrinkled, a little broader than long, somewhat narrowed in front; posterior angles pointed, projecting backwards, which makes the posterior margin broadly arched. Elytra of a brown, more or less dark, finely transversely strigose, becoming narrower from the base to the extremity, which is obliquely truncate. Legs brown; thighs often blackish. Size very variable.

Distinguished at first sight from all the allied species, except *varicornis* and *validus*, by its truncate elytra. From *C. varicornis* it is distinguished by the apex of the antennæ not being light-coloured, and from *C. validus* by its smaller size and by the different proportions of the joints of the antennæ.

Common in Britain, and generally distributed all over Europe.

54. *C. varicornis*, Rosenhauer.

Catops varicornis, Rosenh. Beitr. zur Ins. Fn. Eur. i. 23; Kraatz, Stett. Ent. Zeit. xiii. 442. 33.

Oblongo-ovatus, niger, fusco-sericeus; antennis brevioribus, *basi apiceque ferrugineis*; thorace elytrisque transversim strigosis, his apice truncatis.

Long. $1\frac{1}{2}$ lin.

Closely allied to *C. sericeus*, and principally distinguished by the form and colour of the antennæ, which are shorter and ferruginous both at the base and the apex, and the beetle is usually somewhat darker. The head is broad, finely punctate, shining black with a grey pubescence; the mouth ferruginous-red. The antennæ scarcely reach beyond the half of the thorax, and are thickened on the outer side so as to be distinctly club-shaped. The individual joints are as in the *C. sericeus*, but form a rounder oblong and thicker club. The first five joints are ferruginous-red, those following brownish; the eighth shorter but not more slender than the remainder; the last transverse, short, and very obtuse, much shorter than in the *C. sericeus*, and reddish-yellow. The thorax is large, black, shining, clothed with a silky pubescence, almost square, a little broader than long, of the breadth of the elytra, somewhat narrowed in front, gently rounded on the sides; the posterior angles pointed, projecting slightly backwards, the posterior margin rounded. The scutellum is large, triangular, transversely strigose. The elytra are dark brown, finely transversely strigose, a little arched, somewhat rounded on the sides, moderately narrowed towards the extremity, not so strongly truncate at the apex as in *C. sericeus*, and more rounded, with a fine brownish pubescence. The under side is black; the legs are brown, the tarsi paler.

The pale terminal joint of the antennæ, combined with the general appearance of *C. sericeus*, at once indicates this species. It is also a deeper insect than *sericeus*, and the sides more nearly approach the perpendicular.

Described by Rosenhauer from three specimens found at

Stettin. It has since been found in other parts of Germany, and no doubt is scattered all over the continent. I have not found it in Scotland, but it has been taken by Mr. Guyon near Richmond, and by Dr. Power near London.

Chaudoir's *C. sericatus* is said by Kraatz to be only a small variety of this species. I have not seen it, but I have no doubt he is correct. Chaudoir's description contains no character sufficient in my view to support the establishment of a new species. His description is as follows :—" *C. sericatus*, hitherto confounded with *C. sericeus*. It is constantly three times smaller, more narrowed behind; the elytra narrower; the wrinkles above less marked; the antennæ less enlarged towards the extremity, the last joints more elongate, the eighth a little narrower, the last less obtuse, and of the colour of the preceding. The breast is less convex; the colour of the elytra is lighter towards the extremity, which is almost ferruginous.

" Found at Kiew in spring, under dry leaves at the foot of trees*."

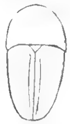
55. *C. colonoides*, Kraatz.

Catops colonoides, Kraatz, Stett. Ent. Zeit. xii. 169. 35.

Oblongo-ovatus, fusco-sericeus; antennis obsolete clavatis, ferrugineis; thorace elytrisque transversim strigosis, *his non truncatis*.

Long. $\frac{7}{8}$ lin.

Fig. 48.



The antennæ are about the length of the head and thorax, imperceptibly thickened towards the point, ferruginous-red; the seventh joint scarcely broader, but at least twice as long as the preceding, always darker-coloured than the remaining joints; the eighth joint somewhat smaller than the sixth; the ninth, tenth, and the acuminate eleventh tolerably equal in size. The head is blackish-brown, finely punctate, with a grey pubescence. The thorax is blackish-brown, somewhat lighter on the extreme posterior margin, extremely densely and finely granulated, about a fourth broader than long, narrowed in front, moderately rounded on the sides; the posterior angles are sharp, projecting backwards. The elytra are dark brownish, towards the apex lighter, finely transversely strigose, covered with a fine silky brown down, gradually narrowed towards the apex. The under side is blackish-brown, the margins of the individual abdominal segments lighter; the legs are ferruginous-brown. Nearly constant in size.

A very distinct species, similar to *C. sericeus*, and, like it,

* Chaudoir in *loc. cit.*

with transversely wrinkled elytra, but smaller than the smallest individuals of that species, and easily distinguished by the wholly different form of the antennæ, by the gradually narrowed and not truncate elytra, and the stronger more distant transverse wrinkling. The club of the antennæ is as a rule somewhat darker, the last joint somewhat larger than the preceding, cone-shaped, acuminate.

Kraatz says that it is taken near Berlin in loose sand at the foot of old oak-trees, and that it is frequent in moors.

[To be continued.]

XXXIV.—*Elucidation of some Plants mentioned in Dr. Francis Hamilton's Account of the Kingdom of Nepál.* By Lieut.-Col. Madden, F.R.S.E., President of the Botanical Society of Edinburgh*.

The possession by the University of Edinburgh of the duplicate herbarium (unfortunately incomplete) and the valuable MS. Catalogue of the Plants collected in Nepál and other parts of India by the late Dr. Francis Hamilton (formerly Buchanan), has recently afforded me the opportunity of comparing them with some which he has introduced into his 'Account of Nepál,' only, or chiefly, by their vernacular designations, which are of no assistance to the English reader. Of the result of this examination I purpose to submit a short statement to the Botanical Society, to the members of which it may prove the more interesting from the fact that, in several cases, the scientific names have not hitherto been given in any, even the latest, works on Indian Botany which have fallen under my notice, although the plants are well known and of general utility in India. Nor will it be considered inconsistent with the object of our meetings, to dedicate a brief space to an inquiry into the botany of a district which engaged the interest and employed the time of this accomplished naturalist†,

* Read to the Botanical Society of Edinburgh, June 12, 1856. The death of the author having occurred since this paper was read before the Botanical Society, it has been printed without the benefit of his corrections.

† The genus *Hamiltonia*, of the order Cinchonaceæ, was devoted by Roxburgh to the memory of this "illustrious peregrinator," as he is called by D. Don. *H. suaveolens* is a shrub of the Rájmáhal and other hills of Behar; and a very beautiful azure-blue variety abounds all along the base of the Himálaya, the *H. azurea* of Wallich, *scabra* of D. Don, *propinqua* of Jacquemont. The flowers are sweetly fragrant till bruised, when they exhale a most fœtid odour, from which the plant derives its Kumáon name

whose late residence, Leny, near Callander, must be familiar to many of our explorers of the romantic scenery of the Trosachs. Dr. Hamilton was, I believe, the first to investigate the botany of Nepál and the adjacent countries, in which he has been zealously succeeded by Wallich, Griffith, and Hooker. I have not myself had the good fortune to visit these regions, and political jealousy has almost sealed Nepál, especially its alpine tracts, to us; but I have traversed its western frontier, and was for several years associated with its military tribes in the service of the East India Company, and have thus been enabled to acquire the popular names of several of the plants in question. I shall not altogether limit myself to those occurring in the 'Account of Nepál,' but shall extend my remarks also to a few of those enumerated in the Catalogue, with respect to which there is reason to think any additional information will be acceptable, or any errors remain to be rectified. Many points must continue undetermined, and will furnish a field of inquiry to future botanists. Dr. Royle has been the most successful investigator of the various sources of the many articles of the Indian Materia Medica, in his valuable 'Illustrations of the Botany of the Himálayan Mountains'; but the origin of many of those contained in his list, published in the 'Journal of the Asiatic Society of Bengal' for October 1832, is still to be made out. With reference to the object before us, the most advantageous plan, perhaps, will be to quote the several passages from Dr. Hamilton's work as they occur, with some regard to the natural sequence of the orders as understood by Dr. Lindley; appending such notices as may be supplied by the Catalogue, and concluding with my own comments.

As Dr. Hamilton always makes use in his Catalogue of the classical names for the various provinces, it may be well to premise that

Magadha	is the modern	Behar.
Mithila	„	Zirhut.
Cosala	„	Oude and Gorakhpur.
Camroop	„	Rangpur and Assam.
Angga	„	North-western Bengal.
Banga	„	Western and Southern Bengal.
Matsya	„	the district of Dinájpur.

of *Padéra*. Dr. Hamilton himself remarks thus on the specific name at No. 694 of the Catalogue:—

"*Hamiltonia suaveolens*. Habitat in sylvis Anggæ et Mithilæ.

"Nomen specificum haud aptum, cum flores, licet aliquando suaveolentes, sæpius, ut in *Pæderia* et *Serissa* affinibus, odorem stercoraceum gravissimum spirant, quod in cæteris ejusdem generis speciebus quoque evenit."

"Pháphar, said by some to be a species of *Amaranthus*, called Amardáná in the low country; but others say that this is a mistake.

"Uyá, which I presume is rye, the natives saying that it is neither barley nor wheat, but has a resemblance to both."

The chief grains of Kullu, a hill province north of the Sutlej river, now a British possession, were reported to Dr. Hamilton to be Pháphar, Chuyá, and Uyá: "The Chuyá, from the description given, would seem to be the *Holcus Sorghum*, although the coldness of the situation renders this doubtful" (pp. 274, 275, 315).

The Uyá is the *Hordeum cœleste*, well known to the residents of Simla as the Uá jáo, or Uá barley, being in high estimation in the preparation of cakes.

Pháphar or Pháphra is the *Fagopyrum rotundatum*, Bab. (*emarginatum*, No. 1688, Wall.), near *F. tataricum*; it is known as Bitter Buckwheat, and is very generally cultivated in the higher and colder sites of the Himálaya; *Fagopyrum vulgare* (or *esculentum*), No. 1687, Wallich, being common lower down, and known as Ogal or Ogla, and Kotu (not Kultu); distinguished from the last as Sweet Buckwheat*. Chuyá and Anárdáná are one and the same: *Amaranthus anardana*, No. 2028 of the Catalogue (exclude synonym *Amaranthus frumentaceus*, Hort. Beng. 67?). "Anárdáná Hindicе. Colitur in arvis Cosalæ et Nepalæ;" and at Bhágalpur on the Ganges, according to Moquin in DeCandolle. Anárdáná implies the supposed resemblance of the grains to the carpels of the Pomegranate. I never met any one who used the name, and incline to think Amardáná, as Dr. Hamilton once writes it, may be the true one, meaning 'immortal grain,' and therefore nearly identical with *Amaranthus*: nothing can better answer to the appellation than this species, which is grown all over the Himálaya, and is also known as Marsá and Báthu. It rises six to eight feet high, and is either of a brilliant crimson or a rich yellow. The effect of a mountain-side, terrace above terrace, covered with distinct fields of these colours, and glowing under the rays of the afternoon sun, is gorgeous indeed; but as an article of food, it must be confessed the reality falls far below the promise of the eye. *Amaranthus caudatus* is occasionally cultivated for the same purpose, and is, in Garhwál, called Rámdáná, 'the grain of God.'

Cynosurus corocanus: Maruya of Nepál: now *Eleusine coro-*

* There is considerable discrepancy in the description of the Himálayan Buckwheats given by Don (Prod. Fl. Nep. pp. 73, 74. Nos. 21, 22, 23), Babington (Linn. Trans. xviii. 93 *seq.*), and Meisner (Pl. As. Rar. vol. iii.). I am only acquainted with two cultivated species, the Ogal and the Pháphar, as noticed in the text.

cana, everywhere cultivated in the British Himálaya as Manduá or Maruá. *E. stricta* is also grown in Garhwál.

Holcus Sorghum. Kaunguni, Muccai, or Muruli,—the first being the Newar name (*i. e.* of the aboriginal Mongolian population), the last two those of their Parbatiya or Hindoo conquerors, also a mountain race. Generally, however, Kanganí is *Panicum italicum*, and Muccai (Makkai) *Zea Mays*: it is probably a term of Indian origin, but the Mohammedans suppose it to be so termed because Maize came to them from Mecca; of this fact it is but a very slender corroboration that the French call the same corn 'Blé de Turquie.' *Sorghum vulgare* is little cultivated in the mountains, but *Sorghum saccharatum* is occasionally seen about Almorah.

Panicum colonum. Tangni, Tangri, or Kakun, p. 231.

Sabe, referred to *Ischæmum*, a grass of the Nepál Tarai, growing in great quantities, and exported to the British territories for the manufacture of ropes (p. 64).

No. 2324. *Ischæmum Sabe.* Sabe, Hindice. Habitat in Mithilæ campis ubi legitur ad ligamina foliis nectanda. (Specimen from Náthpur.)

No. 2325. *Ischæmum sparteum.* Sabe, Hindice. Habitat in Magadhæ montosis. Ad usum eundum cum præcedente inservit. (Specimen from Ghoramára.) These two plants are identical; *Spodiopogon laniger*, No. 8845 B. of Wallich's Catalogue, Nepál, 1821, being there referred to a new genus, "*Erianatho* affine." In 1850 I found it stacked in large quantities on the bank of the Ganges at Bhojpur and Monger in Behar, where the owners called it Sába, Sáma, and Sábar, and informed me that it was brought down from the Rájmáhal Hills, south, and from those of Tirhut, north—the localities specified by Dr. Hamilton. Dr. Royle (Illustrations, p. 416) states that *Spodiopogon laniger* is "one of the grasses found in the northern as in the southern parts of India." In Kumáon it occurs as far in the mountains as Almorah, and up to an elevation of 5000 feet, flowering in April. Mr. Edgeworth informs me that it is abundant in the *ráos* or hot-water courses of the Sewálik and lower ranges of the Himálaya in the Pinjor Dun, below Simla, up to 3000 feet; there, as throughout Northern India, it is termed Bán (a word which in Shakespeare's Hindustani Dictionary is erroneously identified with Munj), and is well known as a common material for making rope, which is much used, especially for the bottoms of beds and similar purposes. Dr. Royle adds that *Eragrostis* (*Poa*) *cynosuroides* is employed for rope-making: under the names Darbh (Dabh) and Kusa, it plays an important part in the religious ceremonies of the Bráhmans, and, when young, it is a favourite food of cattle; but any other destination has not fallen under my observation. *Eriophorum* (*Trichophorum*) *comosum,* Wall., *cannabinum,* Royle, called Bábar and Baib, and *Saccharum* (*Erianthus*) *Munja,* also yield excellent material for cordage (the latter requiring the preliminary process of being pounded); but we are indebted to Dr. Hamilton for having indicated the importance of *Spodiopogon laniger* as supplying one of the textile articles of Indian produce.

Kshir Kangkri, or Titi Píráln; a *Lilium* or *Pancratium* (p. 86).

No. 855. *Pancratium sylvestre.* Titi Piralu montanorum, Hindice. Habitat in sylvis Nepalæ inferioris. (Marked in the margin *Allium cumaria.*) From Chatera, April 1810. There is no specimen in the Herbarium, but Wallich believed it to be his No. 8974, *P. verecundum.* Dr. Hooker met "a very sweet-scented *Crinum*" in the Sikkim Tarai, perhaps identical with this.

Dr. Royle (Illustr. p. 374) has a *Crinum* (*C. Himalense*) from Mansár, in the interior of the Himálaya; and the late Dr. M'Gregor assured me that he had found one wild in the valleys near Sabáthu.

Dr. Hamilton, however, states that the true Titipirálu (which signifies the bitter bulb or *Colocasia*) consisted of the dried scales of a tuberous root, having every appearance of being a species of *Lilium.* Of this genus, as well as of *Fritillaria,* many species inhabit Nepál, and among them *L. japonicum,* sometimes called *L. Wallichianum,* known in Kumáon as Findora, a corruption of Pindálu. "The bulb-scales of *Lilium japonicum* dried are said to be employed in China, like salep, in pectoral complaints." (Royle, Illustr. 388. Figured, Wight's Icones, t. 2035.)

According to some of his informants, the Kshir Kangkri is one of the *Cucurbitaceæ*; this is borne out by the signification 'juice of the cucumber;' perhaps *C. Hardwickii,* which is called Air-álu in Kumáon, and Pahári Indráyan, Hill Colocynth, in Garhwál, from its bitterness. Royle, t. 47. f. 3.

Amomum: Desi Eláchi, large Nepal Cardamom, with membranous angles (pp. 74, 75).

No. 13. *Amomum? aromaticum,* Hort. Beng. 1; Roxb. Fl. Ind. i. 44. Alaichi montanorum in Nepala. Colitur inter montes Nepalæ. (To this is added at a subsequent date),—To this probably belonged the specimen received from Surat, which Linnæus considered as the true *Cardamomum.* (Linn. Trans. x. 252.)

There is no specimen in the Herbarium. In Dr. Christison's valuable collection of Materia Medica, this species is named "Java Cardamom, Pereira, ed. iii. p. 1135. From *Amomum maximum,* Roxb. Java and Bengal." I observed it exposed for sale in considerable quantities at Barmdée, a mart on the western frontier of Nepál, where it was said to come from Dotî, a province bordering Kumáon to the east. Roxburgh (*l. c.*) describes *Amomum aromaticum*, Morang Elachi, as a native of the valleys on the eastern frontier of Bengal, with an ovate capsule, the size of a large nutmeg; those of Dotî are much smaller.

"Sínggíya Bikh or Bish (of the lower mountains and hills, p. 98), much celebrated among the mountaineers. The plant was brought to me in flower, but was entirely male; nor did I see the fruit, which is said to be a berry. So far as I can judge from these circumstances, I suppose that it is a species of *Smilax* with ternate leaves. To pass over several of its qualities that are marvellous, the root, which resembles a yam, is said to be a violent poison. The berries also are said to be deleterious, but when applied externally are considered as a cure for the goître," p. 87.

No. 2219. *Smilax? virosa.* Sínggíya Bish vel Bikh montanorum, Hindice. Habitat in Nepalæ montibus. Identified by Wallich with No. 5099 of his Catalogue, *Dioscorea virosa*, which Dr. Royle informs us occurs also in Garhwál and Sirmur under the name of Rámberee (the divine Zizyphus). It is remarkable in this genus from having its stems furnished with aculei; and Dr. Royle calls our attention to the fact that this species, with *D. triphylla*, *pentaphylla*, and *dæmona*, all with compound leaves, are distinguished by the acridity of their tubers*. Sínggíya a Bikh, signifying 'horned poison,' alludes to their curved form in *D. virosa*†.

No. 220. *Smilax? narcotica.* Bharbang montanorum, Hindice. Habitat in Nepala inferiore ad montium radices.

This is identified by Wallich with the preceding.

* Roxburgh (iii. 806) and Graham (Cat. of Bombay Plants, p. 218) agree that the tubers of *D. pentaphylla* are wholesome, and used as an esculent. Graham tells us that the root of *D. triphylla*, "intoxicating and intensely bitter," is often sliced and infused in toddy to render it more potent. It occurs in Kumáon as high as 6000 feet; *D. dæmona*, with equally nauseous tubers, only reaches to 3000.

The root Charmaghás, so often mentioned in the Sanscrit dictionaries, has not been identified. I found it sold at Barmdee by the Nepalese traders; but my specimens were destroyed by the 'Fish insect,' *Lepisma saccharina*, the scourge of our Indian libraries and herbaria. It may be the Shám, or root of *Chærophyllum esculentum*, mentioned in Royle's 'Illustrations,' which is probably the Chamaas, "a wild edible root used as a relish" by the people of Rol, near the Shátul Pass, Basehar (Lloyd and Gerard, i. 293). The *S. nálika* implies a plant with a tubular stem: *saptalá*, having seven leaves.

† The vernacular Sing, 'a horn,' softened from the Sanscrit Sringa, gives the origin of the Arabic and Persian word for ginger, Zinjabíl, from which the Greek Zingíberis is derived. The common source of all is the Sanscrit Sringavéram, signifying 'antler-shaped;' and it is remarkable that this classical name, as well as that (Nalada) from which the ancients formed their term (Nardos) for spikenard, is no longer used in the Indian dialects, being superseded by some of the many synonyms.

Pinus Picea, W. Common Spruce Fir. Hingwál Ka Ch'hota Saral, *i. e.* Small Alpine Pine, pp. 83–96.

No. 2064. *Pinus striata* : *Pinus Picea,* Hamilton's Nepal, 83, 96. Hingwál Ka Ch'hota Saral (Alpium parva Pinus), Hindice. Habitat in Nepalæ alpibus. On the label, "leaves very odorous." This is *Picea Webbiana,* and is identified by Wallich, No. 5058 (for 6058), *Pinus Webbiana* : *P. striata,* Ham.

Neither Wallich nor Hamilton has the Himálayan Spruce (*Abies Smithiana,* or *Morinda*) from Nepál; it is also absent from Kumáon, but is common both east and west of these provinces.

P. excelsa is figured by Wall. Pl. As. Rar. iii. t. 201; but t. 216, *P. Smithiana,* errs in exhibiting the cones *erect.*

Catalogue, No. 2063. *Pinus Strobus.* Gobiya Saral montanorum, Hindice. Habitat in Nepalæ alpibus. (The native name belongs to the last.) Weymouth Pine, p. 83. *Pinus excelsa,* which is very near to *P. Strobus.* In Lambert's 'Description of the genus *Pinus,*' it is characterized as follows :—"This species approaches so near in habit and in the figure of its cones to *P. Strobus,* that were it not for the simple round membranous crest of the anthers, it would be almost impossible to distinguish their limits as distinct species. The leaves of this species are considerably longer than those of *P. Strobus,* and the cones larger." *P. Strobus* has "antherarum crista omnium minima è setis duabus erectis brevissimis." Mr. D. Moore of Glasnevin informed me that it is, in Ireland, less hardy than *P. excelsa.* A variety of this in our Horticultural Society's Garden, with short leaves, removes one of the differences on which Lambert relies. Colonel Markham (Shooting in the Himálaya, 213, 214) says that, in Kunáwar, "torches are made from the Cheel Pine, which, being full of turpentine, burns beautifully, and gives a capital light. . . . . . The gum of the Cheel is held in great estimation for its healing qualities throughout the hills." So Hooker, Journals, ii. 45.

The Salla of Dr. Hamilton is *Pinus longifolia,* also called Chír, a species occasionally introduced into our Pineta, but quite unfitted to endure the severity of our winters, being a semi-tropical plant.

It is observable that Dr. Hamilton nowhere mentions the Deodár, which he could scarcely have failed to procure had it been indigenous to Nepál. When in India, with very scanty materials for an opinion, I came to the conclusion that we have no evidence of its existence till we come to Garhwál, though it is usually quoted as a native of Nepál: a reference to Dr. Wallich's Catalogue establishes the correctness of this conclusion, for under his No. 5060 (for 6050?) we have "*Pinus Deodara,* Roxb. a Kamaon, R. B. (Robert Blinkworth). ? *β.* ex horto quodam ad Pátan in Nepalia, 1821." But even in Kumáon, where fine groves occur, the tree is clearly introduced.

Juniperus: Dhupi. Alpine Nepal. No. 2280. *Juniperus squamosa.* Dhupi montanorum, Hindice. Hamilton's Nepal, 96. Habitat ad Emodi nives: labelled, "Thibet Hills." So Wallich, No. 6043. *J. squamosa,* Ham. Gosainthán, Chur. The common species of the Himálaya, with considerable diversity as found in the dry or the rainy districts. The description of the Dhupi in the 'Account of Nepal,' p. 96, can, however, only agree with *Juniperus excelsa*: "A very large tree." "Its wood has a beautiful grain, a fine mahogany colour, and a remarkably pleasant scent, a good deal resembling that of the pencil Cedar, but stronger, and I think more agreeable. Planks of this are sent to Thibet, from whence they are probably carried to China." Dhup signifies 'incense.'

Juniperus: a low bush; Thumuríya Dhupi. "Branches and leaves have an agreeable smell, and are used in fumigations," p. 96.

No. 2279. *Juniperus? incurva.* Thumuriya Dhupi montanorum, Hindice. Hamilton's Nepal, 96. Habitat ad Emodi nives. No. 6042, Wallich. *Juniperus recurva,* Ham., identified with his *J. recurva.* Gosainthán. Dr. Hamilton's specimen quite resembles some of the north-western forms of *J. squamosa,* and has neither the hue nor the pendulous branchlets of the *J. recurva* of our collections, which is certainly not a native of the British Himálaya. Dr. Hooker (Journals, ii. 28, 45) calls it the weeping Blue Juniper, and figures it as a tree 30 feet high, in Upper Sikkim, but comparatively scarce.

Catalogue, No. 2067. *Cupressus sempervirens.* Bhairopati, Hamilton's Nepal, 97. Habitat in Nepalæ alpibus. Labelled, "Brought from the alps of Thibet: said to be a shrub." ("Its dried leaves have a disagreeable sulphureous smell," p. 97.) The name is here given, 'Bhaingropati;' and in p. 97, Bhairopati (*i. e.* Siva's leaf) is said to be a *Rhododendron.* Wallich (No. 6041) identifies Dr. Hamilton's specimen with *Juniperus excelsa*; and has *Cupressus torulosa* (No. 6046) only from Nítí in Garhwál. I have stated elsewhere, on the authority of the late Mr. J. E. Winterbottom, that he had obtained it from Gosainthán in Nepál; but he subsequently discovered that his specimens were those of a Juniper. Dr. Hamilton's plant has the branches four-sided, agreeing with Don's "quadrifariam imbricatis" of *C. torulosa* (Prod. Fl. Nep. 55) and with my own observation. Lambert says, "ramulis teretibus," perhaps from a young state of the plant.

Hingwál Ka bará Saral: the Yew, according to Dr. Hamilton, confirmed by his specimen No. 2281. *Taxus baccata falcata.* Yew-tree, Anglorum. Híngwál Ka bara Saral montanorum, Hind. Hamilton's Nepal, 83, 96, 117. Habitat in Nepalæ alpibus. The name signifies 'great Alpine Pine,' and is certainly misapplied, probably by the carelessness of the collectors; as 'small Alpine Pine' cannot belong to *Picea Webbiana.* They have most likely been interchanged.

Zuccarini* constitutes a distinct species (*Taxus Wallichiana*) for the Himálayan Yew; but though the leaves are more curved, and the berries smaller than in our European tree, the difference is so trifling, that, with our knowledge of such a marked variety as the Irish Yew generally reproducing the common form, a new species seems uncalled for. Dr. Hooker (Journals, ii. 25) holds that the Himálayan, the North American, and several connecting links, all belong to *Taxus baccata*; he tells us (i. 186) that the red bark is used as a dye, and for staining the foreheads of the Bráhmans in Nepál. The timber found by Layard in the palaces of Nineveh, and pronounced by him to be Cedar, is in reality Yew.

Dr. Wallich (No. 6054, and Tent. Flor. Nep. t. 44. p. 57) identifies *Taxus baccata falcata* of Nepál with *Taxus nucifera* of Kaempfer from Japan, an oversight which has been set right by Zuccarini, as well as by the fact that no one has hitherto detected that plant or other *Taxus* in any part of the Himálaya. Dr. Wallich has indeed, in "No. 6056, *Taxus? Lambertiana,* Wall. Pini spec. Wall. Herb. 1824. Himálaya, Webb, Govan, Kamroop." No specimen exists in the collection here; but from Lambert's genus Pinus iii. t. 67, we know it to be *Pinus* (*Picea*) *Pindrow.* "Dr. Wallich, who had seen neither flowers nor fruit, supposing it to be a *Taxus,* has doubtfully referred it to that genus under the name of *Taxus Lambertiana,* in the Catalogue of his Herbarium. It does not appear to have been found in Nepál, but is frequent in the countries to the westward, having been observed in Kumáon by Captain W. S. Webb, and in Sirmore and Garhwál by Drs. Govan and Royle." Dr. Thomson (Western Himálaya and Tibet, p. 86) considers it one species with *Picea Webbiana*: "The long green-leaved state is that of the moist Himálaya; in the driest regions the very short glaucous-leaved form occurs." The Himálayan chain from Kumáon to Baséhar on the Indian face is annually drenched with rain; and still more the various detached outliers, Dudutoli, Chur, &c., rising above 11,000 feet. Everywhere in this tract, so far as my observation extends, the Pin-

* Morphology of the Coniferæ, 52, 53, in Reports and Papers on Botany, printed for the Ray Society, London, 1846.

drow alone will be found up to about that elevation, when in a few hundred feet it yields to *P. Webbiana.* Owing to this lofty habitat, *P. Webbiana* is stimulated into premature growth by our early springs, and often cut down by subsequent frosts; the Pindrow, though from a lower zone, is not liable to this accident.

The preparation of a kind of tea from the Yew-tree is, I think, peculiar to the Himálaya, and it is remarkable that so dangerous a plant should have been selected. Col. Markham (Shooting in the Himálaya, p. 115) thus describes its use in Kashmir: "There is a capital substitute for tea, in the inner bark of the Yew-tree, dried and prepared like tea. The colour is perfect; but I never could find much taste in the infusion, although one of my friends once said that he liked it better than tea." It is for this reason that, in Kunáwar, *Taxus baccata* is called Sang-chá = Sang *tea*, perhaps connected with the name of the mountain Sung-lo in Kiangnan, "famous in China as being the place where the green tea shrub was first discovered, and where green tea was first manufactured*."

Of the popular idea of the great age attained by this tree, I met with a curious illustration in 1851, when an Irish gardener repeated the following as being an ancient composition taught him by old people. Three years being the age assigned to the unit, the total comes to 2187:—

Tri saoghail muic, saoghal con;
Tri saoghail con, saoghal eich;
Tri saoghail eich, saoghal aufhir;
Tri saoghail aufhir, saoghal seade;
Tri saoghail seade, saoghal iolair;
Tri saoghail iolair, saoghal au iur.

In English.

Three lives of a pig = life of a dog;
Three lives of a dog = life of a horse;
Three lives of a horse = life of a man;
Three lives of a man = life of a path (or furrow);
Three lives of a path = life of an eagle;
Three lives of an eagle = life of a yew.

[To be continued.]

---

* Fortune's Tea Countries of China, 86.

XXXV.—*Notice of a New Subgenus of* Helicinadæ. By Dr. J. E. Gray, F.R.S.

There is an inclination, in several groups of Marine Univalve Mollusca, for the animal to form a more or less deep notch or fissure on the hinder part of the outer lip, as in the genera *Pleurotoma, Amphibola, Pleurotomaria,* and *Siliquaria*; this notch appears to be formed to facilitate the entrance and exit of the water from the respiratory chamber. Sometimes the slit, or a series of holes which may be considered as an interrupted slit, is placed more in front, as in *Haliotis*; or when the shell is symmetrical, as in *Emarginula,* it is in the centre of the front edge. Some shells which are normally destitute of this notch are liable to a malformation exhibiting it, as is the case in the common *Littorina littorea.*

I had never observed any indication of such a conformation in any terrestrial mollusk until Mr. Damon of Weymouth kindly showed to me some specimens of a species of *Helicina* he had received from Cuba, under the name of *Trochatella regina,* which have this notch most perfectly developed, and as it indicates a peculiar structure in the animal, I propose to separate it from the group hitherto recognized in the family *Helicinadæ,* as a distinct subgenus. Dr. Pfeiffer has considered it as forming a peculiar section of the genus *Trochatella,* but none of the other species of that genus show any inclination to this peculiarity.

I may here remark, that some species of this family have a notch or very narrow slit in the front of the outer lip near the axis, but this slit appears to have no relation to the notches or slit referred to in the other genera, being merely formed by a process in the front of the outer edge of the operculum, a peculiarity I have not observed in any other family of Mollusks.

Hapata.

Shell conical, subglobose; spire conical, acute, whorls striated; aperture semiovate; outer lip expanded, with a deep sinus in front and a deep wide notch in the hinder part of the outer edge. Pillar-lip callous, straight in front, without any anterior slit. Operculum half-ovate, annular, thin, horny; nucleus in the middle of the inner straight edge; covered internally with a thick, smooth, shelly, callous coat.

Hapata regina = *Trochatella regina,* Pfeiffer, Pneum. Mon. 328; Cat. Phanerop. Brit. Mus. 236.

Hab. Cuba.

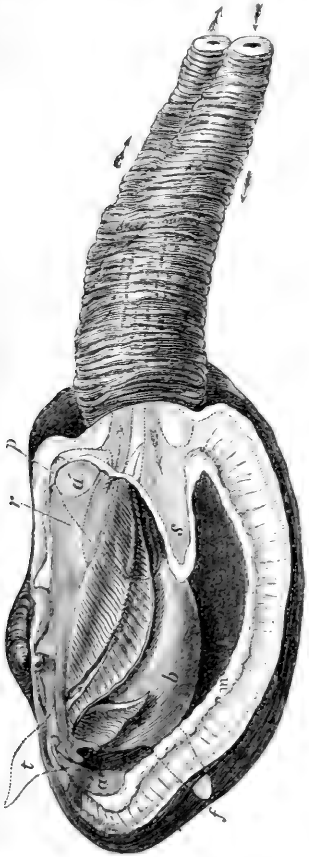
PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

November 27, 1855.—Dr. Gray, F.R.S., in the Chair.

On Panopæa Aldrovandi, Lam. By S. P. Woodward, F.G.S.

The specimen of *Panopæa Aldrovandi*, preserved in spirits, and now exhibited to the Zoological Society, was presented by Capt. Guise to the Gloucester Museum, and was lent me for examination through the kindness of J. W. Wilton, Esq., of Gloucester.



Panopæa Aldrovandi, *Lam.*
(*Chama glycimeris*, Aldr.)
One-fourth natural size.

a, a', Adductor muscles.
p, p', Pedal muscles.
r, Position of renal organ.
t, Labial tentacles, or palpi.
b, Body.
f, Muscular foot.
m, Pallial muscle, or retractor of the mantle.
s, Siphonal muscle.

The arrows indicate the inhalant, or branchial siphon, and the exhalant or anal siphon, communicating with the channels above the gills.

This species is found at Sicily, and on the south coasts of Spain and Portugal; but not, so far as we are aware, at Mogador or the Canaries.

On the coast of Sicily, according to M. Philippi, it is rare, and only found between La Trezza and Aci Castello. M. H. Crosse, who purposely visited this locality, found a rocky beach in which it could not possibly live, and the only spot where the fishermen were acquainted with it was the village of Giardini, near the sandy bay of Taormina; even there only odd valves were procured, and he says it would be exceedingly difficult to obtain the animal on account of the absence of tides*.

Capt. Guise has favoured me with the following note:—

"The *Panopæa* was collected, together with many of the rarest forms of Mediterranean Mollusca, by the Rev. L. Larking, on the coast of Sicily; the animal, when alive in a vessel of sea-water, was a most lively mollusk—slashing its siphons about, and discharging the water with the force of a piston."

There appears to be no description of the animal published. Philippi had not seen it, nor Valenciennes, at the time he wrote the monograph of the genus for Chenu's 'Conchological Illustrations.' Being the type of the genus *Panopæa*, I was the more desirous of examining it, especially as British naturalists have taken their notion of *Panopæa* from the British shell called "*Panopæa Norvegica*"—which it now appears does not belong to the genus, or even to the same family, but must be referred to *Saxicava* amongst the *Gastrochænidæ*.

In *P. Aldrovandi* all the visible portion of the mantle and the long united siphons are clothed with thick, brown *epidermis*, striped with black, and very much wrinkled by the contraction of the animal in alcohol: it was impossible, without dissection, to see whether the orifices of the siphons were fringed as in *Mya*. The anterior gape of the shell exhibits an oval space, perforated in the centre by a small pedal orifice, scarcely large enough to admit the little finger.

By lifting up one valve and removing the portion of the mantle within the pallial line, the internal organs were seen and sketched.

The body is large and oval, suspended by four muscles whose attachments are close to those of the adductors; it is truncated in front, where it supports a small finger-like muscular foot; behind it is produced into a blunt point.

The *oral palpi* are triangular and pointed, but were probably larger and broader during life; they are deeply plaited inside, with a plain posterior border.

The gills are two on each side; the *inner* gills extend from the base of the respiratory siphon to the palpi, between which they are received; they are deeply plaited, the plaits being in pairs, and the lower edge of the gill is grooved. The inner dorsal margins are not united to the body, so that the dorsal channels are only closed by the apposition of the parts.

The *outer gills* are simpler in structure, being formed of a single series of vascular loops placed one behind another; the free edge is not grooved, and the gill terminates in front some way behind the

* Journ. Conch. vol. ii. 1851.

inner gill. The dorsal margin of the outer lamina is expanded beyond the line of suspension, and is fixed.

The gills of the opposite sides are united to each other behind the body and to the branchial septum.

The whole structure is closely like that of *Mya arenaria*, the chief differences being the shortness of the palpi, and the inequality of the gills.

There are nine other reputed recent species of *Panopæa*.

1. P. ABBREVIATA, Val.; discovered by M. d'Orbigny on the coast of Patagonia between the R. Negro and S. Blas. This shell appears to have been again met with by the U. S. Exploring Expedition, under Commander Wilkes, and is described by Dr. Gould as *P. antarctica*.

2. P. ZELANDICA, Quoy; of which an odd valve only was picked up on the beach.

3. P. SOLANDRI, Gray; probably the same as the last.

4. P. AUSTRALIS, G. Sby. (Genera of Shells, pl. 40. f. 2), one of G. Humphrey's shells from New South Wales; of which there is a series in the British Museum, from Tasmania.

5. P. AUSTRALIS, Val. (not Sowerby's).

This species is as large as *P. Aldrovandi*, and very like it. Being quite distinct from the *P. australis* of Sowerby, it is proposed to call it *P. natalensis*.

It was discovered in the sandy bays of Port Natal, by Capt. Cecile and the officers of the French frigate 'Heroine,' who observed the tubes of the shell-fish projecting through the sand at low water.

"The sailors endeavoured to draw the creature out of its habitation by the tube, but in vain; for the siphons, after offering considerable resistance, in every instance gave way, and often were withdrawn entire, in spite of the grasp of its persecutor. Curious to know the nature of the being which thus escaped them, they dug for it with spades, and at length uncovered the *Panopæa* buried several feet below the surface of the sand, and gregarious*."

6. PANOPÆA JAPONICA, A. Adams, Zool. Proc. for 1849, p. 170. pl. 6. f. 5. This species, of which the original and unique example is in the Leyden Museum, is much like the fossil *P. intermedia* of the London clay.

7. PANOPÆA GENEROSA, Gould; Puget Sound, Oregon. (U. S. Expl. Exped.)

8. PANOPÆA NORVEGICA, Spengler, is found throughout the Arctic seas, from Behring's Straits to Newfoundland, the North Sea and Russian Lapland.

I was so convinced of the affinity of this shell to the *Saxicava*, that (in my Manual) I placed the latter genus next to *Panopæa*; it now appears that I should have left it in its former place with *Gastrochæna* and have removed the *Panopæa norvegica* to it. The shell differs from *Panopæa* in having the pallial line broken up or divided

* Forbes, i. p. 174, from Valenciennes' Archives du Muséum, t. i. 1839.

into a number of separate spots, and the animal has very long tapering gills, prolonged far into the branchial siphon.

9. Panopæa middendorffii, A. Adams, Zool. Proc. for 1854, p. 137. Arctic Seas. (Haslar Museum.) Appears to be a variety of *P. norvegica*.

The Geographical Distribution of the genus *Panopæa* affords an illustration of the rule, or "law," so earnestly investigated by the late Prof. E. Forbes,—that the range of *genera*, as well as of *species*, depends in great measure on their geological antiquity; and that when the members of a group are scattered over the greater part of the world, we may expect to find evidence of their existence in the intervening spaces during a former age. M. d'Orbigny describes 139 extinct species of *Panopæa*, commencing in the *Permian* age, and occurring in every part of the world where secondary or tertiary strata have been found.

December 11, 1855.—Dr. Gray, F.R.S., in the Chair.

Characters of Two New Species of Tanagers. By Philip Lutley Sclater, M.A.

1. Dubusia auricrissa.

Dubusia cyanocephala? Sclater, P. Z. S. 1855, p. 157.

D. supra flavescenti-olivaceo-viridis: capite nuchaque cæruleis: loris nigris: subtus cærulescenti-cinerea: tectricibus subalaribus et ventre imo crissaque cum tibiis vivide aureo-flavis.

Long. tota 6·5, alæ 3·6, caudæ 3·0.

Hab. in Nova Grenada, Bogota.

Obs. Species *D. cyanocephalæ* simillima, sed rostro minore, colore dorsi flavescentiore olivaceo, capitis cæruleo magis extenso, ventre cærulescenti- neque albescenti-cinereo, et tectricibus subalaribus necnon ventre imo crissoque cum tibiis vivide aureo-flavis.

Since compiling the list of Bogota birds, in which I have included this species under the name *Dubusia cyanocephala*?, I have examined D'Orbigny's types of that bird in the Paris Museum, and find them so different from the present as to lead me to conclude that they are specifically distinct.

The present bird—which must be considered as the representative of *D. cyanocephala* in the mountain ranges of New Grenada—is common in collections from Bogota. The British Museum contains examples of both the species. Those of *D. cyanocephala* were procured by Mr. Bridges in Bolivia.

2. Iridornis porphyrocephala.

Tanagra analis, Tschudi in Mus. Berolinensi.

I. supra purpurea, dorso imo et marginibus alarum et caudæ viridescentibus: fronte, loris, mento summo et regione auriculari nigris: gutture late et læte aureo-flavo: pectore summo purpurascente: ventre viridescente, medialiter rufescenti-ochraceo: ano intense *ferruginescenti-castaneo: tectricibus alarum inferioribus viridescentibus: rostro superiore nigro, inferiore albo.*

Long. tota 5·6, alæ 3·0, caudæ 2·2.

Hab. in Nova Grenada et rep. Equatoriana.

Obs. Affinis *Iridornithi anali*, sed capite dorsoque summo purpureis, pectore purpurascente et ventre viridescente facile distinguenda.

When at Berlin in 1854 I first noticed a specimen of this Tanager, which is in the Museum there under the name "*Tanagra analis*, Tschudi." But having just before that had the opportunity of examining type specimens of the latter bird in the collections of Brussels and Bremen, I saw at once that the present was to all appearance a distinct although closely allied species, and accordingly assigned to it a new name in my MS. At Neufchatel I again saw Tschudi's *analis* (the types described in the *Fauna Peruana* being contained in the Museum at that place), and I was also so fortunate as to obtain by exchange, through the courtesy of M. Coulon, the Directeur of the Museum there, a duplicate example of that species. Upon comparing this with a skin lately received by Mr. Gould along with other birds from the neighbourhood of Quito, I find the same differences as I had previously noted in the Berlin Museum specimen; and, fortified by a second example, no longer hesitate to introduce the bird as new to science under the title of *Iridornis porphyrocephala*.

February 12, 1856.—Dr. Gray, F.R.S., in the Chair.

On the Genus Assiminia (Leach). By Dr. J. E. Gray, F.R.S., P.B.S. etc.

In a list of some species of British shells at the end of an arrangement of Mollusca in the 'London Medical Repository' for 1821 (vol. xv. p. 239), I noticed a new mollusk under the name of "*Nerita* (*Syncera*) *hepatica*, n. s. The animal of this shell differs from all others of this order by the eyes appearing to be at the end of the tentacula, but I believe that they are placed on a peduncle as long as the tentacula, and the peduncle and tentacula are soldered together."

Dr. Leach, when he examined the animal of this shell, formed it into a genus under the name of *Assiminia*, and named the species after myself as *A. Grayana*, described under this name at the end of the genus *Limnea*, in Fleming's 'British Animals,' p. 275 (1828), who observes, "Dr. Leach sent me several years ago a shell from Greenwich marshes, constituting a new freshwater genus, under the title *Assiminia Grayana*. The lip is thickened on the pillar and reflected over the cavity, but is destitute of the oblique fold, and the lip does not extend over the body whorl. The colour is brown; whorls six in number, conical, regularly increasing in size, glossy, with minute lines of growth. Length about $\frac{2}{10}$ths of an inch."

In my paper "On the Difficulty of distinguishing certain genera of Testaceous Mollusca by their Shells alone, and on the Anomalies in regard to Habitation observed in certain species," published in the 'Philosophical Transactions' for 1835, p. 301, I observe: "About fifteen years since I first observed in the marshes near the bank of the Thames, between Greenwich and Woolwich, in company with species of *Valvata*, *Bithynia* and *Pisidium*, a small univalve shell, agreeing with the smaller species of the littoral genus *Littorina* in every character both of shell and operculum. Yet this very peculiar and, apparently, local species has an animal which at once distinguishes it from the animal of that genus and from all Ctenobranchous Mollusca. Its tentacula are very short and thick, and have the eyes placed at their tips, while the *Littorinæ*, and all the other animals of the order to which they belong, have their eyes placed on small tubercles on the outer side of the base of the tentacles, which are generally more or less elongated. The shell in question and its animal were described and figured by Dr. Leach in his hitherto unpublished work on British Mollusca, under the name of *Assiminia Grayana*, and as this name has been referred to by Mr. Jeffreys and other conchologists, it may be regarded as established, and that of *Syncera hepatica*, proposed by myself in the 'Medical Repository,' vol. x. p. 239, will take rank as a synonym. A second species of this genus has lately been made known by Mr. Benson, by whom it was found on the ponds in India. Its shell is banded like that of *Littorina 4-fasciata* and several other smaller *Littorinæ*, and has been figured in the Supplement to 'Wood's Conchology,' t. 6. f. 28, under the name of *Turbo Francesiæ*."

In my edition of 'Turton's Manual,' 1840, p. 88, I characterize the genus thus:—*Assiminia*: Shell ovate, conical, solid; mouth ovate; tentacles very short, scarcely longer than the tubercles on which the eyes are placed, and united to their side, p. 78, f. 4, 5, 6, observing, "the animal differs from *Littorina* in the apparent position of the eyes, which is an anomaly among the water and Ctenobranchous Mollusca;" and after quoting Mr. Berkeley's description of the tentacula I observe,—"I am inclined to retain my former theory, for if the pedicel of the eye of this genus is minutely examined, it will appear to be formed of two parts united by a suture."

In 1852, having obtained permission of the family, I printed Dr. Leach's 'Molluscorum Britanniæ Synopsis' above referred to, and he there described the genus—"ASSIMINIA. Testa conica, spira mediocris. Animal tentaculis duobus brevibus, apice paulo angustioribus obtusis, ad apicem oculigeris, instructum; oculi parvi, rotundi; operculum tenue."

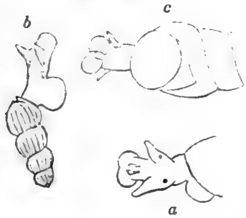
"From the form of the shell this genus might be considered as belonging to the second stirps (*testa conica, spira brevis*), but the animal proves that it is more nearly allied to *Sabanæa* than to any other of the British genera." (p. 155. t. 9. f. 4, 5.)

Lately some doubt has been attempted to be thrown on the distinctness of the genus, which it has been proposed should be united to the genus *Truncatella* of Risso.

Considering the very great similarity which often exists in the general appearance of the animals of very distinct genera of Mollusca,—a similarity so great, that if a person was to place before me, without the shell or operculum, the animal of the genera *Murex, Triton, Pur-*

pura, Fasciolaria, Columbella, &c., I should not be able to distinguish one from the other without the examination of the teeth or the lingual membrane, and that would only enable me to separate *Triton, Cassis* and *Fasciolaria* from each other and from *Murex, Purpura* and *Columbella*, and not the three latter genera from each other; and it is the same with the animals of several other orders and families;—

Fig. 1.



1. *Truncatella truncatula β.*
a. With foot extended, in the act of drawing up the shell.
b. Side view.
c. Seen beneath as crawling up a glass, when the muzzle is exserted.

Fig. 2.

2. *Assiminia Grayana.*
a. Under side of animal and shell.
b. Side view.
c. Front of foot, showing how the lower lamina of the foot projects beyond the upper.

yet the animals of the two genera *Assiminia* and *Truncatella* (see figs. 1 and 2) proposed to be united, are so unlike in general appearance, minute structure and habit, that it is extraordinary that any person should have made the proposal.

I think the best way to show the distinction of these two genera will be to copy, in addition to the extract already given, the figures (see figs. 1 and 2) and descriptions of the animals given in different authors, commencing with Mr. Lowe, who has figured and described the animal of *Truncatella* in the fifth volume of the 'Zoological Journal,' and Mr. Berkeley's description and figure of the animal of *Assiminia*; then the description of the animal of the Indian species of the latter genus, both printed in the volume above referred to; and, lastly, some extracts of additional peculiarity of the genus *Truncatella*, observed by Mr. Clark, and published in his work on British Mollusca.

"1. Truncatella. R. T. Lowe, Zool. Journ. v. 299. t. 19. f. 4.

"*Tentacula* (2 *contractilia*) *cylindrico-conica, brevia, obtusa, basi distincta, proboscide separata; oculis sessilibus paullo supra basis angulum externum positis. Caput proboscidiforme exsertum. Os ad extremitatem proboscidis cylindricæ, inter tentacula exsertæ, disciformem, supra emarginatam* (*sc. bilobam, ob buccas labiales in proboscidem ipsam coadunatas vel commutatas*). *Pallium collare siphone nullo; orificio ad dextrum corporis ut in* Helice, Melampode, Pedipede, *&c. Pes rotundatus vel ovalis, brevis, minimus, posticus. Operculum corneum simplex, i. e. non spirale, ovale, aperturam testæ omnino claudens. Testa turrita; adulta cylin-*

drica, decollata vel truncato-obtusa; anfractibus distinctis, vel lævibus vel transverse costatis. Apertura ovalis, brevis; peritremate continuo. Labrum simplex. Epidermis nulla.

Animal littorale, amphibium, sed revera marinum et branchiis spirans. Ingredienti, discus terminalis proboscidis pro pedis parte antica servit; itaque modo fere larvarum Phalænidarum Geometrarum gradibus alternis incedit. Testa junior, tereti-acuminata, e pluribus anfractibus quam adulta constat; prioribus in plerisque demum (ut in Hel. Bulimo decollato) *defractis, truncata evadit.*

"It is now nearly three years (1829) since the acquisition of a single live specimen of *Cyclostoma truncatulum*, Drap., and a long and continued observation of its animal, convinced me that it was entitled to rank as a distinct genus from any which were then constituted. I had accordingly designated it in my MSS. by the generic name of *Herpetometra*; derived from its peculiar manner of crawling. This appellation I had since purposed changing into *Truncatella*, the very name by which I find the self-same species designated by Risso in his 'Histoire Nat. &c. de l'Europe Méridionale.' In this work, however, the genus rests, like very many others of the same writer, on most unsubstantial ground, the animal being entirely neglected."

"Assiminia. Berkeley, Zool. Journ. v. 429. t. 19. f. 4.

"*Voluta denticulata*, Mont. (*Carychium Myosotis*, Michaud, Compl. de l'histoire de Drapard.), and *Assiminia Grayana*, Leach, abound under stones in the salt marshes by the Thames at Gravesend. Having an opportunity of examining both in a living state in the summer of 1832, I was surprised to find manifest indications that both were pulmoniferous, which were confirmed on a minute inspection of the internal structure, as far as perhaps could be expected in such small animals. I was enabled in the former to trace distinctly the course of the vessels, and was decidedly of opinion that the lungs were constructed for the breathing of air unmixed with water. In the other case I was not so successful, though the utmost pains were taken; but as the animal is only half the size, the difficulty was much increased. I am enabled, however, to assert, that I could detect nothing like branchiæ; and what is more to the point, that the vault of the cavity of respiration was traversed by a multitude of minute vessels all tending one way towards a large vessel running down in the direction of the heart, which is exactly the structure in *pulmoniferous Mollusca*. This, perhaps, will be esteemed as decisive when the external characters of the animal are taken into consideration."

"Assiminia Grayana.

"Foot broadly obovate, obtuse, composed evidently of two distinct laminæ, the lower projecting beyond the upper, and separated from it by an accurately defined line; above fuscous, beneath olivaceous, shaded with cinereous. Tentacula very short and obtuse, fuscous; eyes at the tips. Muzzle porrected, not truly proboscidiform, deeply notched in front, fuscous, strongly annulated; the edge of the lip paler; on each side is a groove running backwards from the base of the tentacula. Mantle open behind. Fæces elliptical (as in *Cyclostoma*). Operculum corneous, ovate, spirally striated. The most remarkable circumstance in this animal is the position of the eyes, at the tips of the tentacula, as in *Helix* and its allies, and not at the base. It would appear as if there were in reality no tentacula, and only the tubercle common to many Mollusca at the base of the tentacula a little more developed than usual. The shell is so like that of some species of *Rissoa*, that it is quite surprising that in Dr. Fleming's 'British Animals,' and in Mr. Jeffreys' paper in the 'Linnæan Transactions,' it should be placed in, or close to, the genus *Limnæa*. Dr. Leach seems to have formed his conclusions from an actual inspection of the animal, and consequently made a distinct genus for its reception. In many points the animal resembles very much that of *Cyclostoma*, and is perhaps a step nearer than that and *Helicina*, which have the mantle open behind, to the *Pectinifera*. Its nearest ally, however, amongst the *pectiniferous Mollusca* I should conceive not to be *Rissoa*.

The animal and shell are figured in Forbes and Hanley's 'British Mollusca,' iii. 70, t. 71. f. 3, 4, and t. H.H. f. 6.

"Mr. Benson, at page 463 of the same volume of the Zool. Journ., has given the following description of the animal of *Assiminia fasciata* (*Turbo Francesii*, Gray, in Wood's Supplement, t. 6. f. 28): —"Animal: Head with only two short, thick, subcylindrical tentacula, with the percipient points placed at their summits. Snout, like that of *Paludina*, transversely corrugated and bilobed, or rather emarginate at the centre of the extremity, the lobes rounded. Mantle free, and branchial cavity open. Foot with a spiral horny operculum, angular at the upper part."

I may add to these descriptions that Mr. Clark has lately stated that the tentacula of *Truncatella Montagui* are "short, flat, broad, triangular, and diverge greatly, scarcely forming an angle of 25°. The eyes are large and black, and have white prominent pupils, which visibly dilate and contract. I have never observed such in any mollusk, though similar ones may have escaped notice; they are placed a little nearer to the base than the middle of their lower half, not on pedicles, but quite flat on the centre of semicircular expansions of the outer side of the tentacles, with an external tendency. The branchial plume is single, of an elongated, kidney-shaped figure, and has the usual constriction or sinus at the end nearest to the heart; it can be detected with high powers in sunlight, through the body volution of pale, clear, thin shells."

The eyes of *Truncatella littorea* "are precisely those of *T. Montagui*, and a similar white pupil is a singular coincidence."

In conclusion, I may observe, that I regard the general form and organization of the animal and shell of *Truncatella* as so peculiar, that I have long considered it the type of a peculiar family, characterized by the form of the lips and feet, the mode of walking, the short, broad, diverging tentacles, the position of the eye and its peculiar form, and the truncation of the shell.

On the other hand, the general form of the animal, the manner of walking, and habitation of the genus *Assiminia* are so like those of some of the smaller species of *Littorina* (which Dr. Leach named *Sabanæa*), that if it was not for the peculiar position of the eye on its long pedicel I should have been inclined to have considered it as a subdivision of that genus, with very short tentacles and elongated eye-peduncles. But Mr. Berkeley's observations have set that at rest, as well as the distinction between it and *Truncatella*; for he shows that *Assiminia* has lungs like *Cyclostoma*, or rather *Helicina*, while the *Littorinæ* and *Truncatellæ* have well-developed gills for respiration, like the greater part of the marine genera; but the gills of *Littorina* and *Truncatella* are very unlike one another, the gills of the former being broad, short, laminar, and of the latter, single, ovate, and pectinate.

P.S.—Messrs. H. and A. Adams, in the number of their work issued since this paper was read, are so impressed with the peculiarity of the combination of characters that the animal presents, viz. a pulmonary respiration, spiral operculum, and terminal eyes, that they have formed for the genus a suborder named *Prosophthalma*, and a particular family, *Assiminiadæ*: see Genera of Mollusca, 313.

MISCELLANEOUS.

ON CLAUSILIA ROLPHII AND MORTILLETI.

I HAVE lately received the first part of Adolf Schmidt's 'Kritischen Gruppen der Europäischen Clausilien,' containing the groups allied, severally, to *Cl. ventricosa*, Dr., *plicatula*, Dr., *rugosa*, Dr., and to the true *gracilis*, Rossm., and placing *Cl. ventricosa*, *Rolphii*, Leach, and *tumida*, Ziegl., in the first group, while *lineolata*, Held, *plicatula*, &c. are assigned to the second.

I am also indebted to Mr. Woodward for a further supply of *Clausiliæ* found by Mr. Sharman at Charlton in Kent. These all prove to be of the form found by Mr. Prentice at Charlton Kings near Cheltenham, and assigned by A. Schmidt to *Cl. Mortilleti*, Dumont. Early in June I called M. Schmidt's attention to the fact of his having altogether ignored *Cl. Rolphii*, as a substantive species, in the Prodromus published in the 'Malak. Blätter' of the present year. It now appears that, after some doubt whether Gray's description did not apply to *Cl. lineolata*, he had finally arrived at the conclusion that the plate presented a better outline of the form of the shell to which he had referred under the name of *Mortilleti*, and which he had received from Mr. Prentice, through his brother, from England, where *Cl. lineolata* had not been detected. *Clausilia Rolphii* therefore appears as a substantive species, with *Cl. Mortilleti* as a synonym.

On a review of the single large specimen first received from Mr. Woodward, and which I regarded as the type of *Cl. Rolphii* (Annals for July 1856, page 75), and on further examination of A. Schmidt's amended characters, remarks and figure, I am disposed to consider the two Woolwich forms as being variations of *Rolphii*; the peculiar form of the subcolumellar plica, and other characters, not admitting of the union of either with any other allied species. The specimen formerly in question must for the present be considered as a large and unusual variety, or accidental deviation from the general type of *Cl. Rolphii*. This deviation is particularly observable in the form of the spire, in the less-developed basal crest, and in the more narrowly rimate and contracted periomphalus. There is also no trace of the slight palatal callus, vanishing towards the base, which is observable in the ordinary form found in other English localities and on the continent.—W. H. Benson.

On the Origin of Greensand, and its Formation in the Oceans of the present Epoch. By Prof. J. W. Bailey.

As an introduction to the subject of this paper, it is proper to refer to various observations which have been made of facts intimately related to those which I wish to present. That the calcareous shells of the Polythalamia are sometimes replaced by silica, appears to have been first noticed by Ehrenberg, who, in a note translated by Mr. Weaver, and published in the Philosophical Magazine for 1841 (vol. xviii. p. 397), says:—

"I may here remark that my continued researches on the Polythalamia of the Chalk have convinced me that very frequently in the earthy coating of flints, which is partly calcareous and partly siliceous, the original calcareous-shelled animal forms have exchanged their lime for silex without undergoing any alteration in figure, so that while some are readily dissolved by an acid, others remain insoluble; but in chalk itself, all similar forms are immediately dissolved."

The first notice of *casts* of the cells and soft parts of the Polythalamia was published by myself in the 'American Journal of Science' for 1845, vol. xlviii., where I stated as follows:—

"The specimens from Fort Washington presented me with what I believe have never been before noticed, viz. distinct *casts* of Polythalamia. That these minute and perishable shells should, when destroyed by chemical changes, ever leave behind them indestructible memorials of their existence, was scarcely to be expected, yet these casts of Polythalamia are abundant and easily to be recognized in some of the Eocene marls from Fort Washington." This notice was accompanied by figures of well-defined casts of Polythalamia (*l. c.* pl. 4. fig. 30, 31).

Dr. Mantell also noticed the occurrence of casts of Polythalamia and their soft parts preserved in flint and chalk, and communicated an account of them to the Royal Society of London, in May 1846. In this paper he speaks of the chambers of Polythalamia as being frequently filled with chalk, flint, and *silicate of iron* (Phil. Trans. 1846, p. 466). To Ehrenberg, however, appears to be due the credit of first distinctly announcing the connexion between the Polythalamia and the formation of greensand, thus throwing the first light upon the origin of a substance which has long been a puzzle to geologists. In a notice given by this distinguished observer upon the nature of the matrix of the bones of the Zeuglodon from Alabama (see Berlin Monatsbericht, February 1855), he says :—

"That greensand, in all the numerous relations in which I have as yet examined it, has been recognized as due to the filling-up of organic cells, as a formation of stony casts (Steinkernbildung) mostly of Polythalamia, was stated in July of the preceding year." He then refers to the Nummulite limestone of Traunstein in Bavaria, as rich in green opal-like casts (Opalsteinkernen) of well-preserved Polythalamian forms, and mentions them as also occurring, but more rarely, in the Glauconite limestones of France. He then proceeds to give an account of his detection of similar casts in the limestone adhering to the bones of the Zeuglodon from Alabama, and states that this limestone abounds in well-preserved brown, green, and whitish stony casts of recognizable Polythalamia. This limestone is yellowish, and under a lens appears spotted with green. These green spots are the greensand casts of Polythalamia, and they often form as much as one-third of the mass. By solution in dilute hydrochloric acid, the greensand grains are left, mixed with quartzose sand, and with a light yellowish mud. The latter is easily removed by washing and decantation. The casts thus obtained are so perfect, that not only the genus, but often the species of the Polythalamia can be recognized. Mingled with these are frequently found spiral or corkscrew-like bodies, which Ehrenberg considers as casts of the shells of young mollusks.

With reference to the perfection of these casts of the Polythalamia, and the light they throw upon the structure of these minute animals, Ehrenberg remarks :—

"The formation of the greensand consists in a gradual filling-up of the interior space of the minute bodies with a green-coloured, opal-like mass, which forms therein as a cast. It is a peculiar species of natural injection, and is often so perfect, that not only the large and coarse cells, but also the very finest canals of the cell-walls, and all their connecting tubes, are thus petrified and separately exhibited. By no artificial method can such fine and perfect injections be obtained."

Having repeated the experiments of Ehrenberg upon the Zeuglodon limestone, I can confirm his statements in every particular, and would only add, that besides the casts of Polythalamia and small spiral mollusks, there is also a considerable number of green, red, and whitish casts of minute anastomosing tubuli, resembling casts of the holes made by burrowing sponges (*Cliona*) and worms.

In the Berlin Monatsbericht for July 1855, Ehrenberg gives an account of very perfect casts of Nummulites, from Bavaria and from France, showing not only chambers connected by a spiral siphuncle, but also a complicated system of branching vessels. He also gave at the same time an account of a method he had applied for the purpose of colouring certain glass-like casts of Polythalamia, which he had found in white tertiary limestone from Java. This method consists in heating them in a solution of nitrate of iron, by means of which they can be made to assume different shades of yellow and brownish-red, still retaining sufficient transparency when mounted in balsam to show the connexion of the different parts.

The interesting observations of Ehrenberg, which are alluded to above, have led me to examine a number of the cretaceous and tertiary rocks of North America in search of greensand and other casts of Polythalamia, &c. The following results were obtained:—

1st. The yellowish limestone of the cretaceous deposits of New Jersey, occurring with *Teredo tibialis*, &c., at Mullica Hill, and near Mount Holley, is very rich in greensand casts of Polythalamia and of the tubuliform bodies above alluded to.

2nd. Cretaceous rocks from Western Texas, for which I am indebted to Major W. H. Emory, of the Mexican Boundary Commission, yielded a considerable number of fine greensand and other casts of Polythalamia and tubuli.

3rd. Limestone from Selma, Alabama, gave similar results.

4th. Eocene limestone from Drayton Hall, near Charleston, South Carolina, gave abundance of similar casts.

5th. A few good greensand casts of Polythalamia were found in the residue left on dissolving a specimen of marl from the Artesian well at Charleston, S.C.; depth 140 feet.

6th. Abundance of organic casts, in greensand, &c., of Polythalamia, tubuli, and of the *cavities of Corals*, were found in the specimen of yellowish limestone adhering to a specimen of *Scutella Lyelli* from the Eocene of North Carolina.

7th. Similar casts of Polythalamia, tubuli, and of the *cavities of Corals*, and spines of Echini, were found abundantly in a whitish limestone adhering to a specimen of *Ostrea sellæformis* from the Eocene of South Carolina.

The last two specimens scarcely gave any indications of the presence of greensand before they were treated with dilute acid, but left an abundant deposit of it when the calcareous portions were dissolved out. All the above-mentioned specimens contained well-preserved and perfect shells of Polythalamia. It appears from the above, that the occurrence of well-defined organic casts, composed of greensand, is by no means rare in the fossil state.

I come now to the main object of this paper, which is to announce that the formation of precisely similar greensand and other casts of Polythalamia, mollusks, and tubuli, is now going on in the deposits of the present ocean. In an interesting Report by Count F. Pourtales, upon some specimens of soundings obtained by the U.S. Coast Survey in the exploration of the Gulf Stream (see Report of U.S. Coast Survey for 1853, Appendix, p. 83), the sounding, from lat. 31° 32′, long. 79° 35′, depth 150 fathoms, is mentioned as "a mixture in about equal proportions of Globigerina and black sand, probably greensand, as it makes a green mark when crushed on paper." Having examined the specimen alluded to by Count Pourtales, besides many others from the Gulf Stream and Gulf of Mexico, for which I am indebted to Prof. A. D. Bache, the Superintendent of the Coast Survey, I have found that not only is greensand present at the above locality, but at many others, both in the Gulf Stream and Gulf of Mexico, and that this greensand is often in the form of well-defined casts of Polythalamia, minute mollusks, and branching tubuli, and that the same variety of the petrifying material is found as in the fossil casts, some being well-defined greensand, others reddish, brownish, or almost white. In some cases I have noticed a single cell, of a spiral Polythalamian cast, to be composed of greensand, while all the others were red or white, or *vice versâ*.

The species of Polythalamia whose casts are thus preserved, are easily recognizable as identical with those whose perfectly preserved shells form the chief part of the soundings. That these are of recent species is proved by the facts that some of them still retain their brilliant red colouring, and that they leave distinct remains of their soft parts when treated with dilute acids. It is not to be supposed, therefore, that these casts are of extinct species washed out of ancient submarine deposits. They are now forming in the muds as they are deposited, and we have thus now going on in the present seas, a formation of greensand by processes precisely analogous to those which produced deposits of the same material as long ago as the Silurian epoch. In this connexion, it is important to observe that Ehrenberg's observations and my own, establish the fact that *other* organic bodies than Polythalamia produce casts of greensand; and it should also be stated that many of the grains of greensand accompanying the well-defined casts are of wholly unrecognizable forms, having merely a rounded, cracked, lobed, or even coprolitic appearance. Certainly many of these masses, which often compose whole strata, were not formed either in the cavities of Polythalamia or mollusks. The fact, however, being established beyond a doubt, that greensand does form casts in the cavities of various organic bodies, there is a great probability that all the masses of this substance, however irregular, were formed in connexion with organic bodies, and that the chemical changes accompanying the decay of the organic matter have been essentially connected with the deposits in the cavities, of green and red silicates of iron, and of nearly pure silica. It is a curious fact in this connexion, that the *siliceous* organisms, such as the Diatomaceæ, Polycistineæ, and Spongiolites which accompany the Polythalamia in the Gulf Stream, do not appear to have any influence in the formation of casts.

The discovery of Prof. Ehrenberg, of the connexion between organic bodies and the formation of greensand, is of very great interest, and is one of the many instances which he has given to prove the extensive agency of the minutest beings in producing geological changes.—*Proc. Bost. Soc. Nat. Hist.* vol. v. p. 364.

On the Cumæ. By Prof. Agassiz.

In a recent number of the 'Annals and Magazine of Natural History,' Mr. Bate describes some Crustacea related to *Cumæ*, which had young, and *therefore were adults.* This is not in conflict with the statement of Prof. Agassiz in this Journal, vol. xiii. p. 426, where he says, "In regard to the Crustacea called *Cumæ*, I cannot say positively that the group must as a whole be suppressed. But I can state with confidence, that all the species of that genus which I have had an opportunity to examine alive—and I have watched three—are young of *Palæmon, Crangon* and *Hippolyte*." Prof. Agassiz, in a recent letter (to J. D. Dana, dated Nahant, July 18th) respecting these observations of Mr. Bate, writes that "they only show how extensive a field of observation remains untrodden among these little forms. Had Mr. Bate looked more fully into the embryology of Crustacea, he would have been better prepared to appreciate the close correspondence there is between the young of certain families and the adults of others, and would have known that these facts are not limited to the Macroura, as I have shown in my Lectures on Embryology, p. 62–69: he would know that the eyes of even the highest Crustacea are sessile in the young, &c., and that such characters observed upon young Crustacea do not therefore prove them to be peculiar types, unless at the same time their reproduction be satisfactorily traced. Acknowledging Mr. Bate's interesting observation as proving that his *Diastylis Rathkii* is an adult animal, the question has made a real progress through his researches; but it remains as certain as before, that *there are Cumæ which are larvæ of Macroura*."—*Silliman's American Journal,* Sept. 1856.

NOTE ON CALLITRICHE HAMULATA.

To the Editors of the Annals of Natural History.

October 13, 1856.

Gentlemen,—While lately in Scotland I had the satisfaction of finding the *Callitriche hamulata* (Kütz.) growing in a ditch communicating with the river Annan, close to Jardine Hall.

The specific character of the *C. pedunculata,* as given in Babington's Manual (ed. 4. p. 293), applies accurately to the *C. hamulata,* with the exception of the supposed want of bracts in the former plant.

On mentioning the subject to Mr. Babington, he informed me that he had detected bracts on cultivated plants of his *C. pedunculata, β. sessilis,* and convinced himself that that plant is *C. hamulata.* He considers *C. hamulata* (Kütz.) as the type of the species, and the *C. pedunculata* (DC.) to be a variety of it.

My discovery does not therefore increase the number of our species, but only corrects the nomenclature by identifying a doubtful plant with a known continental species. This is a highly satisfactory result.

I may add that Mr. Babington mentioned that the bracts are usually very deciduous in this plant; such I found to be the case in the Scottish specimens.

I am, Gentlemen, yours obediently,

Frederick Townsend.

RARE BRITISH BIRDS.

To the Editors of the Annals of Natural History.

Plymouth, October 16, 1856.

GENTLEMEN,—During the late gales we have been visited by rather an unusual number of the *Sterna arctica* and *S. hirundo*.

Specimens of each species have been shot in the neighbourhood.

The *Thalassidroma pelagica* was captured alive on the 2nd of this month, in the passage of a house, Woodlane Terrace, by H. O. Bullmore, Esq. The bird was in excellent condition, fat and fleshy, but right wing was broken.

I am, Gentlemen, yours truly,
W. P. COCKS.

Descriptions of two New Species of the Genus Orthotomus. By FREDERIC MOORE, Assist. Mus. East India Company.

At a Meeting held in the early part of the present year, I laid before the Zoological Society a monograph of this interesting genus, and since that time I have been favoured by my brother with a search through the birds contained in the Derby Museum, which has resulted in the discovery of two additional undescribed species. These I now proceed to characterize.

ORTHOTOMUS DERBIANUS, Moore.

Forehead, crown and occiput dark ferruginous; back, rump and sides of neck ash-colour; ear-coverts, throat and breast pale ash, with the centre of the feathers whitish; flanks ashy-white; belly and vent dull white; wings brown, broadly margined throughout with yellowish-green; edge of shoulder pale brown; under wing-coverts rufescent-white; tail much graduated, ferruginous-brown above, dusky at base, paler beneath, and without discernible terminal spots or band; thighs ferruginous; upper mandible horn-colour, lower mandible and legs pale.

Length, $5\frac{1}{2}$ inches; of wing 2 inches; tail $2\frac{1}{2}$ inches; bill from frontal plumes $\frac{5}{8}$ths inch, to gape $\frac{10}{12}$ths inch, and tarsus $\frac{8}{10}$ths of an inch.

Hab. Philippines ? (H. Cuming). In Derby Museum, Liverpool.

Remark.—May be distinguished from all the previously known species by its greater size, and in having the ear-coverts, throat and breast ash-colour, with the centres of the feathers whitish.

ORTHOTOMUS MACULICOLLIS, Moore.

Forehead ferruginous, becoming dull on crown; feathers of the occiput greenish-brown, faintly edged with black; nares, behind the eyes, a line under, with the ear-coverts and sides of neck ferruginous-white, each feather being edged with black; back and rump greenish; throat white; breast, belly and vent ferruginous-white; sides of breast black, and flanks light greenish; wings brown, edged exteriorly with greenish-ferruginous-brown; edge of shoulder and under wing-coverts pale rufescent-white; tail brown above on the inner webs, and yellowish on the outer, beneath pale ashy-brown, having indistinct dusky spots towards the end, and pale at the tips and inner margins of the feathers; thighs pale ferruginous. Bill, darkish horn above, paler beneath; legs yellowish.

Length, $4\frac{3}{10}$ inches; of wing $1\frac{8}{10}$ in.; tail $1\frac{8}{10}$ in.; bill to gape $\frac{5}{8}$, and tarsus $\frac{8}{10}$ of an inch.

Hab. Malacca. In Derby Museum, Liverpool.

Remark.—Allied to, but distinguished from *O. longicauda* by having the sides of the head and neck ferruginous-white, each feather being edged with black.—*Proc. Zool. Soc.* Dec. 12, 1854.

METEOROLOGICAL OBSERVATIONS FOR SEPT. 1856.

Chiswick.—September 1. Very fine: thunder and lightning at night, but without rain. 2. Shower: very fine: clear. 3, 4. Heavy dew in the mornings: very fine. 5. Slight fog: cloudy and fine. 6. Slight fog: rain at night. 7. Very fine. 8. Foggy: very fine. 9. Dense fog: very fine: cloudy. 10. Slight haze: very fine. 11. Overcast. 12. Cloudy: very fine: rain. 13. Cloudy. 14. Clear and fine. 15. Fine: overcast. 16. Clear: fine. 17. Overcast: rain. 18. Rain: very fine. 19. Clear, quite cloudless: very fine. 20. Very clear: cloudy and cold: slight frost at night. 21. Fine: rain. 22. Clear: showery: fine. 23. Clear: cloudy: bright sun at intervals. 24. Clear: heavy showers. 25. Clear: dense clouds: fine. 26. Fine: rain at night. 27. Heavy rain. 28. Rain: heavy showers. 29. Cloudy and fine. 30. Very fine: cloudy: fine at night.

Mean temperature of the month	54°·41
Mean temperature of Sept. 1855	56 ·11
Mean temperature of Sept. for the last thirty years	56 ·95
Average amount of rain in Sept.	2·455 inches.

Boston.—Sept. 1—4. Fine. 5. Cloudy. 6. Fine. 7. Fine: rain A.M. 8, 9. Fine. 10. Cloudy. 11. Cloudy: rain A.M. 12. Cloudy. 13. Cloudy: rain A.M. and P.M. 14. Fine. 15. Cloudy. 16. Fine. 17. Cloudy: rain P.M. 18, 19. Fine. 20. Cloudy. 21, 22. Fine: rain P.M. 23. Cloudy. 24—26. Fine. 27—29. Cloudy: rain A.M. and P.M. 30. Cloudy.

Sandwick Manse, Orkney.—Sept. 1. Clear A.M.: clear, aurora P.M. 2. Bright A.M.: clear P.M. 3. Clear A.M.: cloudy P.M. 4, 5. Clear A.M. and P.M. 6. Bright A.M.: cloudy P.M. 7. Drizzle A.M.: damp P.M. 8. Damp A.M.: fog P.M. 9. Fog A.M. and P.M. 10. Fog A.M.: showers P.M. 11, 12. Bright A.M.: showers P.M. 13. Showers, bright A.M.: cloudy P.M. 14. Drizzle, bright A.M.: showers P.M. 15. Showers A.M. and P.M. 16. Showers A.M.: rain, lightning P.M. 17. Showers A.M.: clear P.M. 18. Sleet showers A.M.: showers P.M. 19. Cloudy A.M.: showers P.M. 20. Showers A.M.: cloudy P.M. 21. Bright A.M.: showers P.M. 22. Rain A.M.: showers P.M. 23. Bright A.M.: showers P.M. 24. Rain A.M.: showers P.M. 25. Showers A.M. and P.M. 26. Clear A.M.: clear, aurora P.M. 27. Hoar-frost A.M.: showers, aurora P.M. 28. Damp A.M.: cloudy P.M. 29. Showers A.M. and P.M. 30. Showers A.M.: clear P.M.

Mean temperature of Sept. for previous twenty-nine years ...	52°·28
Mean temperature of this month	50 ·83
Mean temperature of Sept. 1855	52 ·74
Average quantity of rain in Sept. for previous sixteen years ...	2·82 inches.

… Society at Chiswick, near London;
by Mr. Veall, at Boston; and by the Rev. C. Clouston, at Sandwick Manse, Orkney.

Days of Month.	Barometer.					Thermometer.					Wind.			Rain.		
	Chiswick.		Boston. 8¾ a.m.	Orkney, Sandwick.		Chiswick.		Boston. 8¾ a.m.	Orkney, Sandwick.		Chiswick. 1 p.m.	Boston.	Orkney, Sandwick.	Chiswick.	Boston.	Orkney, Sandwick.
1856. Sept.	Max.	Min.		9¼ a.m.	8¾ p.m.	Max.	Min.		9¼ a.m.	8½ p.m.						
1.	29·842	29·787	29·40	29·77	29·86	72	44	53	54½	48½	sw.	calm	calm	....	....	....
2.	30·174	29·910	29·50	29·96	29·77	67	33	57	50	56½	n.	nw.	nw.	·01	....	....
3.	30·255	30·207	29·81	29·99	29·66	73	37	53	50	56	nw.	nw.	sse.	....	....	·06
4.	30·196	30·095	29·73	29·87	29·85	75	34	53	61½	54	se.	calm	s.	....	....	....
5.	29·984	29·863	29·58	29·95	30·03	71	37	61	56	52	e.	se.	se.	....	....	....
6.	29·742	29·597	29·34	30·02	29·96	70	42	65	56½	53½	e.	e.	ese.	·12	....	....
☽ 7.	29·866	29·738	29·28	29·84	29·85	72	38	57·5	53½	53½	sw.	w.	e.	....	·16	·05
8.	29·893	29·891	29·46	29·90	29·97	74	40	54·5	56	51	w.	wnw.	e.	....	....	....
9.	29·877	29·788	29·45	29·92	29·89	72	52	60	53½	52½	se.	e.	se.	....	....	....
10.	29·994	29·869	29·47	29·91	30·05	74	48	63·5	57	50½	e.	ene.	w.	....	....	·02
11.	30·140	30·089	29·66	30·20	30·22	72	47	59	55½	50	ne.	n.	calm	....	....	·04
12.	30·142	30·066	29·72	30·12	29·95	72	46	58	55	52½	ne.	n.	wsw.	·11	·02	·07
13.	30·079	29·970	29·57	29·95	30·04	66	45	58	54	51½	nw.	nw.	w.	....	·12	·08
○ 14.	30·224	30·123	29·70	29·89	29·79	67	35	50·5	55½	53	se.	n.	wsw.	....	·02	·08
15.	30·186	30·126	29·64	29·69	29·61	69	44	59·5	50	50	sw.	sw.	w.	....	....	·21
16.	30·130	30·092	29·60	29·76	29·60	68	41	57·5	52	49	w.	nw.	ssw.	....	....	·80
17.	29·952	29·798	29·40	29·38	29·43	67	48	57·5	50½	46	sw.	wsw.	wnw.	·10	....	·13
18.	29·860	29·836	29·37	29·53	29·63	64	37	52·5	46	46½	nw.	w.	wnw.	·01	·07	·31
19.	29·965	29·851	29·43	29·83	29·98	60	36	45	50½	46	nw.	nw.	wnw.	....	....	·12
20.	30·043	29·997	29·60	30·11	30·04	58	29	46·5	49	46	n.	nnw.	w.	....	....	·06
☾ 21.	30·042	29·616	29·50	29·69	29·41	66	41	51	49	48	w.	sw.	e.	·12	....	·03
22.	29·510	29·244	29·05	29·17	29·23	65	47	51	51½	49	sw.	ssw.	e.	·18	·08	·37
23.	29·235	29·175	28·68	29·22	29·25	66	45	56	52½	50	sw.	sw.	ne.	·04	....	·23
24.	29·231	29·070	28·75	29·28	29·30	66	42	52	50	50	sw.	wsw.	nne.	·20	....	·25
25.	29·510	29·241	28·74	29·28	29·33	63	39	52	51	48	sw.	sw.	nne.	·05	....	·09
26.	29·657	29·374	29·15	29·36	29·48	63	45	47·5	48	41	sw.	sw.	calm	·27	....	....
27.	29·138	28·968	28·83	29·61	29·71	55	46	55	49	45	s.	se.	ne.	·61	·13	·07
28.	29·002	28·722	28·50	29·62	29·56	60	46	56	45	47	s.	se.	nne.	·13	·52	·04
● 29.	29·449	29·137	28·65	29·56	29·60	63	45	53	43	48½	sw.	n.	nne.	·02	·18	·04
30.	29·789	29·566	29·05	29·61	29·67	65	41	54	49	45½	sw.	w.	calm	·02	·12	·03
Mean.	29·837	29·690	29·32	29·730	29·724	67·16	41·67	55·0	51·08	49·62						

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SECOND SERIES.]

No. 108. DECEMBER 1856.

XXXVI.—*New Land Shells collected by* E. L. Layard, Esq., *and described by* W. H. Benson, Esq.

The following shells were collected by Mr. E. L. Layard at the Cape of Good Hope, and on his route to that colony, at St. Vincents, in the Cape de Verde Islands, and St. Helena. His researches have added new localities for several species already known, and he has furnished some interesting facts respecting their habits.

Bulimus arenicola, nobis, n. s.

Testa vix perforata, trochiformi, irregulariter subplicato-striata, nitidula, albida, rufo-castaneo fasciata; spira attenuato-conica, sutura leviter impressa, apice acuto, castaneo; anfractibus $6\frac{1}{2}$ subplanulatis, ultimo magno, dimidium testæ efformante, acute carinato, subtus convexiusculo, fasciis duabus, altera suturali, altera ad carinam, ornato; apertura magna, subquadrato-rotundata; peristomate simplici, acuto, margine externo infra ad peripheriam angulato, columellari verticali arcuato, expansiusculo, superne breviter appresso-reflexo, perforationem fere claudente, basali valde arcuato.

Long. 17, diam. 15; long. apert. 10, lat. $8\frac{1}{2}$ mill.; diam. anfr. supra aperturam ad carinam 11 mill.

Hab. ad colles arenosas prope sinum "Waterloo" dictum Caffrariæ.

Were it not for the evident affinity of this shell to the Natal species, *Bulimus spadiceus*, Menke, I should have been inclined to refer it to the genus *Helix*. Mr. Layard states that there is a brown, bandless variety. It may be at once distinguished from *B. spadiceus* by its higher and more slender spire, by the acute carination of the last whorl, and by its imperfect perforation; the umbilicus in *B. spadiceus* being pervious, although narrow, and merely hidden by the free dilatation of the columellar lip.

Bulimus Gemmula, nobis, n. s.

Testa rimato-perforata, ovato-conica, striatula, nitida, cornea; spira conica, sutura impressa, apice obtusiusculo; anfractibus 5, ultimo ad basin circum umbilicum subangulato-compresso; apertura rotundato-ovali, tuberculo vix conspicuo parietali subangulari munita; peristomate undique expansiusculo, tenui, acuto, margine dextro arcuato.

Long. $2\frac{1}{3}$, diam. $1\frac{1}{3}$ mill.

Hab. ad insulam Sancti Vincentii Promontorii Viridis, sub lapidibus.

Found by Mr. Layard on the west side of the island, under the Duke's Head Mountain; not uncommon. This little shell belongs to the group which contains *Bulimus nitidulus*, Pfr., *B. putillus*, Shuttl., *cœnopictus*, Hutton, *tutulus*, nobis, and *marginatus* (*fallax*), Say, which have been indifferently assigned to *Bulimus* and *Pupa*, and all of which are characterized by the tubercle at the right angle of the parietal border.

Bulimus compressilabris, nobis, n. s.

Testa vix perforata, subuliformi, confertim flexuose costulato-striata, cerea, albida, sutura subimpressa, marginata, apice obtusiusculo; anfractibus vix 7, ultimo $\frac{2}{7}$ longitudinis æquante; apertura truncato-ovali, basi rotundata; peristomate tenui simplici, margine dextro superne antrorsum arcuatim producto, subcompresso, columellari verticali, breviter reflexo, subtus nullo modo truncato nec emarginato.

Long. $6\frac{1}{2}$, diam. 2 mill.

Hab. ad insulam Sanctæ Helenæ in horto publico non infrequens.

This is a form of the widely spread type to which *Bulimus Goodalli, Octona*, &c. belong. Mr. Layard found it in a little artificial watercourse in the public gardens at the entrance of Jamestown.

Achatina Spiculum, nobis, n. s.

Testa imperforata, subulato-cylindracea, gracillima, hyalæa, politissima; spira elongata, apice obtuso, sutura impressa, marginata; anfractibus sub 6, convexiusculis, ultimo $\frac{1}{3}$ testæ æquante; apertura verticali, attenuato-pyriformi, basi rotundata; labro obtusiusculo, leviter arcuato; columella ad basin oblique valde truncata et pariete callosis.

Long. 4, lat. 1 mill.; long. apert. $1\frac{1}{3}$ mill.

Hab. ad insulam S^{ti} Vincentii sub lapide.

A single specimen was found by Mr. Layard on the west side of the island, under the Duke's Head Mountain. This is a very distinct species of the *Acicula* type. An uncertain species, *Ach. vitrea*, W. B., from Teneriffe, is contained in D'Orbigny's collection in the British Museum. Dr. Pfeiffer has, on examination, transferred it to the genus *Bulimus*, in which he places it as

577 *a.* Suppl. He has favoured me with a copy of his diagnosis, from which I am enabled to state that it has no close relationship with the present species.

Achatina Veru, nobis, n. s.

Testa imperforata, subulato-cylindracea, gracili, lævigata, cerea, nitidula, translucente; spira elongata, apice obtuso, sutura impressa, marginata; anfractibus 5 convexiusculis, ultimo $\frac{1}{3}$ testæ æquante; apertura verticali, pyriformi, basi latiuscula rotundata; peristomate acuto; labro tenui, leviter arcuato; columella subcallosa, ad basin leviter oblique truncata.

Long. $4\frac{1}{2}$, diam. 1 mill.; long. apert. $1\frac{1}{2}$ mill.

Hab. in insula Sanctæ Helenæ.

A single specimen was found by Mr. Layard with *Bulimus compressilabris.* It belongs to the aciculoid type, and is deficient in the lucid transparency and peculiar slenderness of *Ach. Spiculum.* The proportions of these two shells differ from those of their allies, *A. Acicula* and *Hohenwarti,* neither of which can compete with the new species in slenderness.

Pupa Acarus, nobis, n. s.

Testa rimato-perforata, cylindrico-ovali, minutissima, cornea, pellucida, sutura impressa, apice obtusiusculo; anfractibus sub quinque, convexis; apertura rotundato-ovata 6-plicata, plica 1 valida lamelliformi irregulari mediana parietali, 2 columellaribus, quarum superiori minuta, inferiori valida transversali, dentibus 3 palatalibus brevibus parum profundis, quarum 1 basali et proxima majori; peristomate tenui, corneo, undique breviter angulatim expanso, intus leviter marginato.

Long. $1\frac{3}{4}$, diam. $\frac{3}{4}$ mill.

Hab. ad insulam S[ti] Vincentii sub lapidibus.

There is some indication of a fourth tooth above, on the palate, in the only specimen received, but it cannot be made out distinctly. The shell occurred in company with *Achatina Spiculum.*

Pupa Layardi, nobis, n. s.

Testa arcuato-rimata, elongato-conica, oblique striatula, albida; spira elongato-conica, apice ——?, sutura impressa; anfractibus 6–7 superstitibus, subplanulatis, ultimo antice ascendente, pone aperturam angustiori, subscrobiculato, basi compresso-cristata; apertura triangulari-obovata, verticali, breviter soluta, sex-plicata; peristomate undique expanso, marginibus tenuibus acutis, dextro plicis tribus, columellari plica unica majori decurrente, parietali 1 angulari, secunda remotiuscula, omnibus profunde intrantibus, munitis.

Long. sp. imperfecti 7, diam. 4 mill.

Hab. ad Promontorii Bonæ Spei extremitatem "Cape Point" dictam.

Three specimens of this singular *Pupa* were found dead under a rock by Mr. Layard. The specimen sent to me is much weathered, is deficient in the upper whorls, and is slightly damaged on the columellar lip; but the characters of the aperture and of the last whorl are too peculiar to allow of its being confounded with any other species. The superior parietal plait and the upper palatal one run almost contiguously parallel for some distance into the aperture, forming an imperfect tube which opens at the top of the aperture.

The rather variable sinistrorse shell (perhaps including *P. capensis*, Kr.) which I found on the shores of Simon's and Hout Bays, and which I referred in a former paper to *Pupa pottebergensis*, Krauss, was found abundantly on the same Point by Mr. Layard, together with *Helix Menkeana*, Pfr., and the true *Helix Lucana* of Müller. A small variety of the latter shell, from Caledon, I was at first inclined to describe as a new species. It differs in having the umbilicus almost rimate, and shows a passage towards a small variety of *Helix Alexandri*, Gray, found, in Namaqua Land, with several varieties of *H. globulus*. The same modification of the umbilicus, in the species dwelling more to the eastward, is observable in a specimen of *Helix Menkeana* sent to me by Prof. Albers, from Elim, as compared with Mr. Layard's specimen, and with the larger inflated variety which I found on the sandhills in Hout Bay. *Pupa Kurri*, Krauss, noted by its describer as a Zwellendam species, has also been forwarded from the George District.

Helix Charybdis, nobis, n. s.

Testa subaperte umbilicata, discoidea, utrinque concava, confertim radiato-costulata, costulis alternis acutis salientibus, cornea; anfractibus $4\frac{1}{2}$ convexis, ultimo angusto, cæteros dominante, superne subangulato, subtus convexo; apertura anguste lunari, altiori quam lata, utrinque testam superante; peristomate tenui, acuto, margine columellari expansiusculo, umbilico profunde perspectivo.

Diam. major $5\frac{1}{2}$, minor $4\frac{1}{2}$, axis $2\frac{1}{2}$ mill. Long. apert. 3, lat. 2 mill.
Hab. ad Promontorium Bonæ Spei.

Mr. Layard found this species rarely, in company with *H. perplicata*, nobis, at the Waterfall, near the highest blockhouse, on the Table Mountain towards Rondebosch. Only three specimens were taken. The specimen described is in bad order, especially about the aperture, the characters of which may be open to correction on the receipt of a better specimen.

Helix Tollini, Albers.

Testa obtecte subperforata, globoso-depressa, tenuiter striata, sub lente striis exilissimis spiralibus utrinque decussata, nitidula, sericea, fusco-cornea, translucente; spira vix elevata, apice prominulo, obtusiusculo, sutura impressa, submarginata; anfractibus 5 convexiusculis, ultimo rotundato, subinflato; apertura verticali, rotundato-lunata; peristomate recto, tenui; margine columellari subito valde reflexo, superne expanso, calloso, appresso, perforationem obsoletam tegente, tum oblique descendente.

Diam. major 12–14, minor 11–12½, axis 7–9 mill.

Previously to the receipt of Mr. Layard's specimens, Dr. Pfeiffer, who had obtained the shell from Dr. Albers, sent it to me for inspection; and I subsequently received examples from Dr. Albers himself, with the name above adopted, Mr. Tollin having transmitted to him the first specimens seen in Europe.

Mr. Layard has found it on all sides of Table Mountain at the Cape of Good Hope, on the Devil's Peak, and in the ravine behind the Admiralty at Simonstown, always in damp shady places, under stones. The caudal portion of the animal is very long and narrow, and carinate above. The inferior tentacula are short and white, the superior very long and attenuated, generally wavy, and black, with white tips, slightly clubbed, in which the small black eyes are set. The animal creeps fast, with a serpentine motion, carrying the shell horizontally on the back, and, when recently taken, has a curious habit of retracting the head into the shell, while the long tail portion remains extruded; it then throws itself about, as Mr. Layard reports, doubling, twisting, and often springing away several inches, with the little button-like shell adhering to the anterior extremity of the part exposed. In connexion with this fact I may mention that Mr. Theobald has lately met, in the Khasya Hills, with a little *Vitrina* which springs 3 or 4 inches from the ground.

Several *Helices*, which I met with round the foot of Table Mountain, have been observed by Mr. Layard at various elevations, as instanced already in *H. perplicata*, which inhabits succulent plants, as well as the under sides of stones. *H. vorticialis*, Bens., occurred on the Devil's Peak, the Lion's Head and Tail, and on Table Mountain, under stones, wood, leaves, and sacking; *H. bisculpta*, B., on the Devil's Peak, under stones. *Helix dumeticola*, B., was met with near the shore at Camp's Bay, *parasitic* on *Helix capensis*, and feeding on that species under ground at the roots of geraniums. Three living specimens were taken with their heads buried in their half-eaten victims, and lived for some time feeding on the small specimens which were introduced into their box. The animal is about half an inch in length, and the upper part of the body is dark grey, with two light stripes running close together down the back, which is minutely mottled. The under side and tail are light brown.

H. sabuletorum, B., lives under stones at Simon's Bay, in the Round Battery, and in the Admiralty Garden. Mr. Layard states that it has two tentacula, with the eyes at the summits. The lower pair may perhaps be inconspicuous, or abortive, as in

Vertigo. He reports also that he had found, on the Devil's Peak, a unique minute conical *Helix* with acute radiating ribs, together with a small *Vitrina*, which was crushed in the act of capture. Another new *Helix*, from a ravine at Simon's Bay, is in a condition too imperfect for description, and an imperfect shell from the ravine which runs between the Devil's Peak and Table Mountain may be another subglobose translucent var. of *H. Menkeana*.

At St. Helena Mr. Layard found a shell, answering to Quoy's description of *Succinea St. Helenæ*, on the leaves of a *Sagittaria*, and of an arborescent Fern, in the watercourse of a ravine at Brown's Hill. The animal was whitish below, and, in old specimens, reddish mottled with brown above, and with a dark line running from each of the superior tentacles down the back. At the same spot whence he procured *Bulimus compressilabris*, B., he got a single specimen of the widely-spread *Helix pulchella* (which I had detected at the more remote locality of the Cape), and of a decayed shell which could not be distinguished from the North American *H. minuscula*, Say. These shells may have been imported into the garden with plants. Under stones, in damp places about Napoleon's Tomb, he found the smaller variety of *Pupa anconostoma*, Lowe, abundant. This is evidently the shell which I got in 1832 between Plantation House and Stitch's Ridge (Annals, 2nd Series, vol. vii. p. 263), and which I lost before I could observe its characters sufficiently. It is found in the Canaries, as well as in Madeira, and by some writers its separation from *P. umbilicata*, Drap., is contested. *Helix remota*, Bens., occurred to Mr. Layard under stones on the upper side of the road leading from Jamestown to Longwood.

Cyclophorus convexiusculus, Pfr., *var. minor*.

I had described this shell as new with reference to the description in the Zoological Proceedings for 1855 of *C. convexiusculus*, Pfr., brought from the Cape by Mr. Macgillivray, Dr. Pfeiffer having omitted to notice the obtuse angularity of the periphery of the last whorl. Wishing however to obviate the possibility of error, I applied to Mr. Cuming, who obligingly forwarded the type specimen, which proves to be the same species, only larger by half the diameter, and with a more obtuse apex, the vertex in Mr. Layard's shell being a little more prominent, and the whorls only four in number. The epidermis is also darker, and more strongly plicate in the smaller variety. The aperture is milky-white internally. Diam. major 4, minor 3, axis 2 mill. This is the only *Cyclophorus* certainly known to inhabit the African continent.

Mr. Layard discovered it in damp mould, amongst a pile of loose rocks, in a steep ravine, on the side of Table Mountain overlooking Camp's Bay, and in company with the next species.

Hydrocena Noticola, nobis, n. s.

Testa subobtecte perforata, globoso-conica, lævigata, nitidula, succinea, pellucida; spira conica, apice obtusiusculo, rubello, sutura valde impressa; anfractibus 4, convexis, ultimo ventricoso; apertura vix obliqua, ovato-acuta; peristomate tenui acuto, callo parietali, columellarique, appresso-reflexo, umbilicum fere tegente. Operculo normali, corneo, pellucido, paucispirato.

Long. 2, diam. $1\frac{1}{4}$ mill.

Hab. cum præcedente.

This is the first species of the genus which has been observed on the African continent. In its smoothness it presents a marked contrast to the Citra-gangetic species from the Khasya Hills and Burma.

A *Lymnæa*, a *Planorbis*, and a *Unio* (probably the shell found by Rang in the Berg River, and nearly allied to the European *U. pictorum*), have been found by Mr. Layard, and will, with some fluviatile shells taken by myself in the vicinity of Cape Town, form the subject of a separate paper.

Cheltenham, November 7th, 1856.

XXXVII.—*Descriptions of three new British Zoophytes.* By Joshua Alder, Esq.

[With a Plate.]

In addition to the new zoophytes described in my former communication to the 'Annals of Natural History,' I now beg to offer an account of three others, extracted from a Catalogue of the Zoophytes of Northumberland and Durham, about to appear in the 'Transactions of the Tyneside Naturalists' Field Club.'

Family Tubulariadæ.

Tubularia implexa, n. sp.

Tubes small, very slender, generally more or less contorted below; smooth, wrinkled, or regularly annulated beneath a smooth transparent epidermis; slightly and subunilaterally branched, the branches going off nearly at right angles to the stem, and a little constricted at their bases. Gregarious, forming a densely tangled mass of $\frac{1}{2}$ to $\frac{3}{4}$ of an inch in height.

Discovered by Mr. R. Howse on an old anchor brought in by the fishermen from forty fathoms water, thirty miles off Holy Island.

As the polype of this species has not been observed, its claim to a place in this genus cannot be fixed very decidedly. Its mode of branching is similar to that of the other *Tubulariæ*, but it is much smaller than any species hitherto described. The division of the tube into two coats is curious. This takes place sometimes near the base, but more frequently in the young branches, where the thin, smooth epidermis shows a strongly ringed tube within. The epidermis in dried specimens shrinks to the form of the inner tube, so as not to be distinguished from it.

Family **Campanulariadæ.**

Laomedea neglecta, n. sp. Pl. XVI. figs. 1, 2.

Polypary minute; stem filiform, subflexuose, with two or three alternate simple branches, each bearing a cell; the stem is annulated with from four to seven rings above the origin of each branch, and sometimes slightly ringed below it; the branches are ringed throughout: cells narrow and deep, with alternately shallow and deep crenations, forming about eight bimucronated denticles round the margin. *Polype* with fifteen or sixteen slender tentacles.

Height $\frac{2}{10}$ in.

On the under side of stones between tide-marks, Cullercoats and Tynemouth: frequent.

This delicate little *Laomedea*, though apparently not rare, has hitherto escaped observation; or, if observed, it has been passed over as the young of Johnston's small variety of *L. gelatinosa* (*L. flexuosa*, Hincks, MS.), with which it is sometimes associated on the same stone. It is, however, not very readily seen unless the stone is examined with a magnifier. It differs from the species above named in being of much humbler growth, more slender, and in having smaller, narrower, and deeper cells, crenulated on the margin. The margin of the other is plain. The crenulations are very difficult to detect, on account of the extreme tenuity of the edges. They resemble those of the true *Sertularia gelatinosa* of Pallas (*Laomedea gelatinosa, var. β*, Johnst.), though the shape of the cell is different, as may be seen by a reference to fig. 3, where a cell of that species is figured for comparison. I have also added two cells of *L. longissima*, Pallas (*L. dichotoma, β*, Johnst.), fig. 4, the only other British denticulated *Laomedea* with a campanulated cell. These two species were supposed to have plain margins by Dr. Johnston, who had not seen them in a perfect state.

Laomedea acuminata, n. sp. Pl. XVI. figs. 5, 6, 7, 8.

Polypary minute, scarcely branched; with a slender, annulated stem; cells thin, membranous, finely striated longitudinally, elongate-ovate or pod-shaped, squared below, and tapering to a fine point above; margin slightly crenulated. *Polype* reaching, when extended, to two or three times the length of the cell, with about twenty muricated tentacles, united by a web at the base.

Height $\frac{1}{10}$ in.

On an old shell of *Fusus antiquus* from deep water, Cullercoats.

This is an extremely curious and interesting species, which one would scarcely think of referring to the genus *Laomedea*, were it not for its near alliance to the *L. lacerata*. The stem rises from a creeping fibre, and is generally more or less annulated throughout, the annulations becoming fainter, or entirely disappearing towards the cell. In most of the specimens observed, the stem bore only a single polype, but in two or three instances a branch, bearing a second polype, was seen proceeding from it. The cells are extremely elastic and membranous, changing form with the polype, and scarcely to be distinguished from it when alive, excepting at the apex when the animal is withdrawn. The polype, when extended, stretches far beyond the cell, the latter adhering closely to it and becoming cylindrical. The whole animal is very extensile, and frequently changes its form. The tentacles sometimes appear short and stout, and at other times they are extended into long and slender threads, as in the freshwater *Hydra*, to which the animal then bears considerable resemblance. The tentacles are united by a web for about one-sixth of their length; a circumstance I have not observed in any other species. The margin of the cell appears to be crenulated, and not divided into deep segments, as in *L. lacerata*. This character, however, is difficult to ascertain. I have watched the opening of the cell several times when the polype was emerging from it, without being able to detect the exact form of the margin, which is extremely thin and membranous.

EXPLANATION OF PLATE XVI.

Figs. 1, 2. *Laomedea neglecta*, natural size and magnified.
Fig. 3. A cell of *Laomedea gelatinosa*, Pallas.
Fig. 4. Two cells of *Laomedea longissima*, Pallas.
Fig. 5. *Laomedea acuminata*, natural size.
Figs. 6, 7. The same highly magnified, with the polype in different states of expansion.
Fig. 8. The same with the polype withdrawn.

XXXVIII.—*Elucidation of some Plants mentioned in Dr. Francis Hamilton's Account of the Kingdom of Nepál.* By Lieut.-Col. Madden, F.R.S.E., President of the Botanical Society of Edinburgh.

[Concluded from p. 413.]

Bhurya patra, or Bhurjapatra, p. 97. *Betula bhojpatra*, Wall. "This bark (of a fine chestnut colour) is imported into the low country in considerable quantity, and is used both in the religious ceremonies of the Hindus, and for constructing the flexible tubes with which the natives (*and Europeans also*) smoke tobacco." Both in India and in Persia this bark was anciently substituted for paper (called Tús in Persia); hence a Sanscrit name of the Birch, Vidhádal, 'leaf of knowledge.' The blocks used in Thibet for stereotype printing are formed of its wood. The Sanscrit Bhurjja, 'firm or hardy in the earth,' seems the origin of our term Birch, Russian Beréza, &c. The Bhárangí bark from Almorah (Royle, J. A. S. B. for October 1832, No. 110) is explained to be *Betula bhojpatra*,—Illustrated Cat. of Great Exhib. of 1851, vol. ii.

Káephal (not Karphal), p. 85. *Myrica sapida*. Káyaphal, from the Sanscrit Katphal, signifies both acid and stony fruit. It is scarcely worth eating; but the bark is sent down to the plains in large quantities, and is used, I think, in dyeing.

Lálchandan, "a timber tree, the foliage and appearance of which have some resemblance to the Laurels" (p. 85). No specimen or reference seems to exist in the Catalogue; but the plant is probably *Goughia Himalensis*, Bentham (a new genus of Euphorbiaceæ, near to *Sarcococca*), which is not uncommon in moist valleys in outer Kumáon and other provinces of the Himálaya as far N.W. as Dharmsála near Kotkángra, at 5000–7000 feet. The Kumáon name, Rakt Chandan, is of the same import as that given by Dr. Hamilton, and signifies 'Red Sandal-wood;' the heart-wood being used for the sectarial mark which the Hindus daub on their foreheads.

The genus *Goughia* is described and figured in Wight's Icones, v. 22. t. 1878–79.

Catalogue, specimen No. 1486. *Sinapis Gorræa*. Ghor ráyi, Hindice. Colitur rarius in Indiæ Gangeticæ arvis ob semina acria. In fr. Surjaghorri, 27 March, 1811. Identified by Wallich (No. 4790) with *Sinapis erysimoides*, Roxburgh, Fl. Ind. iii. 123, from Wynaad, a district of Malabar.

Ten years since, I noticed this plant under cultivation at Almorah, with the names Makara ráí, Asl ráí, Tarantula and True

Mustard. I referred it doubtfully to *S. erysimoides* or *nigra*. On a voyage down the Ganges in 1850, I found the plant commonly grown from Mirzápur as far down as Bar in Behar, but in the greatest abundance about Benares, being cultivated (like the rest of the genus) in the cold season, on the rich clay banks of the river. The leaves are used as cress, the seed for the same purposes as with us; as well as in horse and camel medicines: hence the name Ghor-rái, Horse Mustard. On arriving in Europe that year, it was at once recognized as *Sinapis nigra*.

The cultivation of *Sinapis nigra* in India does not appear in our works on its agricultural resources. Dr. Royle enters *Sinapis nigra*? (No. 219) among the Indian articles of Materia Medica (Journal As. Soc. Bengal, Oct. 1832); and in the Liverpool Collection of Imports, Class 29. No. 270. of the Exhibition of 1851, is "Mustard Seed, Brown: *Sinapis nigra*, from Bombay. Import, 1100 quarters in 1850." In the Illustrated Catalogue, ii. 879, is a similar entry,—"Annaloo Noonæ (*Sinapis nigra*) from Tanjore;" and "Khardal rai, *Sinapis nigra*." (871.)

It appears from Ainslie's 'Materia Indica,' i. 231, that the plant was cultivated long since in the Calcutta Botanic Garden from seeds "brought from England by Colonel Garstin."

Malayagiri, p. 84, "a pale yellow wood, with a very agreeable scent."

1262. *Michelia Zila*. Ham. Nepal, 217. Zila champa. Habitat in sylvis Nepalæ. This is apparently *M. Kisopa*. *Michelia Doltsopa* is described by Don (Prod. Flor. Nep. 226) as "arbor vasta ligno odorato gaudens, ad ædes ædificandas omnium arborum Nepaliæ optima." *Magnolia* (*Michelia*) *excelsa*, Wall. (Tentamen Fl. Nep.), yields a valuable timber, of a fine texture, at first greenish, but soon changing into pale yellow. This is probably the *champa* of Darjîling, described as "an excellent yellow timber." One of these I suppose to be the Malayagiri, a term implying 'mountain Sandal-wood.' Dr. Hooker mentions the *Cupressus funebris*, Chandan, as "valued only for the odour of its wood" (*l. c.* ii. 45), which is probably yellow. *Ligustrum nepalense, Buxus Himalensis, Symplocos cratægoides*, have all yellow wood, but without odour. *Camphora glandulifera*, the Nepal Camphor-tree, however, has pale yellow wood, while fresh smelling strongly of camphor, and may be the Malayagiri.

"Bish, Bikh, and Kodoya Bish or Bikh; nor am I certain whether the Mitha ought to be referred to it, or to the foregoing kind," Bishma.

"I have only seen the flower and fruit of one. This is called Bishma or Bikhma, and seems to me to differ little in botanical characters from the *Caltha* of Europe," p. 99.

Catalogue, No. 1247. *Caltha? Bismia.* Bishma vel Bikhma, Hamilton's Nepal, 99. Habitat inter nives Emodi.

1248. *Caltha? Nirbisia.* Nirbishi vel Nirbikhi. Ham. Nepal, 99. Habitat cum præcedente. Montanorum unus hanc pro radice indica toxicaria ostendebat, alter autem sequentem afferebat. Flores non vidi.

1249. *Caltha? Codoa.* (No specimen.) Kodoya Bish vel Bikh, Hamilton's Nepal, 99. Habitat cum duabus præcedentibus. Credo hanc esse reveram Toxicariam Indorum radicem. Flores non vidi.

In Brewster's Edinburgh Journal of Science, i. 249–251, "On the Herba Toxicaria," Dr. Hamilton informs us that his specimens were collected in July 1810, near the sources of the Kosi River, and therefore necessarily quite immature; still it is surprising that he should have referred them, even doubtfully, to *Caltha,* to which they bear no resemblance. In the very short account in the Journal last mentioned, founded probably on the specimens before us, he says of *Caltha Bismia,* "The Bikhma is used in medicine, and is a strong bitter, very powerful in the cure of fevers*." *Caltha Nirbisia* "has no deleterious qualities," while *Caltha Codoa* includes Bish and Kodoya Bish. Dr. Wallich† showed that all these specimens belong to *Aconitum*: his 4723, *A. palmatum,* being *Caltha? Bishma,* H. Ham.; and 4721, *A. ferox,* including *Caltha? Nirbisia* and *C.? Codoa,* H. Ham.

It would be impossible to unravel this complication without a visit to Nepál; but perhaps some additional light may be thrown on the subject by eliminating the known from the unknown, and rejecting the specimens as misnamed. Dr. Hamilton (p. 98) expressly says there are "four different plants." We know that the Bish‡ proper is *Aconitum ferox.* Kodoya

* So in the Account of Nepal, p. 99.

† He left occasion for additional criticism. The description of *A. ferox* in the 'Pl. As. Rar.' is full and interesting, pp. 35–39; but the plate (t. 41) and specimen 4721 A. belong to *A. dissectum,* Don's Prod. 197. *A. ferox* flourishes at from 11,000 to 13,000 feet; it has beautiful deep-blue flowers in August and September, and is described and figured by Dr. Balfour and Mr. M'Nab in the Ed. New Phil. Journal, October 1849, plate 5, from plants which first flowered that autumn in our Horticultural Garden. *A. multifidum* is abundant at from 12,000 to 14,500 feet; *A. palmatum* grows at Nagkhanda near Simla in forests at 8500 to 9500 feet, and flowers from May to July; *A. heterophyllum* at from 8500 to 13,000 feet.

‡ The term *vish,* Sanscrit, denotes 'poison' simply, and is from the same root as *vishnu,* 'penetrating, pervading.' In the mountains and the north-west provinces it is pronounced Bikh; in Behar and Bengal, Bish; but there is no difference in the original word. Narbishi means 'not poisonous,' a term from which Don (General System of Gardening, i. 63) forms his genus *Nirbisia* to include two deadly Aconites and an innocent *Delphinium,*—as uncalled-for therefore in botany as it is false in etymology.

Bikh may be *A. palmatum*, or Dr. Hooker's new species from Upper Sikkim, *A. luridum*, reported to be as virulent as *A. ferox* (Journals, i. 168; ii. 108). *A. ferox* is found all over the alpine Himálaya; on the Shátúl Pass, in Basehar, it is well known as Bikh; also Maur, Máúr, and Máhur, of the same import. Vatsanába, 'calf-destroyer,' is the original of the Bachnag*, mentioned by Dr. Royle from the Makhzanul Adwiyyah. In order to ascertain whether it were justly called Mitha, 'sweet,' I masticated a very small slice, and found it was so; but this was soon succeeded by the most distressing burning all over the mouth and fauces, though nothing was swallowed.

Plants of other genera are also known as Bikh and Máhúr: the root of *Meconopsis Wallichii* is reported in Sikkim to be very poisonous (H. and Th. Flor. Indica, 254); and the root of a *Convallaria* with verticillated leaves is considered a very virulent poison (Hooker's Journals, i. 168)†. Dr. Royle (Illustr. 382) says that "*Polygonatum verticillatum*, L., called Mitha-dúdhya in Sirmore, and *Smilacina pallida*, called Dúdhya-mohura, are both accounted poisonous in the Himálayas." On Mahásu, near Simla, I observed people gathering the young shoots of *P. verticillatum* or *cirrhifolium*, to induce intoxication; and the poisonous root Máhura was useful, they said, in cases of ringworm.

Nirbishi denotes some plant, "not *Aconitum ferox*," but resembling it. Dr. Royle observes that he was struck with the resemblance of some *Delphinium* roots from the Himálayas to those sold as Narbisi; and both at Pindri in Kumaon and Bhojgara, on the south side of the Kowárí Pass in Garhwál, at 11,000 to 14,000 feet above the sea, I found the beautiful *Delphinium Kashmerianum*, Royle, p. 55. t. 12 (*Jacquemontianum*, Cambassedes, Voyage aux Indes, viii. t. 7), with cylindrical tuberous roots, absolutely identical in form with the ordinary Nirbisi, and, I doubt not, its true source. No one, however, could previously supply me with the least information as to the province which produced it: the Nepalese said it came from the west; the Tibetans told Major H. Strachey it came from the east.

* Bachnag, according to Graham's 'Bombay Plants,' is *Gloriosa superba*; its root is a virulent poison.

† In the Journ. As. Soc. of Bengal for May 1849, page 438, Dr. Hooker states that "another far more powerful Bikh is yielded by a plant of the order *Compositæ*, which I have gathered abundantly at 10,000 and 9000 feet; and it requires care to distinguish its root from that of the Aconites; when mixed, the Bhotiyás could not separate them." Dr. Hooker informs me that the plant in question is a *Cacalia*, allied to *C. aconitifolia*; and that the reputed qualities having never been confirmed in any shape, he does not doubt that they are altogether due to the similarity of its foliage to the Aconite.

Dr. Royle (J. A. S. B. October 1832) got the root (No. 49) from Amritsir. Its properties seem to be unknown; he describes it as having a pure bitter taste*.

The Bishma of Dr. Hamilton is expressly stated to be a *bitter*, which precludes the idea of its being *Aconitum ferox*, of which the taste is sweet; and Colonel Kirkpatrick, in his 'Account of Nepál,' p. 182, *note*, long since supposed it might be a kind of Gentian. Dr. Royle conjectures that it may be *Aconitum heterophyllum* (excellently figured, 'Illustr.' t. 13), the root of which, called Atís, Patís, and Mahaushadham, 'the great drug,' is in much estimation for its medicinal qualities. Atís is a vernacular corruption of the Sanscrit Atívísha, 'overcoming poison,—antidote,' (erroneously rendered *summum venenum* by Wallich,) with the synonyms Upavish, 'reverse of poison,' and Prativishá, 'against poison, an antidote'†; the last is the origin of the vernacular Patís. This plant, however, is not quoted as indigenous to the east of Kumáon; and we may therefore substitute *Gentiana Kurroo*, Royle, which is much used in the N.W. mountains, or *Aconitum multifidum*, a very abundant species in the alpine Himálaya, "planta *A. Anthoræ* affinis," Royle; of this or *A. dissectum*, Colonel Munro states (Hooker and Thomson's Fl. Indica, p. 58) that "the roots are eaten in Kunáwar as a pleasant tonic." Dr. Royle's *A. multifidum* is from that district. *A. Lycoctonum* (*læve*, Royle) is as common in the Himálaya as in Alpine Europe; and its roots, which are, I believe, harmless, may also be so employed‡.

* Dr. Royle distinguishes this Amritsir and Basehar drug from the common sort: according to him it is fusiform, externally black, somewhat flattened and wrinkled, and in some respects resembling the Bikh itself, with a slight degree of bitterness and acrimony (Illustr. p. 49). This would agree well with the roots of Wallich's fig. of *Aconitum ferox* (*A. dissectum*), and with Colonel Munro's fact of a Kunáwar species being used as a tonic. It appears, on the authority of Linnæus, that in certain cold climates the root of *A. Napellus* is eaten with impunity.

† It is the Jadwár or Zedoary of the Arabs and Persians. "Ideoque dixit Avicenna nihil esse ea præstantius ad ebibitum Napellum" (Royle, Illustr. 50). In all probability this is purely an imaginary virtue.

‡ Griffith (Journals of Travels, ix. 37, 57) says, "I hope before my return to have seen *Coptis Teeta* in flower, and to have proved that the Beese is different from that of Nepál." The Coptis, called Mishimí *Tita*, or *Bitter*, from being indigenous to the Mishimí Mountains, a branch of the Himalaya, bounding Assam to the east, is, like the best Chiretta, of a yellow colour, "a pure intense bitter of some permanence, but without aroma." He calls it a "valuable drug." It may be one of the Bikhmas. In Hindustani, Bikhmán is explained by Shakespeare, "name of a medicine or poison," perhaps from the Sanscr. *vishama*, uneven. Bee or Bih is merely the Assamese form of Bish: thus we have Koni-bih (*Croton Tiglium*), Naga-bih (*Gordonia integrifolia*). Mr. Griffith (J. A. Soc. Beng. 1837, 331–335) mentions "the celebrated poison, Bee," of the *Ranunculaceæ* (and

Jumne-mundroo, p. 85. *Berberis* (*Mahonia*) *nepalensis*; properly Jámani mándru.

Chootraphul, *i. e.* fruit of the Chotra, a Barberry. Catalogue, No. 841. *Berberis asiatica*, Hort. Beng. 25; DC. i. 107. Habitat in dumetis Nepalæ. The specimen is wanting, and Chotra, Chutro, is the proper name of *B. aristata*; but Wallich has, No. 44, *B. asiatica*, Roxb., from Nepál and Kumáon.

Catalogue, No. 1082. *Rhododendron puniceum*. Potasar: Gorangs: montanorum Hind. The common *R. arboreum*.

"Sanpati: a small *Rhododendron*, like *Myrica Gale*; the leaves are very odorous, and even when dried retain their fragrance. It is used in fumigations, and sent to the low countries," p. 97.

Catalogue, No. 1083. *Rhododendron*. Son Pati. Hamilton's Nepal, p. 97. The specimen is imperfect, but seems to belong to *Rhododendron anthopogon* or *pendulum*; the leaves of the first are very aromatic, and are burned as incense.

Bhairopati. *Rhododendron*. "Its qualities are similar to those of the former, but it is less fragrant," p. 97.

Catalogue, No. 1084. *Rhododendron Bhairopatium*. Bhairopati v. Bhaingropati. This specimen is also without flowers or fruit, but belongs to *R. lepidotum*, or one of the varieties or allied species discovered by Dr. Hooker.

Catalogue, No. 1062. *Melia Azederach*.

α. Enc. Method. i. 341; Willd. Sp. Pl. ii. 558. Colitur ad urbes Indiæ rarius, habitat in Nepála. In flower, Calcutta Botanic Garden, 4th January 1814.

No. 1063. *M. Azederach*.

β. Enc. Method. i. 341. *Melia sempervirens*, Willd. Sp. Pl. ii. 559. Habitat ad Indiæ pagos. In flower, Jolpigorry, 31st March 1809.

Wallich's Cat. 1251. *M. sempervirens*.

Nepál and Kumáon.

Ibid. 1250. *M. Azederach*, L. H. B. C.

Dr. Hamilton's first No. has oval-lanceolate leaflets; in 1062 they are somewhat broader and less arcuate; the difference, however, is certainly not more than is usual in specimens from the same tree; and hence Dr. Hamilton finds *M. Azederach* in Nepál, where Dr. Wallich finds *M. sempervirens*; and *M. sempervirens* in the Indian villages, which Dr. Wallich has only from

says it is "in very great request") as one of the three staple articles of the Mishims. Masters (J. Agri. and Hort. Soc. Calc. iv. 200) tells us that "the juice of this fruit (*Dillenia speciosa*) is mixed with the Mishimi *Bih* to prepare the poison for arrows." And Wilcox (As. Res. xvii. 456) mentions two kinds of poison from the mountains north of Assam,—the Bor Bis (great poison) and Sengumuri Bis; all no doubt to be included in the above-mentioned species of *Aconitum*.

the Calcutta Botanic Garden. I am satisfied that the Himálayan plant is identical with that of the Gangetic plains; in the hills it is called Dek or Jek and Betain; in the plains, Bakáyan, a name which is applied to *M. sempervirens*, As. Res. xi. 170. No specific name could be more inappropriate, since it is completely leafless during the winter months; and this appears to be true also, to a somewhat less extent, of the West Indian *M. sempervirens*, Swartz, which is said to vary from a small bush to a tree. Seemann (Kew Journal of Botany, October 1851) informs us that this is a native of Panamá, and known as 'Jasinto.' DeCandolle (i. 621) mentions Jamaica as its habitat, and says, "priore minor, florens jam biennis, folia tardius autumno deponens, et tepidarium per hyemem in nostris hortis requirens." Roxburgh (ii. 395) adds to the difficulty: he says *M. sempervirens* is "a native of Persia, now common throughout India...... It blossoms the greater part of the year in our gardens, and is perfectly distinct from *Azedarak*, which is a robust, deciduous timber tree, and this is a small delicate evergreen, of short duration compared with the other." He gives Bakarja as the Hindustáni name,—evidently the Bengáli name, Bakarjan, of *M. Azederach*. This last he calls a native of China. Graham (Cat. of Bombay Plants, p. 30) says it is common "about villages" in the Concan and Deccan, S. India. Jacquemont (Voyage dans l'Inde, iii. 147) finds it under the same circumstances in the Punjáb, but scarcely indigenous, nor has it the least claim to be so considered anywhere in Northern India. Its Sanscrit names, Mahátikta, 'the great Bitter,' and Mahanímb, therefore, go for nothing, and are not in the Amera Kosha. The Persian Azád-i-darakht, 'the spreading tree,' which gives it the specific name, with its popular one, 'Indian or Persian Lilac,' is compatible with its importation from America by the Portuguese, who, like other Roman Catholic people, use the berries in rosaries (Bead-tree); once introduced, its "very great beauty," and flowers like the Lilac, sweetly fragrant (Roxburgh), would speedily cause its general diffusion. Wight and Arnott (Prodromus, p. 117) found Roxburgh's own specimens of *M. Azedarach* and *sempervirens* so much alike as to appear as if cut from the same tree; and the figure of the latter in the Botanical Register, t. 643, may very well be *M. Azedarach* in a young state, and forced in a stove. In Dr. Royle's List, No. 191, Bakain is entered as *M. sempervirens*; and in February 1850 I saw this last in the Calcutta Botanic Garden in full flower, a tree 30 feet high, called Mohá ním by the Bengáli gardeners, and quite the same with the Bakáyan of Northern India.

Timmue (for Timmur) or Taigbul: a mountain shrub; and an arboreous species on the lower hills (p. 84). The first, well known for its aromatic capsules, and for the thick prickly clubs used by fakírs (mendicants), is the *Xanthoxylon hastile* of Royle (*X. alatum* of Roxb. iii. 768, and *X. acanthopodium*, DC.), called Tímúr and Zejbal, the last expressive of its strong pungency. It seems to be the Jwarántika, 'fever-ender,' of the Sanscrit. It is (perhaps erroneously) referred to *X. aromaticum*, a West Indian species, in the Illustrated Catalogue of the Great Exhibition of 1851, ii. 895. There is a new species flourishing in shadier and loftier sites in Kumáon, which Mr. Edgeworth proposes to call *X. tomentosum*; of this the native name is Símur; it has similar properties. The arboreous species mentioned by Dr. Hamilton may be *X. Budrunga* of Roxburgh, of which the capsules are of a warm spicy nature, with the fragrance of lemon-peel. *Toddalia floribunda*, Wall., and another species of *Xanthoxylon* are natives of Nepál; and *Tetrodium cymosum* and *fraxinifolium* (Royle, 157) may be from Lower Nepál.

Padam chhál "is a plant with a thick cylindrical root that is used in medicine, and brought to the low country for that purpose. The specimen that I procured had one large heart-shaped rough leaf, and had somewhat the appearance of an Anemone" (p. 100). The name signifies 'bark of the Lotus,' and, according to my Nepalese authority, belongs to some species of *Rheum*, probably *R. Emodi*, or *Webbianum*, or both, the roots of which have "a spongy texture" (Royle) resembling the Lotus.

Sied burrooa: *Daphne papyrifera*, Ham. pp. 85, 232; properly written Seta-baruwa, *i. e.* White Baruwá. The shrub abounds in the temperate districts of the Himalaya; and the paper made from its bark, though coarse, is not touched by insects. "The bark is exceedingly strong and pliable, and seems to be the same with certain tape-like bandages employed by the Chinese in tying many of their parcels."

Sinkauri, Silkauli: the leaves, Tejpát. "Both its bark and leaves have a fine aromatic smell and taste, and this quality in the leaves is strengthened by drying" (p. 84). *Cinnamomum albiflorum*; *Laurus Soncaurium*, Ham., Linn. Trans. xiii. 557; *C. Cassida*, Don, Prod. 67. Another Sinkauri is distinguished by its aromatic quality residing in the bark of the roots. Dr. Hamilton received it from the mountains of Morang, the tract between the rivers Kosi and Tista. In the Trans. Linn. Soc. xiii. 558, he describes this plant as *Laurus Sailyana*: "vis aromatica tota in radicis cortice posita. Hic autem cortex lævis, colore lateritius, odoratissimus, sapore grato aromaticus. Cortex ramorum et folia insipida, inodora." Nees von Esenbeck (in Wall. Pl. As. Rar. ii. 73–75) identifies it as *Cinnamomum albiflorum β*, very near *C. Tamála*, 'Taj' Bengalensium, cultivated in the gardens of Cámrup.

Machilus odoratissimus (*Laurus Champa et bombycina*, Herb. Ham.), a fine tree of all the warmer valleys of the Himalaya, is known in Kumáon as the Kaula, which term enters into Hamilton's Nepalese names. Dr. Hooker found *Cinnamomum* in Sikkim, up to 8500 feet (i. 162).

"The Seta and Cálá Bhot más of the Parbatiyas (Hindoo mountaineers) are called Musa and Gya by the Newars (the Mongolian aborigines of Nepál). They are two varieties of the *Dolichos Soja*, the one of which has yellow flowers and white seeds, and the other has black seeds and purplish flowers. The former is ripe about the 1st of November, the latter about the 1st of September" (p. 228).

Catalogue, 1778. *Dolichos Soja*. *Soja hispida*, DC. Garo Kolai, Bengalensium. Bhot mas, Montanorum Hindice. Colitur in Camrupæ orientalis et Nepalæ montosis.

Thence abundantly up to Kumáon, where the Soy Bean plants are called Bhat. "Bhut. *Soja hispida*, Kumaon." Illustrated Cat. of G. E. of 1851, ii. 871. No mention of it, however, in this respect occurs in our botanical or agricultural works on India. Soy pulse is reckoned rather unwholesome, and much of the sickness which assailed the divisions operating against Nepál in 1813–14 was popularly attributed to its use.

Catalogue, 1690. *Hedysarum Alhagi*. Habitat in ripis Gangis et Jomanis arenosis. Labelled, "Monger, 17th June, 1811."

This is the common Jawásá or Camel Thorn of the plains of Northern India, and is here introduced as an example of the way in which species are unnecessarily formed, on the supposition that a new locality (though erroneous) requires a new species. The plant extends from the extreme north of India down to Behar, where I have seen it in the neighbourhood of Monger, near the well-known hot spring of *Sitákund*. It is Dr. Wallich's No. 5760. *Alhagi Maurorum*, *Hedysarum Alhagi*, H. Ham. e Monger; and neither of these botanists gives any intimation of the genus being found in Nepál, nor is there any known Sitákund in that country. Yet, on the supposition that it is from that country, *Alhagi Nepaulensium* forthwith appears in our books:—Don, System of Gardening, ii. 310, "Native of Nepaul, near Sitaucund." DeCandolle, Prod. ii. 352. Syn. *Genista Juasi*, Ham. *Hedysarum Hamiltonii*, Sprengel, Syst. iii. 316; and *Manna Nepaulensis*, D. Don, Prod. Fl. Nep. 247. Habitat in Nepalia, prope Sitaucund, Ham., in which DC. follows.

In the same manner D. Don has (Prod. 101) *Heliotropium obovatum*. Hab. versus ripas fluminis (Bhagirathi) infra Morshídabad, Ham. (it is *H. europæum*, L.), to which DC. prefixes, "*In Nepalia* versus," &c., the locality being *Bengal*. A *Me-*

lianthus Himalayanus is constituted (Linn. Trans. xx. 417) from a garden specimen of *M. major* grown at Háwalbágh, near Almorah, the only individual of the genus in Kumáon. In short, if we take as criteria the genera *Viburnum*, *Lonicera**, *Cirsium*, and others in DeCandolle's Prodromus, one-fourth of his Himalayan species have no reality independent of the different names imposed by different botanists, and adopted as species without examination.

Alhagi Maurorum is interesting as the shrub which yields the 'Manna' of N. Persia, Bokhara, and Samarkand, called Tarangabín or Taranjabín; the plant itself being Khár-i-Shutar and Ushtar-Khar, *i. e.* Camel Thorn. The Manna of Mount Sinai, a product of *Tamarix gallica*, is also formed in Louristán and Irák, where it is called Gazángabín or Gazánjabín. The names are all *Persian*.

Saxifraga ligulata, Wall.

S. Pacumbis, Ham. MSS. in Don, Prod. 209. Dr. Hamilton's specific name, I doubt not, is a misprint for Páshán-bhéd, its Sanscrit designation (pronounced Pakhán-bhédin in the mountains), still preserved as Pákhán-bhéd in Nepál and Garhwál: so Royle, J. A. S. B. Oct. 1832, No. 121. H. H. Wilson erroneously explains the Sanscrit term by *Plectranthus scutellarioides*. It signifies 'Rock-splitter'; and it is the more interesting that the name should in this remote district be applied to a species of our genus *Saxifraga*, since Pliny (H. N. xxii. 30) refers *Saxifragum* to *Asplenium Trichomanes*, or *Adiantum Capillus-Veneris*: "calculos e corpore mire pellit frangitque, utique nigrum. Qua de caussa potius, quam quod in saxis nasceretur, a nostris saxifragum adpellatum crediderim."

Catalogue, 771. *Calotropis procera.* Habitat in arenosis Mithilæ, Magadhæ, et Cosalæ.

The distribution of this plant (*C. Hamiltonii*, Wight, Contrib. 53) is ill understood. Abundant in the south of Syria (Beid-el-osshar), Northern Africa, and all the warmer regions of Asia, I traced it down the Ganges to Nadiyá in Bengal, where it apparently ceases. It appears to have escaped the observation of Roxburgh, and is not mentioned in his 'Flora Indica.' The allied species, *C. gigantea*, is unknown in Northern India, except at the base of the Himálaya below Nainí Tál in Kumáon, where for some miles it occurs in profusion: thence southward I met with it wild till ten or fifteen miles below Rajmáhal, from which to Nadiya both species are intermingled, *C. gigantea*

* *Lonicera quinquelocularis* of Hardwick and Roxburgh (DC. iv. 338. no. 50) is *L. diversifolia*, Wall. (no. 24, 334), as I ascertained on the spot where the General discovered it. Exclude "ramis volubilibus."

reaching Calcutta. The name Madár* applies to both: the term Ak, also often applied, is from Sans. Arka, 'the sun,' to which the flowers always turn; hence, where the two occur, *C. gigantea* is called Bará ákand; *C. procera*, Chhota ákand; great and small Calotropis.

Griffith (Itinerary Notes, p. 207) has nearly the same distribution as above: "*Calotropis Hamiltonii*; very common throughout the sandy plains of India, on the N. side of the Rajmahal hills, to the complete exclusion of *C. gigantea*. In appearance there is scarcely any difference, and, as far as foliage goes, perhaps none; the flowers are smaller, and invariably the leaflets much smaller and bilobed at the apex." Dr. Hamilton (Linn. Trans. xiv. 246–248) explains the differences excellently. Dr. Hooker (Notes of a Tour in the Plains of India, P. ii. p. 78) notices nearly the same distribution as Griffith: "The species look very different, but when gathered, there is extreme difficulty in recognizing them." He adds, that "there is considerable discrepancy of opinion as to their comparative efficacy, the votes being in favour of *C. gigantea*."

Catalogue, No. 781. *Swertia Chirata*. Bará Chiráta.

No. 782. *Gentiana Cherayti*. Chhota Chiráta.

Dr. Hamilton informs us (p. 85) that of these two species the smaller (782) is the one most in request. It is the *Agathotes Cherayta* of D. Don (Linn. Trans. xvii. 522); *Gentiana floribunda* (Prod. 127); *G. Chirata*, Wall. (P. A. R. iii. 34. t. 252, where the flowers are of far too intense a yellow). Dr. Hamilton truly describes it as a perennial; it has *yellow* roots, hence the Arabic Kasb-al-zarīrach, 'yellow stem or twig' (Royle, 278); it brings twice the price of the other kinds: "sapore intense amaro," Wall., who also notes its "radix perennis." It flourishes in woods and shady places, with Plantago-like leaves, and is the largest plant of the whole, reaching 4½ feet high; so that the native appellation, given by Dr. Hamilton, does not apply.

No. 781 is probably *Ophelia angustifolia*, from which much of the Chiráyitá of commerce is obtained†; but several other

* Madarine, the active principle of *C. gigantea*, "possesses the property of coagulating by heat, and becoming again fluid on exposure to cold."

† D. Don (Linn. Trans. *l. c.* 524) says it is "more bitter than the last," the *Agathotes*. Wallich, on the contrary (Pl. As. Rar. iii. 2), says that it and *paniculata* "possess only a slight degree of bitter taste." Don is here most correct, according to my experience.

The large and handsome Swertias of the Alpine Himálaya do not appear to be imported to the plains.

Chiráyitá derives its name from the Kirátas, a people of Eastern Nepál, the *Cirrhadæ* of Arrian: hence the Sanscrit Kiráta-tikta; but the mountaineers call it simply Kánda Títa, 'bitter stem.'

species, *alata, cordata, fasciculata, purpurascens,* are equally esteemed or collected. These are annuals, and abound in open sites, at various zones from 4000 to 12,000 feet above the sea. *Ophelia angustifolia* and *paniculata* are figured in Wallich's Pl. As. Rar. iii. t. 204–5.

"The Kutki is another officinal plant, with a woody root, and a stem containing many alternate leaves, toothed on the edges and shaped like a spathula. It has much the appearance of a Saxifrage. The roots are brought for sale" (p. 100). *Picrorhiza Kurrooa,* Royle, Illustr. t. 71. f. 2, a bitter for which he tells us that *Gentiana Kurroo* is frequently substituted. *Nima quassioides,* occurring in the valleys of Baschar and Upper Garhwal at 5500 to 8000 feet, is also called Karwí, from its exceedingly bitter bark and wood.

Picrorhiza Kurrooa is abundant in the Alpine Himalaya, on the open downs above the limit of forest, 12,000 to 14,000 feet. There is a second species in Kumáon, discovered by Major R. Strachey, at similar heights.

Jatámángsi, p. 97: the Nard or Spikenard of the ancients; Hebrew Nereddc, from the Sans. Nalada, *i.e.* 'giving fragrance.' *Nardostachys Jatámánsi,* Royle, Illustr. t. 54. f. 2. *Patrinia Jatamasi,* Don, Prod. 159, 160. The Indian women consider the smell very agreeable, and most of them that can afford it use oil impregnated with this root for perfuming their hair. "All I can say is," adds Dr. Hamilton, "that if this root was the Spikenard of the Roman ladies, their lovers must have had a very different taste from the youth of modern Europe." Cant. i. 12. There is, however, a larger species, *N. grandiflora* (DC. Prod. iv. 624), in Kumáon, flourishing at similar elevations (13,000 to 14,000 feet) to *N. Jatámánsi**, and with a similar root; "but it is much larger, and its smell is more agreeable" (Wall. P. A. R. iii. 40); and Lambert (Genus Cinchona, 1821, p. 179) says, it "may be considered as possessing the most agreeable odour of any" of the Valerians. His figure (p. 180) evidently represents this species, not *N. Jatámánsi*; and the description, anticipated from Don's Prodromus, proves that the latter also, unless made from Nepál specimens, belongs to it. The perfume and properties of the genus are, in fact, very nearly those of *Valeriana Celtica* and *Phu*; and it is curious enough that the radical leaves of the last two species (the roots of which are substituted in Western Asia for the Spikenard) are simple, and bear a considerable resemblance to those of *Nardostachys.*

* It is strange that DeCandolle (iv. 624) should assign Mándu and Chitor in Central India as stations for this plant, which cannot live at Almorah, 5500 feet, beyond a few months.

The name Jatámánsi signifies 'locks of hair,' sometimes simply Mási; and the vernacular Bálchhar denotes 'hairy staff,' all with reference to the root, which has been compared to the tail of an ermine, "on account of its withered stalks and ribs of leaves, cohering in a bundle of yellowish-brown capillary fibres." Pliny's description accords (N. H. xii. 26): "Cacumina in aristas se spargunt: ideo gemina dote nardi spicas ac folia celebrant." *Spica* is a translation of the Arabic Sumbul, Hindí Bal, 'an ear of corn.' Sir W. Jones, in As. Res. ii. 405–10, iv. 109, where the figure (copied, except the root, by Roxburgh, *ib.* iv. 435) with cordate radical leaves, is, as Lambert truly observes (*l. c.* p. 179), that of *Valeriana Hardwickii* (Pl. As. Rar. iii. t. 263). The roots of this very common species have the same smell as those of *V. officinalis*, are also used medicinally, and were substituted by Sir William Jones's collectors without any very glaring imposture. In Pliny's time also, adulteration took place by Pseudo-nard, "crassiore atque *latiore* folio." They are called Shameo in Nepál and Kumáon, the Sanscrit Shami, from Sham, 'to calm'; proving how widespread is the antispasmodic energy attributed to them.

The aromatic-rooted Grass, *Andropogon Jwaráncusa* (*i. e.* the 'fever-goad,' also Jwaranásaka, 'fever-destroyer'), at first taken for the Spikenard*, is abundant all along the base of the Himalaya, and in the valleys of Kumáon up to 4000 feet. At a lower level in the valley of the Alakananda in Garhwál, the still more fragrant species, *A. Calamus-aromaticus*, Royle, t. 97, *nardoides*, Nees, from which the celebrated Rusa, or Grass-oil of Nimmár, is distilled, is not uncommon. Dr. Royle only traces it north to Delhi.

"The Manjít, or Indian Madder, seems to be of two kinds: the *Rubia cordata* of Willdenow, and a species of *Rubia* not described in the common systems of Botany. Both seem to be equally fit for the purpose, and grow in the same manner. It is cultivated exactly as cotton is among the hills" (p. 74).

Catalogue, No. 354. *Rubia cordifolia.*

Catalogue, No. 355. *Rubia Chaya.* From Bhotan.

The first is *Rubia Manjistha*, Roxb. i. 374, the *R. cordata* of Thunberg, from Japan; differing by its pentandrous flowers from *R. cordifolia*, L., from Siberia. But this test is not satisfactory, as remarked by Wight and Arnott, whose statement is perfectly correct, that the flowers of *R. Manjisthá* are frequently tetrandrous. DeCandolle (iv. 588) describes them as all pentandrous, and those of *R. cordifolia* both tetrandrous and pen-

* "The root of *Andropogon muricatum*" is given as a secondary meaning of *Nalada*, Spikenard.

tandrous, agreeing with *R. Javana* (*R. cordifolia*, Blume), which he considers a medial form. Wight and Arnott (Prod. 442), Wight (Icones, i. t. 187; Illustr. ii. t. 128 *bis*), and Don (Prod. 133) all identify them. *R. Manjistha* is very abundant in the Himálaya, from 4000 to 9500 feet, with black fruit, and deep red flowers, not yellow, as represented in Archer's Popular Economic Botany, P. xv. f. 78.

The second species, which Dr. Hamilton considers new, is by Dr. Wallich (No. 6069) identified with *R. cordifolia*, L. Our Edinburgh specimen, however, though imperfect, seems to be an undescribed species, which I found in the glen of the Sarju River in Eastern Kumáon, in two localities, Rámesar and Gangoli, at 3000 to 4000 feet elevation above the sea. Mr. Edgeworth proposes to name it *R. nervosa*. Griffith (Itinerary Notes) probably found it in Bhotan; his No. 11 is *Rubia Manjistha*, Dewangiri, in woods. No. 116. *Rubia cordifolia*; alt. 2800 ped. in sylvis. No. 367. *Rubia cordifolia*. Khegumpa. Yields Manjistha (Madder). No. 1021. *Rubiæ sp.* Scandens, hirsuta, certe distincta a *R. cordifolia*; towards Panga, in woods, 6500 to 7500 feet. In the Journals of Travels, p. 203, he writes at Dewangiri, elevated 2000 feet: "I find that large quantities of Manjistha or Madder are sent to the plains from this, where the plant is very common." At p. 292 we have *Rubia hispida*, at 8700 feet; and at p. 296, *Rubia hirsuta*, at 5500 feet. At p. 209 he says, "Madder is furnished by both *Rubia Manjistha* and *R. cordifolia*; these species are quite distinct, the latter affecting greater elevations than the former, scarcely descending below 4000 feet." The plant becomes shorter and stouter at high elevations; and in a matured Report, published in the Journ. As. Soc. Bengal for April 1839, p. 281, he modifies this view, and identifies these two supposed species, adding that "Bhotan has *two* species. The two species used in Bhotan are very distinct, and very general constituents of other mountainous floras; one of them has leaves without stalks." This is perhaps Dr. Hamilton's plant from Bhotan. His specific name *Chaya* appears to vindicate a practice condemned by Mr. Archer (*l. c.* 212): "Munject is often called Chay-root; but this is a mistake, the latter being the produce of a totally different plant," *Hedyotis umbellata*, in Tamul Saya. In Bengal, Cháyá is *Ærua lanata*. Wallich (Roxb. Fl. Ind. i. 384) has *Rubia alata*, from Nepál, which Don reduces to *R. cordifolia*; and Major Strachey has a *Rubia* from Nítí in Garhwál, with greenish flowers, which he considers to be *R. Manjisthá* of Roxburgh. *Rubia purpurea*, figured and described by Decaisne in Jacquemont's 'Voyage aux Indes,' is merely *R. cordifolia*, one of the many instances in that valuable work of needless synonyms, owing to the want of ordinary precaution as to what previous botanists had already named.

"Umbelliferous plant with root resembling *Athamanta Meum*, and when fresh, an uncommonly fragrant smell" (p. 98). Very probably the well-known *Chora*, *Angelica glauca* of Mr. Edgeworth, abundant at 9000 to 10,000 feet (and which I take to be the aromatic Gertheon or Certheana of Assam, a compound of *Valeriana* and *Pastinaca*, Griffith, Journals, 37, 57; and J. A. Soc. Beng. 1837, 331, 335). Two thousand feet higher flourishes the Hushiál, also very aromatic, which I believe to be *Hymenolæna angelicoides*, DC. Prod. iv. 245; as well as *Hymenidium Brunonis*, Nesir or Lesir* of the mountaineers, a very fragrant plant.

Bhutkes: Bhutkesar, pp. 86, 98. "A thick woody root, on the top of which were many stiff bristles, and from among these the young leaves were shooting." These Dr. Hamilton thought belonged to *Thalictrum*, and Dr. Royle (Illustr. p. 69) refers Bhutkes to *Corydalis Govaniana*; but it is actually the root of *Oreocome filicifolia* and *elata* of Mr. Edgeworth (Linn. Trans. 1845), especially the former. This is probably identical with *Selinum Candollii* (*Peucedanum Wallichianum*, DC. Prod. iv. 181; *Selinum tenuifolium*, Wall.) and *Pleurospermum cicutarium*, Royle, Illustr. Don's three species of *Athamanta*, Prod. 184–5, described in accordance with the signification of Bhutkes, seem to belong to *Oreocome*. Both the above plants, and one or two species of *Cortia*, growing at great elevations (14,000 to 15,000 feet), are well known all over the Himalaya by Dr. Hamilton's names, which signify 'hair of the spectre,' against which they are worn as charms. They are often called simply Kés, 'hair,' for the same reason as the Jatámánsi. With the medicinal root Bhutkes, Dr. Hamilton mentions another, called Jainti, which he refers to an Orchid growing among moss on large stones, on the higher mountains. *Cœlogyne præcox* is so described on his authority in Don's Prodromus, p. 37. "Brim" (p. 100) is another

* Dr. Hoffmeister has pointed out the resemblance of this name and plant to the *Laserpitium* (Lesir-pati) of the Romans, the *Silphium* of the Greeks, which the historians of Alexander inform us that his army found in Afghánistan. The Greeks of Cyrenaica represented the plant (*Thapsia Silphium* of Viviani, Flor. Lib., or *Thapsia garganica*, Desfontaines) on their coins still extant; and Pliny (N. H. xix. 15; xxii. 49) paints in high colours the virtues of its gum-resin, *Laser Cyrenaicum*, as a medicine and perfume. The celebrated drug, *Asa dulcis* of Cyrene, recalls the Assafœtida of Persia, as well as a kind of incense from the Himálaya, called Asá purí (*i. e.* 'the fulfiller of hope'), of which the Nepalese told me wonderful virtues.

orchideous root used in medicine; but neither of this nor of the Bariyalbhera seeds (p. 285) from Chhináchhin in Yumila, a province east of Kumáon, have I any identification to bring forward.

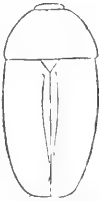
XXXIX.—*Monograph of the genus* Catops. By Andrew Murray, Edinburgh.

[Concluded from p. 404.]

Exotic Species.

56. *C. suturalis* (mihi).

Fig. 49.



Affinis *C. sericeo*, sed elongatior, lateribus minus rectis, et thorace forma breviore; elytris longioribus. Long. $1\frac{1}{8}$ lin.

Fuscous; head and thorax with fulvous sericeous pubescence; elytra ferruginous-brown, with the anterior half of the sutural margin and the margins of the elytra darker; inflexed margins of elytra and margins of under side of thorax clear ferruginous, remainder of under side pitchy-black; legs ferruginous. Antennæ with base ferruginous, club and apex dark; first joint large and long; second not so long; third and fourth of nearly the same length; fifth shorter than fourth; sixth shorter than seventh; seventh large and broad; eighth very small; three last nearly of the same size. Thorax faintly transversely strigose, posterior angles obtuse. Elytra deeply transversely strigose. Scutellum elongate. Sutural stria shortened, joining the suture at about one-third from the apex. Elytra truncate at the apex; pubescence on elytra darker than on thorax.

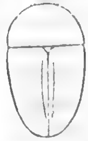
This species has a great resemblance to *C. sericeus*, but differs from it in the following particulars. In general outline it is scarcely broader in front than behind, while *sericeus* is usually markedly so. The thorax begins to round-in towards the head almost immediately from the base forward, while in *sericeus* it does not begin to turn inwards till about the middle of the thorax. Scutellum more elongate than in *sericeus*. The length of the elytra is $2\frac{1}{2}$ times that of the thorax, while in *sericeus* it is not so much as twice that length. The elytra also are not so broadly truncate at the apex.

Described from a specimen in M. Chevrolat's collection received under this name from M. Motschoulsky. Locality not mentioned; supposed to be from Mongolia.

57. *C. californicus*, Leconte.

Catops californicus, Lec. Synopsis of Silphales of N. America, Proc. Acad. Philadelphia, vol. vi. 1853, p. 281.

Fig. 50.



Oblongus, subovalis, piceus, sericeus, subtilissime punctulatus et transversim strigosus; antennarum basi, pedibus, elytrisque pallidioribus, his stria suturali profunda; thorace antrorsum valde angustato, angulis posticis paulo productis subacutis.
Long. 1 lin.

The antennæ are slightly clavate and as long as the head and thorax; the thorax is strongly narrowed in front, truncate at base, and slightly sinuate near the posterior angles, which are subacute; the sides are broadly rounded; the disk is sometimes blackish, and the sides dark rufous. The punctures of the upper surface in this species are very indistinct, and the transverse striæ very fine; the pubescence is sericeous, but not dense; the anterior tarsi of the male are strongly dilated, the intermediate pair simple, the posterior pair longer than the tibiæ.

Dr. Leconte mentions that it is abundant at San Jose and San Diego, California. He also observes that one female specimen which he had from San Diego appeared more elongated than the others and much more narrowed posteriorly. He could not, however, find any other difference.

58. *C. consobrinus*, Leconte.

Catops consobrinus, Lec. Syn. Silph. N. Amer. Proc. Acad. Philad. vi. 1853, p. 281.

Fig. 51.

"Oblongo-ovalis, subelongatus, ater, subsericeus, vix punctulatus, subtiliter transversim strigosus; antennis basi rufo-piceis; elytris stria suturali profunda; thorace antrorsum modice angustato, angulis posticis leviter productis.
"Long. 1 lin.

"Georgia. This species resembles the two preceding, but is a little more elongated and more oval; it is entirely black, excepting the base of the antennæ and the tarsi, which are rufo-piceous. The thorax is more than one-half wider than long, moderately narrowed in front, broadly truncate at apex, very slightly rounded on the sides, truncate at base, and faintly sinuate at the posterior angles, which are slightly acute. The punctures are very indistinct. The transverse scratches are as fine as in *C. californicus**."

* Leconte in *loc. cit.*

59. *C. Lecontei*, mihi.

Catops strigosus, Lec. Syn. Silph. N. America, Proc. Acad. Philad. vol. vi. 1853, p. 281.

"Oblongo-ovalis, subelongatus, piceo-rufus, sericeus, distinctius strigosus; thorace latitudine sesqui breviore, antrorsum modice angustato, angulis posticis vix productis, subacutis; elytris stria suturali profunda; antennis magis incrassatis, piceis, basi testaceis.
"Long. 1 lin.

Fig. 52.

"One female, South Carolina, Dr. Zimmerman. This species resembles the preceding, but the thorax is less narrowed in front and less rounded on the sides; the transverse lines on the thorax and elytra are more distinct; the punctures are very indistinct; the first four or five joints of the antennæ are testaceous, the rest are piceous; the apex is indistinctly paler*."

The "Synopsis of the Silphales of America north of Mexico," in which this species was described by Dr. Leconte under the name of *strigosus*, was published in February 1853, while M. Kraatz's description of the European species so named by him was published in the 'Stettin Ent. Zeitung' in 1852. By the rule of priority therefore, the name *strigosus* must be retained for Kraatz's species, and another name given to this. It appears to me that it is an appropriate homage to name it after the eminent naturalist who first described it.

60. *C. oblitus*, Leconte.

Catops oblitus, Lec. Syn. Silph. N. Amer. Proc. Acad. Philad. vi. 1853, 282.

"Subellipticus minus convexus, rufo-fuscus, pubescens; thorace punctulato antrorsum subangustato basi truncato, angulis posticis fere obtusis; elytris transversim minus dense strigosis, stria suturali distincta; antennis flavis, art. 4–10 fuscis.
"Long. $1\frac{1}{2}$ lin.

Fig. 53.

"Three specimens, Georgia. Easily distinguished by its subelliptical and less convex form. I cannot discover any punctures on the elytra; if they exist they are concealed by the dense pubescence, which is however scarcely sericeous. The male has three joints of the anterior tarsi dilated; the middle tarsi are simple in both sexes†."

The mesosternal keel is less elevated in this and the next than in the other species.

* Leconte in *loc. cit.*

† Leconte in *loc. cit.*

61. *C. parasitus*, Leconte.

Catops parasitus, Lec. Syn. Silph. N. Amer. Proc. Acad. Philad. vi. 1853, p. 282.

"Breviter ovatus, piceo-rufus, sericeus; thorace disco obscuriore, brevi, antrorsum valde angustato, angulis posticis non productis; elytris transversim strigosis, stria suturali profunda; antennis basi apiceque flavis.
"Long. $\frac{3}{4}$ lin.

Fig. 54.

"New York, in ants' nests, with *Hæterius brunnipennis*, March and April. This species is much broader and more suddenly narrowed posteriorly than the others. The thorax is fully twice as wide as its length, punctulate, not strigose, strongly narrowed in front, broadly rounded on the sides, truncate at base, with the posterior angles simply rectangular and not produced. The elytra are punctulate and distinctly striate transversely. The antennæ are as long as the head and thorax, very slightly incrassated, rufo-piceous, with the first four joints and the apical one yellowish; the seventh joint is more than twice the length of the sixth; the eighth joint is much shorter, but scarcely thinner than the following ones. The anterior tarsi of the male are broadly dilated; the first joint of the middle tarsi is less dilated than in *C. terminans**."

The mesosternal keel is finer and less raised in this and *C. oblitus* than in the other species.

62. *C. ascutellaris*, mihi.

Oblongo-ovatus, fusco-sericeus; antennis vix ad apicem incrassatis, fuscis, basi apiceque ferrugineis; thorace elytrisque leviter transversim strigosis, his stria suturali impressis; *scutello inviso*.
Long. $\frac{7}{8}$ lin.

Fig. 55.

Fuscous-brown. The antennæ are scarcely so long as the head and thorax, so slightly clavate as to be almost filiform, fuscous, the basal joints ferruginous, the two apical joints pale; first and second joints long and slender, those following short, gradually though very slightly increasing in breadth up to the seventh; the seventh is rather shorter than the ninth, and of about the same thickness; the eighth is not narrower than those on each side of it, but shorter, being about half the length of the ninth; the ninth and tenth are equal in length and thickness; the eleventh is larger than the tenth, and becomes acuminate towards the point. The head is darker than the rest of

* Leconte in *loc. cit.*

the body. The thorax forms a continuous or nearly continuous line with the elytra; its posterior angles do not project behind; both thorax and elytra are seen under a powerful lens to be very finely though distinctly transversely strigose. The elytra are not truncate, although they are rounded rather rapidly at the apex. The scutellum is not visible. The sutural stria is distinct at the base, but it draws closer to the suture as it proceeds to the apex, and is lost before it reaches it. Under side and legs ferruginous-brown.

From Caraccas. I received this species from M. Deyrolle, under the manuscript name of *æquinoctialis*; but the advantage of having a name bearing reference to some particular character, when that can be had, is so obvious, that I am sure that that excellent entomologist will excuse my not adopting the name he had destined for it.

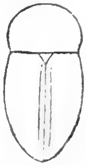
63. *C. australis*, Erichs.

Catops australis, Erichson, Wiegm. Arch. (1842) p. 243.

Mesosterno carinato, niger, nigro-pubescens; thorace elytrisque transversim strigosis.

Long. $1\frac{1}{3}$ lin.

Fig. 56.



Oval, lightly convex, black, with black pubescence. Antennæ of the length of the head and thorax, the apex slightly thickened, the eighth joint narrower than those next it, black, piceous at the base. Thorax about the same breadth as the elytra, with the sides lightly rounded, the posterior angles slightly projecting obliquely behind, nearly right-angled; the base subsinuate on each side, finely transversely strigose. Elytra transversely feebly strigose, the strigations rather widely separated, impressed with a sutural stria, rounded at the apex. Legs concolorous, tarsi piceous, the anterior lightly dilated at the base in the males. Mesosternum slightly keeled.

This species seems to come between *strigosus*, Kraatz, and *sericeus*.

It is found in Tasmania, and is the only species yet recorded from the southern part of the hemisphere.

Genus Catoptrichus, mihi.

Antennæ of eleven joints, the last eight of which are strongly serrated in the males, somewhat less so in the females; the three first are slender; the eighth joint is very slightly, if at all, narrower or shorter than those on each side of it. In other respects the characters do not differ from those of *Catops*.

1. *C. Frankenhæuseri*, Mann.

Catops Frankenhæuseri, Mann. Bull. Soc. Imp. Mosc. 1852, pt. 2. p. 332.

Elongatus, fusco-piceus, griseo-pubescens; antennis pectinatis, basi ferrugineis, articulo ultimo pyriformi apice acuminato; thorace quadrato, angulis rotundatis, obsolete canaliculato, postice in medio impresso; elytris oblongo-ellipticis, subtilissime punctulatis, tenue striatis, stria suturali profundiore, rufo-testaceis, cinereo-holosericeis, pilis longis fuscis præsertim in margine obsitis; pedibus ferrugineo-piceis.

Long. $2\frac{1}{2}$–3 lin., lat. $1\frac{1}{4}$–$1\frac{1}{2}$ lin.

Fig. 57.

Elongate, having a good deal the form of the first group (subg. *Choleva*) of the genus *Catops*: fuscous, clothed with a griseous pubescence. Antennæ pectinated, black, ferruginous at the base; the first three joints slender; third longer than second; fourth to tenth each of nearly equal length, globose, with a long spine proceeding outwards. Thorax quadrate, angles rounded, obsoletely canaliculated, impressed behind in the middle. Elytra oblong-elliptic, very finely punctulated, feebly striated, the sutural stria deeper, rufo-testaceous, with a cinereous bloom and clothed with long brown hairs, especially on the margin; legs dark ferruginous.

Inhabits the island of Sitka. Several specimens were taken by M. Frankenhæuser in a human body lying in a wood, and in putrid fungi.

I owe the above figure to Dr. Leconte.

Genus Catopsimorphus, Aubé.

Catopsimorphus, Aubé, Ann. Soc. Ent. France, 2 sér. vol. viii. p. 324.

" Antennæ with eleven joints, very much flattened; the eighth not narrower and scarcely shorter than the seventh and ninth. Epistome cut almost straight. Labrum broadly and deeply emarginate, and provided in front with a small very slender membrane, strongly emarginate in the middle and ciliated in the emargination. Mandibles denticulated at the extremity and furnished within with a ciliated membrane. Maxillæ with the internal lobe terminated by a small hook; the external lobe obtuse and hairy at the extremity. Maxillary palpi with four joints, the first very small, the second slightly clavate, the third obconic, the last conical, a half smaller than the third. Labium membranous, pretty deeply emarginate. Labial palpi with three cylindrical joints, the last smallest. Tarsi with five joints, the anterior and middle probably dilated in the male. The facies of this genus is completely analogous to that of *Catops*. It differs from it principally in the form of the antennæ. We know nothing of its mode of life*."

1. *C. orientalis*, Aubé.

Catopsimorphus orientalis, Aubé, Ann. Soc. Ent. Fr. 2 sér. viii. 325.

Fig. 58.

"Ovalis, convexiusculus, niger, griseo-pubescens; antennis, ore, elytris pedibusque ferrugineis; thorace antice angustato, angulis omnibus rotundatis.—$3\frac{1}{2}$ mill.

"Head black, somewhat brilliant, tolerably broad, very finely punctate and slightly pubescent. Labrum, palpi and antennæ testaceous; the latter with the first joint longish, cylindrical; the second almost globular; the remainder transverse, flattened and gradually increasing in size to the last, which terminates in a point; the eighth scarcely shorter than the seventh and ninth. Thorax black, pubescent and finely punctate and reticulated, more than one and a half times broader than long, much narrower in front than behind, cut almost straight at the apex and the base, very broadly rounded at the sides; the anterior and posterior angles obtuse and rounded. Elytra as broad as the thorax at the base, about one and a half times longer than broad; broadly rounded behind; ferruginous, less finely punctate and reticulated than the thorax; pubescent and marked with a deeply impressed stria on each side of the suture. Under side of body black, with the extremity of the abdomen somewhat ferruginous. Legs ferruginous; thighs slightly brown†."

Dr. Aubé mentions that he had two individuals of this species, both taken in the neighbourhood of Constantinople. He supposes them to be both females from their having all their tarsi simple.

Since the first part of this paper was in print, I have had an opportunity of carefully examining the specimens in the collection of the Count Dejean, now belonging to the Marquis de Laferté Senectère, who kindly placed them in my hands for that purpose; and it may be desirable that I should state the

* Aubé in *loc. cit.*

† Aubé in *loc. cit.*

result of my examination in reference to the names used by Count Dejean and published in his Catalogue. The specimens are for the most part in good order and preservation. A few, however, were in a less satisfactory state, and of course I give my opinion of these with doubt. As might be expected in such a difficult genus, there were sometimes more than one species placed under the same name, so that it is a matter of opinion which was the typical species he intended to designate.

The names in the collection correspond with those published in the 3rd edition of his Catalogue, 1837. His

Catops rufescens=*C. angustatus*, Erichs.
—— *oblongus*=*cisteloides*, Frœhl. (*castaneus*, Sturm).
—— *ovatus*, Dej.=*agilis*, Erichs.
—— *major*, Dej.=*picipes* Erichs.
—— *Americanus* was in too bad a state to determine.
—— *morio*=*nigrita*, Erichs.

Under this name were found specimens of *nigrita*, *fuscus*, and *umbrinus*, but the preponderance in point of number was decidedly in favour of *nigrita*.

Catops tibialis, Dej.=*coracinus*?, Kelln.

This species and a portion of those standing under the next name, *fuscus*, but which were the same, were marked as coming from Portugal. I thought they came nearer to *coracinus* than any other, but am not satisfied that they were not perhaps an undescribed species.

Catops fuscus=*tristis*, Erichs.

I have no doubt that Dejean meant *tristis* to be the type of his *fuscus*. He had a number of *tristis*, and one of *grandicollis* under it, and none of these under any other name. At the same time he had among them several of the above Portuguese species, and some of *alpinus*, Gyll., as well as *Spencianus*, Kirby (*cadaverinus*, Mann.).

Catops chrysomeloides=*chrysomeloides*, Sp.
—— *australis*=*australis*, Erichs.
—— *agilis*=*fumatus*, Erichs.

Some of *C. alpinus*, Gyll., were mixed with *fumatus* under this name, but the great majority were the latter.

Catops truncatus=*sericeus*, Erichs.

A single *fumatus* and a single *velox* have found their way into the mass of *sericeus*, but this is obviously by inadvertence.

Catops transverso-striatus=a new species described by me under this name in the foregoing pages.

Catops pallidus=*velox,* Spence. Represented by a single bad specimen.

—— *luridus*=*scitulus,* Erichs.

The first specimens are *scitulus,* then follow some of *velox,* and lastly what may be *brunneus,* Sturm.

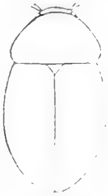
—— *flavescens*=*præcox,* Erichs.

—— *minutus*=*anisotomoides,* Spence.

The remainder of his species are different species of *Colon,* and do not fall within this Monograph.

On looking over the preceding parts of this paper, I am not satisfied with the figure given of *C. nigrita* (fig. 12), and would beg the reader instead of it to adopt the figure I now give, as a more accurate representation of the species.

A figure of *transverso-striatus* ♂ was omitted to be given with the text. It is now supplied.



C. nigrita.

C. transverso-striatus.

I have only now to add the Dichotomous Table of the European species which I promised at the commencement of this paper. It is not to be understood as a substitute for the descriptions, but merely as a slight aid in turning to the quarter where the species are likely to be found.

Dichotomous Table of Characters of European Species of Catops.

	Mesosternum simple	1
	Mesosternum keeled	30
1.	Antennæ nearly filiform and decidedly longer than thorax	2
	Antennæ more or less clavate, and not longer or very slightly longer than thorax	5
2.	Thorax broader towards base than in front	*agilis.*
	Thorax not broader towards base than in front	3
3.	Punctuation coarse, pubescence long and sparse, and elytra bellied out	*spadiceus.*
	Punctuation fine, pubescence dense and short, and elytra elongate and narrow	4

4.	Margins of thorax paler than middle	*angustatus.*
	Margins of thorax not paler than middle ... *do.* var.	*cisteloides.*
5.	Base of thorax cut in, so as not to form a continuous outline with elytra	6
	Base of thorax forming a continuous outline with elytra or nearly so	19
6.	Colour of pubescence grey and brown or dull yellow on thorax, yellowish hairs on base and margins of elytra wanting or scarcely perceptible, and either no bloom or grey bloom on elytra	7
	Colour of pubescence clear yellow on thorax, a brownish-blue or purplish bloom on the elytra, and yellowish hairs on base and sides of elytra...	14
7.	Antennæ longish and subfiliform, not heavily clubbed	8
	Antennæ shorter and more clavate	12
8.	Elytra transversely strigose	*acicularis.*
	Elytra not transversely strigose	9
9.	Antennæ with apex pale	*picipes.*
	Antennæ with apex not paler than rest	10
10.	Posterior angles of thorax acuminate behind	11
	Posterior angles of thorax not acuminate behind...	*fuscus**.
11.	Posterior angles much produced, antennæ wholly ferruginous	*meridionalis.*
	Posterior angles only slightly produced, antennæ more dusky towards apex	*nigricans.*
12.	Antennæ very heavily clavate	*chrysomeloides.*
	Antennæ only moderately clavate	13
13.	Insect thin and narrow	*morio.*
	Insect shorter and more compact	*coracinus.*
14.	Antennæ comparatively long and subclavate	*nigrita.*
	Antennæ heavily clavate	15
15.	Thorax deeply punctured	*neglectus.*
	Thorax more or less transversely granulose or wrinkled	16
16.	Thorax nearly parallel on the sides	*quadraticollis.*
	Thorax not parallel on the sides	17
17.	Thorax faintly transversely wrinkled	18
	Thorax granulose .... *tristis*, var.	*rotundicollis.*
18.	Thorax short, transverse, and not broad; elytra usually very long	*tristis* (type).
	Thorax broad, elytra moderate in length ... *tristis*, var.	*grandicollis.*
19.	Middle tarsi widened in males	20
	Middle tarsi not widened in males	25

* *Fuscus* is one of those species, which, from their transitional characters, nearly put dichotomy at defiance. It might almost be placed under No. 19 instead of No. 6, as the base of the thorax has only a slight interruption in its continuity; and again, its brown or purplish elytra are not unlikely to induce one to place it under No. 14 instead of No. 7.

20.	Antennæ heavily clavate	21
	Antennæ subclavate	22
21.	Thorax not narrower at base than elytra	*fumatus.*
	Thorax slightly narrower at base than elytra	*alpinus.*
22.	Thorax with posterior angles rounded	*brevicollis**.
	Thorax with posterior angles not rounded	23
23.	Thorax with lateral margins reflexly sinuated	*depressus*†.
	Thorax with lateral margins rounded	24
24.	Thorax with posterior angles projecting strongly backwards, forming an acute angle; elytra not distinguished by sericeous pubescence	*umbrinus.*
	Thorax with posterior angles projecting slightly backwards, the angle not acute but right-angled; elytra distinguished by a silky pubescence which in different lights shows like a light band across them	*scitulus.*
25.	Thorax not wider at base than elytra	26
	Thorax slightly wider at base than elytra	*præcox.*
26.	Elytra more than three times the length of thorax	*transverso-striatus.*
	Elytra not more than three times the length of thorax	27
27.	Basal margin of thorax sinuated	*velox.*
	Basal margin of thorax straight	28
28.	Posterior angles of thorax right-angled	*badius*‡.
	Posterior angles of thorax obtuse	29
29.	Insect roundish	*anisotomoides.*
	Insect more elongate	*brunneus*‡.
30.	Body polished and shining	*lucidus.*
	Body not polished	31
31.	Elytra not truncate	32
	Elytra truncate	33
32.	Elytra acuminate	*strigosus.*
	Elytra not acuminate	*Colon.*
33.	Antennæ with apical joint pale	*varicornis.*
	Antennæ with apical joint not pale	34
34.	Antennæ heavily clubbed, with base not paler than rest	*validus.*
	Antennæ moderately clubbed, and base paler than club	*sericeus.*

* Not having seen this species, I only place it under No. 19 provisionally, the description given by M. Kraatz being scarcely sufficient to satisfy me as to its place.

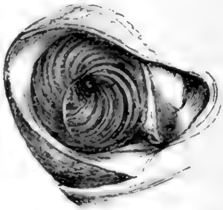
† Not having seen the male of this species, it is only from supposition that I have placed it under No. 20.

‡ Not having seen *badius* nor *brunneus*, their place is marked provisionally and with hesitation.

XL.—*On the Abnormal Operculum of* Polydonta elegans *of New Zealand.* By Dr. J. E. Gray, F.R.S. &c.

In the 'Annals and Magazine of Natural History' for May 1854, N.S. vol. xiii. p. 419, I described the reproduced operculum of a *Fusus,* fig. 1, and the restored operculum of *Pleurotoma babylonica,* showing that the restored operculum and the mended part of one only partially destroyed differed from the normal form of the operculum of the species.

At that time I had not observed the same fact in opercula of a spiral form. In an interesting collection of shells and other animals made in New Zealand by Dr. Andrew Sinclair, the late Colonial Secretary of that colony, I found a specimen of *Polydonta elegans* with a very abnormal operculum; arising, I have little doubt, from the operculum having been entirely destroyed by some external violence and reproduced by the animal.


Reproduced operculum of *Polydonta elegans.*

The reproduced operculum is circular, of the size of the mouth of the shell, but instead of being formed of numerous narrow, very gradually enlarged whorls, it has a rather large central circular part or nucleus, which extends into a broad, rather rapidly enlarging whorl and a half, somewhat like the opercular or the more circular-mouthed *Littorinidæ.*

I may observe, that though I have examined all the opercula of shells that have come under my notice for years, I have never seen any example of reproduction of the operculum in the *Trochidæ* before; but according to the following paragraph, extracted from Mr. Clark's 'Marine Mollusca,' p. 309, it is not uncommon in *Trochus lineatus*:—"A singular character is attached to this species, which I have not observed in any other *Trochus.* The animal either casts the operculum, or is deprived of it by the attacks of enemies, perhaps from its own *pulli,* white masses of which, in the genial season, I have seen deposited on the foot, and they may possibly feed on and destroy it; however this may be, numerous examples are found with the opercula in various stages of development and renewal, but never resembling the original: this is a curious fact, which I can at present scarcely account for on rational grounds. The renewals and reparations form irregular spiral, oblique and elliptical curves, or, instead of the sixteen normal volutions, often only show two grossly spiral ones, as in the *Littorina littorea.* I have many such in my collection. I may observe, that, however the sculpture of the area may be varied, the operculum always retains the circular form."

I think the irregularity may be easily explained, when we consider that the animal has to reproduce the operculum in the most rapid manner to replace the lost part, and therefore commencing from the centre, it forms only one or one and a half broad whorl, instead of the large number which it gradually deposited. As it has to adapt the operculum to the increased size of the mouth of the shell and of the foot on which it is formed, and the end of the foot of the animal and the circular mouth of the shell not being altered by the abstraction of the operculum, the reproduced operculum is naturally of the form of the previous normally formed one.

XLI.—*Note on* Reticularia immersa *and* Halia prætenuis. By the Rev. Thomas Hincks, B.A.

In the 'Annals' for February 1855 I described a supposed Polyzoon under the name of *Halia prætenuis*. I had never met with the species living, and merely inferred from the character of the cell, &c. that it must be ranked as a Polyzoon, and not as a Hydroid. Mr. Alder, having recently made a careful examination of the common parasite of *Sertularia abietina* and other zoophytes, which passes as the *Reticularia immersa* of Professor Wyville Thomson, has informed me that he can detect no difference between this species and the *Halia*, and that he believes them to be identical. I have now no doubt that his opinion is correct, and that the genus *Halia* was founded on specimens of the zoophyte which Prof. Thomson has described as *Reticularia immersa*. In characterizing this species, however, he has fallen into a mistake as to the form of the cell, and his figure (*vide* Annals, Ser. 2. vol. xi. pl. 16) is not an accurate representation of the reality. Deriving my knowledge of *Reticularia*, as I did, from his description and figure, there was nothing to lead me to suspect its identity with the form which I had obtained on mussel-shells from the Dogger Bank, and which I published as *Halia prætenuis*. I could have no doubt that *the zoophyte of his paper* was not the species which I had before me when I constituted the new genus.

The cause of this mistake on the part of so able a naturalist may perhaps be found in the difficulty which attaches to the examination of *Reticularia* in its ordinary state,—the cells being densely packed together and forming a confused mass, amidst which it is no easy matter to trace the form. When the species creeps over shell (as was the case in my specimens) the character is greatly altered,—the cells are sparingly distributed along the fibre, and the difficulty vanishes. Both Prof. Thomson and myself overlooked the fact, that the production, which we respectively designated as *Reticularia* and *Halia,* had been previously described by Mr. Hassall in the Transactions of the Microscopical Society (vol. iii. p. 163) under the name of *Campanularia serpens.* Mr. Hassall's description may not perhaps be as full and precise as might be desired, but it is sufficient for the identification of the species. There is no doubt that it has no claim to a place in the genus *Campanularia,* and that Prof. Thomson was right in constituting a new genus for its reception. The name *Reticularia,* therefore, must be retained, but Mr. Hassall's specific designation is entitled to precedence.

The characterization may be revised as follows :—

Order Hydroida.

Fam. ——— *.

Genus Reticularia.

Polypidom "a parasitical, investing network of horny tubes, immersed in a horny crust;" *cells* decumbent, adherent, irregularly disposed along the fibre, to which they are attached at the base. "*Polype* of a greenish colour, with numerous smooth, solid tentacula ; very minute."

Reticularia serpens.

Campanularia serpens, Hassall, Microscop. Transact. vol. for 1852.
Reticularia immersa, W. Thomson, Annals, vol. xi. for 1853.
Halia prætenuis, Hincks, Annals for Febr. 1855.
Capsularia serpens, Gray, List of Brit. Radiated Animals, p. 151.

Cells elongate, with upturned, terminal, and more or less tubular orifices, inoperculate, and with even rim.

The polypidom is a creeping fibre of great delicacy, which forms an irregular network, corneous and closely adherent ; it is invested by a kind of *crust,* which, when the zoophyte is in a recent state, gives it a soft and spongy appearance, but is not apparent when it is dried ; the *cells,* which occur sometimes in pairs, one on each side of the fibre, sometimes singly, sometimes in companies, are elongate, attached by the base to the polypidom, adherent, except at the anterior extremity, which bends

* I do not associate *Reticularia* with any of the existing families of *Hydroida,* fully agreeing with Prof. W. Thomson in the opinion that the section of the genus *Campanularia* which embraces *C. syringa, dumosa, parvula* (and to these may now be added the *C. gracillima* (Alder)), together with the genera *Coppinia* and *Reticularia,* should form a distinct group "intermediate between the Sertularians and the Campanularians."

upwards, and terminates in a circular aperture; they are commonly laid alongside the fibre, and often appressed to it, but occasionally stand out from it.

There are two very distinct states of this zoophyte. In old specimens, spreading over the stems of *Sertularia*, &c., the cells are massed confusedly together, and the form is with difficulty distinguishable. On shells it presents a much simpler appearance: the cells are sparingly distributed and distinct, and in such specimens I have never been able to detect any trace of a crust.

Hab. Exceedingly common on our coasts, both north and south, on *Sertularia abietina* and other zoophytes; also on mussel-shells from the Dogger Bank, &c.

XLII.—*Contribution to the Conchology of France.* By J. Gwyn Jeffreys, Esq., F.R.S.

Having spent part of this autumn on the coast of Normandy, with my family, I have been requested by some of my scientific friends to publish the result of my researches; but I fear my story will not be much longer than that of the weary knife-grinder. In fact the whole of my work in the North of France was fruitless, as regards the discovery of new or rare species; although perhaps a list of some species taken by me, and which have not been noticed by writers on French Conchology, may be of some use in contributing towards the elucidation of the important problem of geographical distribution.

Etretat (where I was located) is a small sea-bathing place, containing about 1800 inhabitants, and is distant seventeen miles from Havre on the road to Dieppe. It is a delightful retreat, and has hitherto escaped invasion by our countrymen, who, if they knew of the clear sea and atmosphere, the picturesque rock scenery, the *fontaine*, subterranean river, and oyster park, and above all the facility of access from England, would soon crowd and spoil the place. This may be a selfish, but I believe it is a common, sentiment.

The fauna of this coast was, I understand, investigated many years ago by the late Abbé Dicquemare, whose MSS. are now to be seen in the public library of Rouen; and Cuvier is said to have made Fécamp (which lies about ten miles to the north of Etretat) his retreat during the storm of the Great Revolution, and to have commenced there his studies on the Mollusca. M. Bouchard-Chantereaux has published a list of the marine Testacea found in the Pas de Calais; M. Collard des Cherres has also published a list of those found in the Department of

Finisterre; and M. Petit de la Saussaye has given in his 'Journal de Conchiliologie' a *résumé* of French marine Conchology, in an article entitled "Catalogue des Mollusques marins qui vivent sur les Côtes de France." This Catalogue was published in 1851; but it is too meagre to offer a satisfactory comparison between the French and our own Conchology, especially as regards the minute species. M. Moquin-Tandon's admirable work, which has lately been published, on the Land and Freshwater Mollusca of France, may be safely consulted for that branch of the subject.

My dredging at Etretat was a complete failure, as the sea-bottom for many leagues seemed to be composed of nothing but flint pebbles; and the shore was nearly as unproductive. The only uncommon species I obtained was *Otina otis*; and of this only a single specimen occurred to me.

I will now enumerate the marine Testacea I found, and which are not included in M. Petit's Catalogue, as well as the localities for a few land shells, which are not given by M. Moquin-Tandon.

1. Montacuta bidentata, *Forbes and Hanley's Brit. Moll.*
2. Trochus Montagui, *Brit. Moll.*
3. —— umbilicatus, *Brit. Moll.*
4. Lacuna puteolus, and variety, *Brit. Moll.*
5. —— vincta, *Brit. Moll.*
6. Rissoa semistriata, *Brit. Moll.*
7. Skenea planorbis, *Brit. Moll.*
8. Odostomia plicata, *Brit. Moll.*
9. —— obliqua, *Brit. Moll.*
10. —— Rissoides, *Brit. Moll.*
11. Otina otis, *Brit. Moll.*
12. Cerithiopsis tuberculare, *Brit. Moll.*
13. Nassa varicosa, *Brit. Moll.* M. Petit refers to this as a synonym of *N. incrassata*, which is also common on the French coast.
14. Zonites glaber, *Moquin-Tandon*; Etretat, Lillebonne, and Honfleur. I do not agree with M. L. Pfeiffer, that the *Z. alliarius* of British authors ought to be united with this species.
15. —— striatulus, *M.-T.* (*Z. radiatulus*, Brit. Moll.); St. Clair near Etretat.
16. Helix aspersa, *M.-T.*; Etretat and Honfleur. I mention this (to us common) species, because M. Moquin-Tandon gives its habitat as "Principalement la France *méridionale*."
17. —— fusca, *M.-T.* (*H. revelata*, Bouchard); Etretat.
18. —— limbata, *M.-T.*; Honfleur and Lillebonne.
19. Clausilia nigricans, *M.-T.*; Etretat.
20. —— Rolphii, *M.-T.*; Honfleur, Le Héve near Havre, and Lillebonne. I observe that Mr. Benson has modified his opinion as to the *Cl. Mortilleti* of Dumont being a distinct species. M. Moquin-Tandon gives it as a synonym of *Cl. Rolphii.*

1 Montagu Square, London, Oct. 31st, 1856.

BIBLIOGRAPHICAL NOTICES.

Flora Vectensis: being a Systematic Description of the Phænogamous or Flowering Plants and Ferns indigenous to the Isle of Wight. By the late W. A. Bromfield, M.D. &c. Edited by Sir W. J. Hooker and T. Bell Salter, M.D. London, 1856. 8vo, pp. 678, xxxv. Portrait of the Author. Map.

We have recently received a copy of this valuable and long-expected posthumous work, and have the pleasure of expressing, upon the whole, our high approbation of it. The editors have wisely avoided adding more than was absolutely necessary to the manuscript of our lamented friend; but, owing to his decease before the completion of his original plan, it was necessary to add the technical characters of many genera and sections of them, and of not a few species, in which the manuscript was deficient. In doing this they have usually adopted the words of Messrs. Hooker and Arnott from their 'British Flora,' but in some cases where it was perfectly manifest that the author was adopting the arrangement of Mr. Babington, they have taken the definitions from that gentleman's 'Manual.' In this we think that they have exercised a sound judgement, although we fancy that they have not always correctly appreciated Dr. Bromfield's views. But this is a matter of very little consequence, for the value of the work is not at all affected by it. It is very unfortunate that the author did not leave behind him a more complete account of his own views on these matters, for his opinions upon the best characters to be employed in defining the genera and species would have been highly acceptable, from the attention which he is known to have paid to the value of characters in the different natural orders. The great peculiarity and value of the book, as it is now presented to us, consists in the elaborate descriptions of the great majority of the species drawn from the examination of very many specimens of each plant. They are by far the most complete and accurate descriptions of British plants which we possess, and strongly remind us of the elaborate and voluminous 'Flora Italica' of Bertoloni, but even surpass those of that eminent botanist. From its proximity to the mainland, the Isle of Wight possesses a more extensive flora than is usually to be found in small islands, and therefore this work contains Dr. Bromfield's descriptions of a very large portion of the common plants of England. From the situation of the Isle, it of course does not include the plants peculiar to the more distant parts of Britain. There are many species of which the full descriptions were not prepared by the author, and in such cases the editors have inserted a specific character derived from one or the other of the above-mentioned British Floras, together with such notes as were to be found in the author's manuscripts. For some months preceding his final departure from England, Dr. Bromfield had been inserting in successive numbers of the third volume of the Botanical Journal called the 'Phytologist,' a very complete account of Isle of Wight plants, in which he communicated to the public a large quantity of most valuable critical and other remarks. As much of this information was acquired, and many of the views there adopted were formed, at a later period than that at which the parts of this work which treat concerning the same plants, were written, we think that the editors might advantageously have added, as notes to the Flora, many extracts from these papers. It is plain that they have thought differently, for the 'Phytologist' is rarely quoted by them.

The author's preface contains some remarks upon the rules to be observed in deciding upon the claims of plants to be considered as indigenous or introduced, which well deserve the consideration of the writers of local and even national floras. He very properly protests against the scepticism of those botanists who "reject as aliens a large proportion of species that have been long recognized and admitted by common consent into our indigenous catalogues," acknowledging at the same time that "they at least err on the safe side." He adopts the view expressed by Fries in the following words: "Eas dico *plantas indigenas,* quæ per longam annorum seriem sine omni cultura inter provinciam copiose et definito loco propellarunt et quotannis sunt multiplicatæ." He is of opinion that "the safest criterion for resolving doubtful claims to enrolment is to be sought for by reference to the geographical distribution of the species under consideration. The more extended study of this important branch of botanical science would . . . . go far in removing many of those scruples that are raised against the admission of no small number of our vegetable productions into the aboriginal lists." Accordingly great attention is paid to the continental distribution of all plants upon which much doubt has been cast. Botanists have cause to thank him for this care; for we are quite convinced that it is the true mode of attaining correct views on this contested subject. It often happens that plants which are now only found in rather doubtful stations in our fully cultivated country are really old natives which have been reduced in quantity or driven from their original sites by improvements in agriculture. When this has happened the plants may now continue to exist in a very few restricted spots, or be found scattered thinly over a large district, maintaining themselves with difficulty in hedgerows or on bits of waste ground. In such cases, it is much the fashion to state boldly that they are not indigenous, without inquiring if their continental distribution is or is not favourable to their claims to admission amongst British plants.

It does not seem desirable to extend this notice by entering upon discussion concerning any of the species, although there are many things stated by the author, or introduced by the editors, which do not accord with our views. In some of these cases we feel quite sure that the remarks would have been omitted or modified had the author been permitted to prepare his work for the press; but the editors have done wisely in printing the manuscript as they found it. It must be remembered that the work has not, alas! had the benefit of the author's revision since the spring of 1850, and that much advance has been made in our knowledge of British plants during the last six years. These facts do not, however, detract from the value of the

'Flora Vectensis,' the essential peculiarity of which lies, as we have already stated, in its valuable original and elaborate descriptions of the species noticed by its author.

Cautioning botanists to bear in mind that the real date of the book is not that of its publication—and that it is posthumous; and recommending those who may use it to distinguish carefully between the work of the author and the additions (clearly marked with inverted commas) of the editors,—we most strongly recommend the work to our readers.

Sylloge Floræ Europææ seu plantarum vascularium Europæ indigenarum enumeratio, adjectis synonymis gravioribus et indicata singularum distributione geographica. Auctore C. F. Nyman. Oerebroæ, 1854–55. Royal 8vo, pp. 442. xxiv.

This is a work which was wanted as affording a mode of easily ascertaining the extent to which any species of plant is known, upon published authority, to be distributed throughout Europe. It cannot fail of being much employed for that purpose, having been drawn up with great care. A list of the works used in its compilation is appended, by means of which the author's accuracy may be tested in doubtful cases. Of course a work of this nature must have occupied a considerable time in its preparation, and therefore we cannot hope to find that it is quite up to the present state of our knowledge. Judging from a somewhat careful examination, it is far more complete in that respect than we expected.

The chief objection to it is found in the system upon which it is arranged. Being the work of a Swede, probably a pupil of Fries, it is not wonderful that he should think the system proposed by that eminent man the proper one to adopt. As that classification is not in common use, some little inconvenience results. This is met by the addition of a copious index to the genera and subgenera.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

February 12, 1856.—Dr. Gray, F.R.S., in the Chair.

Descriptions of some Coleopterous Insects in the Collection of the British Museum, hitherto apparently unnoticed. By Adam White.

The number of "new species" of Coleopterous Insects in the Museum collection is in relative proportion to the great richness of the other branches. In this paper, some species belonging to the families *Prionidæ*, *Lamiadæ*, and *Cetoniadæ* will be given, as there is every likelihood, from the way in which these great groups have been investigated by Messrs. Serville, Burmeister, Schaum, Gory, and other entomologists, that the species are as yet unrecorded in scientific works; it is to the kindness of Dr. Gray, the keeper of the department, that I am indebted for permission in laying these descriptions before the Society.

Tribe Longicornia.

Family Prionidæ.

The *Prionidæ* consist of several marked subfamilies, in one of which we would place Trictenotoma, G. R. Gray, one of the most interesting of the genera of Beetles. This form, which appears to me to be altogether Longicorn, is chiefly remarkable for its heteromerous tarsi, and for the ninth and tenth joints of its antennæ being serrated or produced at the end, almost as in the *Lucanidæ*. It is one of those "aberrant" forms which naturalists call "annectent," and which appear to partake of the characters of several groups,—for instance, with the depressed form and velvety pilosity of many *Elateridæ*, it has five joints to the two first pairs of legs, and four only to the hind pair. Its head, jaws, and legs are essentially Longicorn, the number of joints of the tarsi being not a necessary character of the group; the tarsi of *Parandra* are pentamerous, and *Dorx pentamera*, an Australian insect described by Mr. Newman, has likewise five joints to all the tarsi. The sternum of *Trictenotoma* is also peculiar, that of the prothorax being received into a notch of the mesothorax, while the sternum of the metathorax is capable of being firmly fixed by "dovetailing," as it were, into the hinder notch of the mesothorax; in fact, this structure must enable the insect, if placed on its flat back, to "right" itself, like those Beetles called "Skip-jacks" (*Elateridæ*). In some species, such as *T. Childrenii* (G. R. Gray), *T. Templetonii* (Westw.), and *T. Grayii* (F. Smith), the sternum of the metathorax bulges; in *T. ænea* (Parry) that part is flattened, and the thorax is curiously serrated on the lateral margin in front, and has a very projecting point on the side beyond the middle, and notched between that point and the posterior angle, instead of being nearly straight and simply angled as in the other three species. Of these *Trictenotomæ*, all the species described are in the Museum Collection; the *T. Childrenii* being the type female specimen from the Tenasserim coast, described by Mr. G. R. Gray in one of the two insect volumes of Griffith's edition of 'Cuvier's Animal Kingdom' (pl. 5 and 5*). The *T. Templetonii* of Westwood (Oriental Ent. tab. 23, f. 3) is a native of Ceylon; like the former, it has a yellowish-grey pile; the *T. Grayii* described by Mr. F. Smith in 1851 (Cat. Coleopt. Brit. Mus. *Cucujidæ*, p. 18) is from Borneo, and has a purplish base beneath the more tawny pile of the upper parts; in the Museum there are two females, one from the collection of Mr. Alfred Wallace, who obtained it at Sarawak. The *T. ænea*, the giant of the genus, is of a brassy green, slightly pilose above. The Museum has lately obtained a specimen from India; the specimen was found by a soldier at Dhargeeling.

To the same family, and not very remote from the subfamily containing *Spondylis* and its allies, belongs, in the opinion of Dr. Burmeister, Mr. Westwood, and Mr. Leconte, the very anomalous *Hypo-*

cephalus, of which a fine figure, with some striking remarks, has been published by Mr. Curtis in the 'Transactions of the Linnæan Society;' of this species, three specimens known to me, exist in this country, one in Mr. Melly's great cabinet at Liverpool, a second drawn by Mr. Westwood in the 'Arcana Entomologica,' from a specimen in his own very curious collection, and a third exhibited at the Linnæan Society in 1854, from the rare cabinet of Mr. Aspinall Turner of Manchester. This remarkable Prionidous insect, like the Mole-cricket, has been altogether constructed for a subterraneous life; its marvellously developed thorax, fossorial and burrowing legs, curiously defended head, abbreviated antennæ, and other characters well shown by Mr. Westwood, and particularly by Mr. Curtis, all mark this; just as *Dorysthenes* of the East, a burrowing insect, is shown by M. Guerin-Meneville to have Walrus-like jaws, as *Lethrus* has incurved mandibles and other features useful in supporting the creature in the holes of the ground whence it comes. As aberrant *Prionidæ* may be mentioned, the very curious genera *Torneutes*, Reich., described in the Trans. Ent. Soc. Lond. (ii. 9, t. 2. f. 7), of which three species are now known, one from Patagonia, described by M. Guerin, and the singularly interesting *Erichsonia* of Mexico, named by Mr. Westwood, in memory of that most laborious and scientific of all the German entomologists, Dr. Erichson. The genus *Thaumasus*, Reich. (Ann. Soc. Ent. Fr. 1853, p. 419), founded on what Olivier described as a gigantic species of *Ips* (*Ips gigas*, Journ. d'Hist. Nat. 1792, i. 267, pl. 14. f. 6; *Thaumasus g.*, Reich. l. c. p. 422, pl. 13. f. 4), may be particularized as another aberrant form. In fact, the family *Prionidæ*, like many other great families, is more negative than positive, and will be found at its extremities, or at many points of its circumference, to lead off to other families, and even tribes: so that the naturalist, who wishes to simplify arrangement, however much he may split up genera, ought to avoid dividing families.

It may interest the general reader to quote a short passage from a privately circulated paper, written by my friend Mr. Empson of Bath, a distinguished natural-history traveller in South America. The insect alluded to is the noble *Psalidognathus Friendii* (G. R. Gray), which is named by the natives of Columbia 'Alaja,' that is, 'the jewel.' Mr. Empson remarks, "The first of these splendid insects which I ever saw, was at a feast given by the Cabildo, at Mariquita; upon that occasion Don Domingo Conde had placed one of them as a button to loop up, after the Spanish fashion, the broad brim of his Panama hat; to this brilliant ornament a loop of living Fireflies was attached, in a mode common in South America, and which does not injure those dazzling insect gems; thus decorated, the *sombrero* of the *cavalero* was more conspicuous in the ball-room than the jewelled tiaras of his more wealthy neighbours, although sparkling with the choice emeralds from the mines of Muzo.

"After many a weary search," adds Mr. Empson, "with Don Domingo for my guide, in the primæval forests on the eastern slopes of the Andes, we captured three of those Alajas." One of those, he remarks, "was resting on the perishing trunk of a palm-tree; in our eagerness to secure it, my hand was so much lacerated that I was obliged to relinquish my prize, and we saw its gorgeous colours flashing beneath the full blaze of a tropical sun; it settled on the stem of a cedar, and was then more cautiously transferred into my possession."

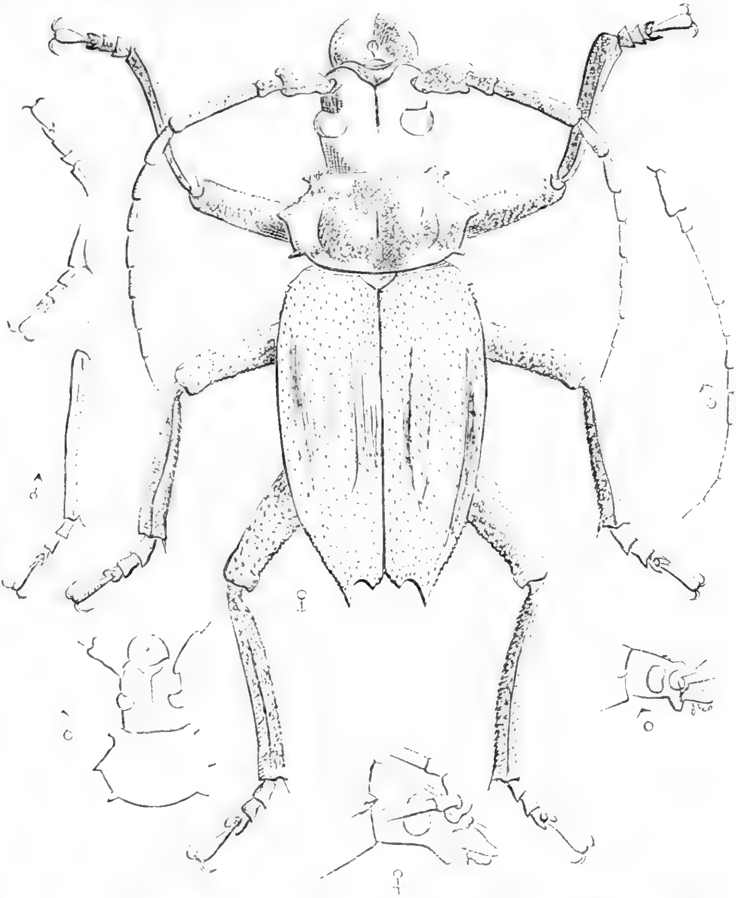
With these few remarks, which might be much amplified, a curious genus of *Prionidæ*, allied to *Psalidognathus*, G. R. Gray, and to *Prionacalus*, figured in a previous part of the Proceedings, may be here briefly described. It is strictly pseudo-tetramerous, and has much of the character of Mr. George Gray's fine Columbian genus. This genus, for which I would propose the name *Psalidocoptus**, is from Tana, in the New Hebrides, and is one of those fine insects for which science is indebted to the researches of Mr. John Macgillivray, the late able Naturalist of H.M. surveying ship 'Herald.' The sternum does not notably differ from that of *Psalidognathus*, but it differs in having very short palpi, much shorter antennæ, the third joint the longest, the eight following about equal in length. Head, exclusive of the jaws, rather longer than wide, behind the eyes somewhat narrowed and without projection. Eyes prominent, transversely kidney-shaped, very slightly notched in front. Thorax wider than long, but much longer than in *Psalidognathus* and *Prionacalus*, with three broadish spine-like projections on each side, one in front, one about the middle, and one before the hinder angle. Scutellum small and wide, covering the abdomen; in the male, considerably surpassing it. Wingless; elytra united on the suture, contracted somewhat at the base, where there is a short spine, gradually dilated about the middle, and as gradually tapering toward the end, where they terminate in two spine-like points, the outer the longest, the inner almost a continuation of the notch, between which would be the suture; the two points curiously rotundate-emarginate. Legs very long and strong, particularly the femora, which are compressed. Tarsi with small pulvillus on end of three first joints; tarsi of female broader and shorter than those of the male.

Psalidocoptus scaber, n. s.

Head between the eyes with a deep line, divided into two in front. Thorax surface curiously undulated, and with the head scarcely rough, although with small scattered warts; the elytra scabrous, with numerous small warts; each elytron with two parallel ridges united behind the middle and a sutural ridge; margin of elytra between warty and serrated. Jaws strong, punctured at the base, incurved, sides parallel, inner side short and obliquely cut between, the cutting edge sharp; a curious tuft of ferruginous hair on trochanter; legs serrated below on femora and tibia, more or less scabrous. The whole insect is of a blackish-brown, with ferruginous hairs bordering the inside of the tibiæ of the first and second pairs of legs; thorax beneath, and other parts, liable to be chafed by motion

* *Ψαλίς*, scissors, and *κόπτω*, from a fanciful idea of the waved outline being as it were cut with that instrument.

of joints ciliated with ferruginous hairs. Abdomen somewhat squamoso-verrucose beneath, a pit behind each scale-like wart, with a short hair proceeding from it.



Note. The figures were drawn on wood by Miss E. Wing, and are of the size of nature.

Family Lamiadæ.

Among the Lamioid Longicorns there is a genus containing many finely coloured African species. The genus *Tragocephala*, Dupont (Dej. Cat. p. 638), was first briefly characterized by Laporte in his 'Animaux articulées,' tome ii. p. 472.

Tragocephala nobilis. *Lamia nobilis*, Fabr. S. El. ii. 297; Oliv. t. 11. f. 76; also described by Fabricius as *Saperda læta*, l. c. p. 318. Sierra Leone. (Coll. Brit. Mus.)

Tragocephala formosa. *Cerambyx formosus*, Oliv. t. 20,

f. 153, is another well-marked species from S. Africa, abundant in collections. (Coll. Brit. Mus.)

Tragocephala pulchella, Westw. Arc. Ent. ii. t. 69. f. 4, is another species from Sierra Leone. (Coll. Brit. Mus.)

Tragocephala variegata, Bertolom., Ann. Sc. Nat. 1845, p. 423. S. Africa (Inhambere).

Tragocephala Galathea, Chevr., Rev. et Mag. de Zool. 1855, p. 184, was procured by the Scottish missionaries at Benin, Old Calabar.

The Tragocephala angolator and T. Lucia, described by Olivier and Newman, belong likewise to this genus, but are aberrant forms, as is the Tragocephala trifasciella, described and figured in the illustrated Proceedings for 1850. The latter differs somewhat from *Tragocephala* proper, while *Lamia angolator*, from its short wide thorax, &c., may hereafter constitute the type of a distinct section: all three are in the Museum Collection.

In the Museum Collection are some undescribed species, which may be characterized as

Tragocephala comitessa.

T. elongata, nigra; fronte aurantiaca; thoracis lateribus aurantiacis, post tuberculum nigris; elytris fasciis duabus sulphureis, lateribus aurantiacis; prima continua, secunda angustiore, antice et postice sinuata; elytris singulis punctis tribus albis; sutura apice albo-punctata, ante apicem macula aurantiaca margine pallidiore; metathorace maculis duabus aurantiacis, aliquando obsoletis; abdominis segmentis tribus basalibus lateribus subtus aurantiacis.

Long. lin. 9¼–11.

Hab. Africa Austr. (Port Natal). Coll. Brit. Mus. (*Gueinzius* et *Krauss*).

T. formosæ affinis sed distincta.

Tragocephala Chevrolatii, n. s.

T. nigra, capite aurantiaco, mandibulis basi aurantiacis, fascia in genis, fascia inter antennas et vertice nigris; thoracis lateribus flavis, tuberculo apice et postice nigro; dorso nigro, macula parva pallida posticali alteraque antica sæpe obsoletis; elytris singulis nigris; fascia mediana aurantiaca subobliqua, ramum antice ferente; maculis duabus aurantiacis sæpe obsoletis, macula magna aurantiaca ante apicem, punctoque parvo ad apicem; abdominis lateribus aurantiaco maculatis; pedibus cinereo-griseis, femoribus flavo maculatis.

Long. lin. 8½–11.

Hab. Africa Austr. (Port Natal). In Mus. Brit., &c.

In honorem L. A. Augusti Chevrolat, Parisiensis, Coleopterophili valde egregii.

Tragocephala ducalis, n. s.

T. capite aurantiaco, fascia oculari, alteraque verticali nigris; antennis crassiusculis, nigris; thorace supra medio nigro, lateri-

bus aurantiaco late marginatis, pube subvermiculata; elytris nigris fasciis duabus aurantiacis suturam haud attingentibus, lateribus latioribus, marginibus pallidis, apice aurantiaco, maculis tribus parvis inter apicem et fasciam secundam, exteriore majore; corpore subtus aurantiaco, abdominis segmentis, medio et lateribus nigris; pedibus ochraceo-griseis, femoribus extus et intus aurantiaco maculatis.

Long. lin. 8–9½.

Hab. Africa Austr. (Port Natal). Coll. Brit. Mus. (*Saunders*, &c.)

Tragocephala gemmaria, n. s.

T. nigra; lateribus frontis maculaque genarum et macula inter antennas pallide cæruleis; thorace supra maculis novem cæruleis, quatuor in margine antica, tribus in postica; elytris singulis maculis 12–13 *pallide cæruleis; thorace subtus et abdominis lateribus maculis cæruleis majoribus; pedibus posticis, femoribus extus, tibiis basi supra cæruleo-notatis; antennis articulo secundo compresso.*

Long. lin. 6½.

Hab. Africa Occid. (Sierra Leone) (*Rev. D. F. Morgan*). Coll. Brit. Mus.

Tragocephala Guerinii.

T. nigra, capitis thoracisque lateribus fascia flava continua, elytris fascia lata guttaque ante-apicali ferrugineo-ochraceis, mesothorace ferrugineo-ochraceo, medio nigro-lineato abdominis lateribus subtus fascia flava extus dentata.

Long. lin. 10.

Hab. Congo.

In honorem Guerin-Meneville, entomologi et carcinologi Parisiensis celeberrimi, naturæque delineatoris exquisitissimi.

Tragocephala Buquetiana.

T. nigra, fronte macula elongata aurantiaca sub oculis ramum haud emittente; elytris singulis basi fascia aurantiaca obliqua, humero et spatio circa scutellum nigris; fascia mediana et macula sub-apicali aurantiacis.

Long. lin. 8¼.

Hab. Sierra Leone (*Rev. D. F. Morgan*).

In honorem M. Buquet, Parisiensis, in Coleopteris exoticis ditissimi et peritissimi.

We have also in the Museum the elegant, slim, little graceful T. tenuicornis, Chevr., from Port Natal, the T. scenica of Dej., from W. Africa, and the T. pictor, Klug, a common S. African species.

Tribe Lamellicornia.

Family Cetoniadæ.

Note.—Mr. Turner of Manchester, the possessor of a very fine collection of the larger and more showy *Coleoptera* of West Africa, and of many of the Beetles of other lands, showed me a specimen of the (so-called) *Goliathus giganteus*, of which I once saw the example in the Hunterian Museum at Glasgow, and which served to show that the sharp and discriminating eye of the able and judicious Dr. Schaum, who, with Dr. Burmeister, is one of the best authorities on the subject of *Cetoniadæ*, was probably right in regarding *G. giganteus* and *G. Drurii* as mere local varieties of one species, to which the name

GOLIATHUS AFRICANUS, Lamarck, may be given.

TRIGONOPHORUS HOOKERI, n. s.

T. læte viridis, metallico valde refulgens, pedibus gracilibus, femoribus viridibus flavescenti-rubro lineatis seu lavatis, tibiis rubris, posticis intus ciliatis, tarsis fuscescenti-nigris; thorace antice angustato, supra dense punctulato, margine postica solum lævissima; scutello fere toto lævi; antennis subrufis, capite maris in fronte rufo.

Hab. In India alpinâ.

Named after Dr. Joseph Hooker, F.R.S., &c. &c., author of many noble botanical works, and of the 'Himalayan Journal.' During his travels in India he found this and many other fine species of insects now in the Museum Collection. We have now all the species of this interesting group except *T. Delessertii*, Guerin-Meneville.

STETHODESMA SERVILLEI.

S. fusco-subpurpurea, sericea, thorace flavo cingulato, elytris singulis maculis decem parvis albo-argenteis, uropygio albo-maculato, subtus rufo-brunnea, plagis albis lateribus singulis in serie duplici ordinatis.

Hab. In Africa meridionali (Port Natal) (*Dr. Krauss*).

The red of the thorax extends on its under side. Mesothorax with scattered scales. Head cut in front, and side lobes produced shortly and somewhat rounded. Legs uniform in colour.

Huic insecto nomen *Servilleanum*, synonymon Entomologiæ, in honorem *Audinet-Serville* amici dilectissimi, proposuit descriptor.

CLINTERIA DUCALIS.

This insect, of which the name only appears in the Museum List of *Cetoniadæ*, p. 15, published in 1847, is regarded by Dr. Schaum as a variety of the very variable *Clinteria atra*. The present variety is of a dull olive-green, and has a patch of golden-yellow about the middle of each elytron. The under side is purplish-brown, and the sides have two rows of small white spots. The head and legs are purplish.

It is a native of Silhet, and notwithstanding the great authority of Dr. Schaum, I cannot help, even now, regarding it as distinct from *C. atra*, Wied., of which *C. funeraria* and *C. biguttata* of Gory and Percheron are varieties.

CLINTERIA HOFFMEISTERI.

This very beautiful and distinct species was described in the 'Annals and Mag. of Nat. History,' vol. xx. p. 341.

Schizorhina Bassii.

Described in the 'Annals and Mag. of Nat. History' (vol. xx. p. 264). The genus *Bassia* was *not* named after Mr. G. Bass.

Schizorhina (Hemipharis ?) Emilia.

S. (*H.* ?) *nitida, subgracilis, subparallela, æneo-viridis, thoracis linea laterali, maculisque duabus postice aurantiacis (aliquando subobsoletis), elytrisque singulis lineatim punctatis, aurantiaco maculatis aut plagiatis.*

Animaleulum hoc pulchrum, Febr. 2ndo, A.D. 1856, die nat. descriptum, Emiliæ Jalland, filiæ fratris mei, dicatum est.

Head rather closely punctured, very slightly notched in front, above distinctly punctured. Thorax indistinctly punctured, except before the hind angles, shaped much as in *H. insularis*, of a highly polished but obscure brassy green, thickened margin of thorax in front yellow, the yellow continuous (beyond the middle of the edge) on the inner side; thorax on each side with a narrow irregularly-edged yellow line, almost parallel with the edge, and truncated and somewhat dilated behind; before the posterior thoracic lobe are two small triangular yellow spots. Scutellum yellow; margins, especially at the apex, green; each elytron is irregularly margined with yellow on the sides at the base, and there are six to eight irregular yellow marks, one before the apex somewhat transverse; sides of meso- and metathorax yellow; sides of abdomen with three yellow spots; pygidium with two yellow marks nearly covering it, and divided by a pear-shaped green spot, or green extended so as to leave only four small yellow spots; tibiæ and tarsi tinted with purplish; base of anterior femora and coxæ rufous. This species quite connects the subgenera *Hemipharis* and *Diaphonia*, and shows the accuracy of the views of that learned entomologist Dr. Schaum. The two specimens are females, and have short lamellæ to the antennæ.

Hab. New Hebrides (Aneiteum). Collected by Mr. John Macgillivray, the able naturalist to H.M.S. 'Herald.'

Schizorhina (Hemipharis) Idæ.

S. (*H.*) *grandis, fusculo-nigra, capitis vertice, thorace supra, elytris a basi usque ultra medium, pygidio, mesothoracis lateribus, metathorace femoribus posticis infra flavescenti-brunneis.*

S. (*H.*) *Brownii* valde affinis et forsan varietas geographica. Dicatur Idæ Pfeiffer, viatricis celeberrimæ quæ in Ceram speciem hanc pulchram invenit.

Cetonia (Protætia) procera, n. s.

C. (*P.*) *supra viridi-subsericea, poroso-punctata, albido paulum submaculata in elytris præsertim, elytris apice spinoso-productis; subtus læte metallico-viridis, abdomine plagis* 16 *albo-pilosis, in quatuor ordinibus dispositis.*

In size between *P. ferruginea* and *P. regalis*; above, including upper side of legs, it is of a fine dull, dark velvety green, which, when rubbed, displays beneath a metallic base, as in many of the

Cetoniadæ, such as *Goliathus torquatus*; the edges of the *nasus* are metallic. The head and thorax above are thickly and distinctly poroso-punctate; there is an indication of a yellowish-white dot near each front angle of the thorax (which dot may vary in size in other specimens); the elytra have four dots passing into short transverse streaks on each side, and a small spot near the suture, about the middle, and a short white streak midway between the middle and the spine; three dots between that and the spine, which is longer and much more distinct than on the sides of elytra, transversely pitted in many shallow short waves; general surface punctured, the punctures chiefly in striæ. Head small, slightly ridged on sides in front of eyes, slightly narrower in front, and rather deeply grooved behind front margin. Under side and legs metallic green; femora and mesothorax aeuducted, the latter with two or three patches of isabella pile; abdomen irregularly punctured, smooth, with eight transverse patches of isabella pile on each side in double columns. Hairs on tibiæ rufous; fore edge of front tibiæ and tarsi of all the legs metallic green.

Hab. Philippine Islands. (Coll. Cuming.)

This is alluded to in Dr. Schaum's second list of *Cetoniadæ*, and is quoted under the above name.

CETONIA (PROTÆTIA) SCHAUMII.

Supra obscure viridis, subtus læte metallico-viridis, capite flavo trilineato, linea media latiore, thoracis marginibus anticis lateralibusque flavis, plaga transversa subheraldice postica flava, scutello flavo apice excepto viridi; elytris flavo irregulariter transverse trifasciatis, elytris singulis medio longitudinaliter sub-bicarinatis, et 9–11-punctato-lineatis, pedibus flavis, extus et apice articulorum subviridibus, tarsis obscure viridi-fuscis, abdominis lateribus subtus punctatis, segmentis quatuor lateribus flavo-marginatis; uropygio flavo triangulariter biplagiato elytris apice suturali acuminato, sterno antice flavo producto.

Hab. Celebes (*Madame Ida Pfeiffer*).

Head semicircularly cut in front, the margins trending inwards.

Seems really to connect *Pachnoda* with *Protætia*.

Named in compliment to Dr. Schaum, whose name and abilities require only to be mentioned when *Coleoptera* are described.

ON A NEW SPECIES OF PIGEON.
BY G. R. GRAY, F.L.S. & Z.S., ETC.

As I believe the members of the Society take some interest in those birds which have passed a portion of their existence in the Gardens, I am induced to place before them a Pigeon, which I have every reason to suppose has remained hitherto undescribed. It belongs to the same division as the Garnet-winged Pigeon of Latham (*Columba erythroptera*, Gm.), which has been placed in Dr. Reichenbach's subgenus *Phlegœnas* by H. H. Prince Bonaparte; but I think that, considering the numerous divisions that have been formed in this class of birds, it might with equal propriety be divided from it.

I am led to consider that there exists some slight confusion in the description of the *Columba erythroptera*, which is stated by Latham (in his History, viii. p. 71) to come from the Isle of Eimeo, which he describes as having the "belly and vent black;" but I think that this is a mistake, as I find amongst Ellis's drawings, made during the voyage of the great circumnavigator Cook in the year 1777–79, a representation of a Garnet-winged Pigeon that was found on "York Isle or Eimao," having those parts pure white, and that it even extends to the end of the under tail-coverts and on the thighs.

Latham has further noticed two varieties; viz. that which forms his var. A. is from Otaheite, and the description was taken from the drawing of Forster, who also accompanied the same celebrated voyager during the years 1772–74, which exhibits the belly and vent as "dusky." Forster had applied the name of *C. leucophrys* to this bird, under which name the description will be found in his 'Descriptiones Animalium, &c.,' edited by Professor Lichtenstein, at p. 168; while the variety B. is stated to be from the island of Tanna, and is recorded as having a "reddish black" belly (the same colour as the back).

From these notices, there appear to be at least *two*, if not three species of Garnet-winged Pigeons; and may not they, like the *Ptilonopi*, be peculiar to the different groups of islands of the South Pacific Ocean? This, however, cannot be at present satisfactorily determined, from want of specimens from the different localities, but I have ventured to draw attention to these differences, that it may lead to a further elucidation when an opportunity offers.

I may add, however, that M. Temminck, in his work on Pigeons (t. 55), figures one that may probably come near to variety B. of Latham, but he describes the belly black with purple reflexions. The British Museum contains two specimens from Bow Island, which approach in some measure to the variety A. of Latham, but the belly is of a dusky greyish black.

The one now exhibited is quite different from those referred to; it may be described in the following terms, with the name of

CALŒNAS (PHLEGŒNAS) STAIRI.

Glossy brown, with coppery reflexions in some lights; top of head and back of neck dark slate, glossy with green; front, side of neck and breast pale vinaceous brown; throat and a gorget round the breast white, which latter is margined outerly with dark garnet colour; abdomen vinaceous brown, dusky on the sides; quills dusky black, slightly margined with rufous; tail brown, with a broad band of black at the end. Bill black and feet pale.

The specimen is marked as a male, and I suppose was brought from the Samoan or Navigators' Islands, as the British Museum was previously in possession of a skin given by the Rev. J. Stair as from that locality, with other interesting birds.

On a New Species of Lepidopterous Insect. By G. R. Gray, F.L.S. & Z.S., etc.

Among the various novelties sent home during the voyages of H.M.SS. 'Rattlesnake' and 'Herald' by Mr. Macgillivray, is the splendid Butterfly now laid before the Society. It belongs to the great genus *Papilio* and to the subdivision *Ornithoptera*, and like the other known species of that group, its flight is very elevated; so much so, that it became necessary to employ powder and shot to secure the specimen; many shots have perforated the wings, and have rather damaged the specimen, but still not so as to entirely destroy the beauty of this remarkable butterfly. No lepidopterous insect of its magnitude has hitherto been known from the locality of this species; which, from the other insects contained in the same box, is supposed (as no memorandum was sent with it) to be either Solomon Islands, Aneiteum, New Hebrides, or the Fiji group,—at any rate from one of the islands in the South Pacific Ocean.

The general colour is glossy bronze-black, with the two outer rows of irregular-sized spots of pure white, while those at the base of the fore wings are rich king-yellow, but partly pure white outerly; the anterior margin of the secondary wings narrowly bordered with king-yellow.

The under surface like the upper; but the anterior margin of the secondary wings broadly bordered, and some of the spots tinged, with rich king-yellow. The head and thorax pure black; the body ochraceous yellow above, and black along the middle beneath.

It is a female. The male remains at present unknown, but one may suppose, by the usual brilliancy of the males of this group to which it belongs, that it is likely to prove a most beautiful insect, exhibiting some gorgeous combination of colour.

The name I propose for this splendid insect is *Papilio* (*Ornithoptera*) *Victoriæ*.

ROYAL SOCIETY.

Dec. 13, 1855.—Colonel Sabine, R.A., Treas. and V.P., in the Chair.

"On the Structure and Development of the *Cysticercus cellulosæ*, as found in the Pig." By George Rainey, Esq.

The *Cysticercus cellulosæ*, in its mature state, consists of two parts: one a small oval cyst, composed of a very thin membrane, rendered uneven on its external surface by minute rounded projections, and containing in its interior, granular matter, particles of oil, and a colourless fluid. This may be called its ventral portion. The other is folded inwards, occupying the centre of the cyst just described, but by pressure it may be made to protrude. This part is sometimes called the neck. Its length varies very much in different *Cysticerci*, depending upon their age. It is hollow, having strong membranous parietes, wrinkled transversely, and composed both of circular and longitudinal fibres. The cavity has no visible communication with that of the ventral portion. It contains a multitude of small oval laminated calcareous bodies, which, when acted upon by acids, effervesce briskly, and become partially dissolved, leaving only a small residue of animal matter. When the neck is protruded, the extremity farthest from the cyst is seen to present an enlargement, sometimes called the head, on the free surface of which there is a quadrangular area, occupied by four circular disks and a ring of hooklets. Each angle contains a disk, and the hooklets are placed in a circle around the centre of this space. The suctorial disks are traversed each by a passage taking rather a spiral course, and terminating in the cavity of the neck. The membrane composing a disk presents two orders of fibres, circular and radiating. The hooklets are generally twenty-six in number, thirteen long and as many short, arranged alternately a long and a short one. Each consists of a curved portion like a bird's claw, and a straight portion or handle; and at the junction of these two parts there are tubercles, two in the short hooklets, and only one in the long ones. The hooklets are crossed by two zones of circular fibres. They are also connected by radiating fibres, which occupy the spaces between each adjacent pair, like the interosseous muscles situated between the metacarpal bones and phalanges. The hooklets are disposed like radii, with their points turned outwards and the extremities of their handles inwards, which, not meeting, circumscribe a circular space whose centre corresponds to that of the quadrangular area before mentioned. At this part there is no perforation answering to an oral orifice, but here the membrane is simply depressed so as to present a conical hollow. By pressure upon the neck, this membrane can be made to protrude in the form of a tongue-like process, to which the handles of all the hooklets are connected, so that when this part in the living animal is made to move, the handles of the hooklets will be drawn in with it, and their points carried from the entozoon, and thus made to penetrate the part to which it attaches itself. These entozoa are chiefly found in the cellular intervals between the muscular fibres, contained in an adventitious cyst formed by the condensation of the surrounding tissues. No more than one entozoon is ever met with in one cyst.

Development of the Cysticercus cellulosæ.

The earliest appearance of the incipient stage of the *Cysticercus cellulosæ* is a fusiform collection of small cells and molecules in the substance of a primary muscular fasciculus, or immediately beneath its sarcolemma. These cells, in this condition of the entozoon, have only an imperfect or partial covering; however, they soon become completely enclosed in a well-defined membrane which is at first homogeneous, but which afterwards sends out short, slender, projecting fibres, resembling short hairs or cilia. These hair-like fibres, though resembling in some respects cilia, differ from them in being much less sharply defined and less pointed; however, for convenience sake, I shall speak of them as cilia. Their direction is remarkable. At either extremity of the fusiform animal they are reflected backwards at a very acute angle, like the barbs of a feather, their direction being of course opposite at the two ends. They become less and less inclined as they approach the middle of the body, where they stand out at right angles to the surface. The apparatus of cilia-like processes above described is evidently designed to give to the entozoon, whilst in this stage of its existence, the power of penetrating between the ultimate muscular fibrillæ, and thus to enable it to force its way from the interior of a primary fasciculus into the spaces between the muscular fibres. This will be the effect of the friction of the fibrillæ against the cilia, which will allow of motion in one direction only. And as its two ends must move in opposite directions, the cilia will also serve to aid the entozoon in its development longitudinally. That such is their office will be apparent on examining a sufficient number of specimens; in some of which the primary fasciculi will be seen to have been completely split up by these animals. But the correctness of this inference is more strikingly proved by the influence which the size and arrangement of the primary bundles of muscular fibres have upon the form and dimensions of the entozoa. Thus in the muscular parietes of the heart, where the primary fasciculi are smaller, and, from their frequent interlacing, shorter than in other parts, the *Cysticerci* are, in this stage of their development, also very short and of a different form to those found in other muscles, composed of striped fibre, although in other respects perfectly similar; and, when completely formed, those taken from the heart cannot be distinguished from those formed in other muscles. The cells which have been alluded to as forming the principal part of the *Cysticercus* thus far developed, and contained in the investment first described, are all of the same character, differing only in their form and size, according to their age and situation. Those situated about the centre, and forming the chief part of its bulk, are collected together into rounded masses, giving to many of the animalcules an obscurely annulose appearance. They are of an elliptical, or rather reniform figure. This form, however, is not essential to these cells, but merely results from the circular shape of the masses into which they enter, the convexity of each cell being a part of the outline of its respective mass. These cells contain minute granules, or rather molecules, which are variously disposed in different cells, so as to present a variety of appearances, such as circular spaces, which might be mistaken for nuclei, but which seem rather to be produced by a deficiency of the cell's contents at these parts, than by any distinct nucleus. The mode of formation of these cells must be examined in the growing parts of the animal, and for this purpose its extreme ends are best adapted. When one of these ends is about to have an addition made to its length, the investing membrane at this part becomes at first very thin, and then disappears. A clear space is next seen, having in some specimens the form of the part which is about to be added to the extremity of the entozoon; in others it has no defined limit. This space contains, in some cases, nothing but extremely minute molecules, of different shapes; in others, these molecules are mixed with granules of various sizes, which have every appearance of having been produced by the coalescence of the molecules; and lastly, with these molecules and granules, there are in other examples very distinct globular cells, of a bright aspect, looking more like nuclei than perfect cells; these soon become flattened oval, and ultimately take the elliptical form before described. All the time these changes are taking place in the molecules and cells, the membrane has been in progress of formation, so that when the molecules have disappeared, and their place has become occupied by perfect cells, the end of the animal is completed. The cilia are soon afterwards added. The lateral growth of these animals takes place in the same manner: the first indication is a separation of the cilia, which, it must be observed, are larger at the sides of an entozoon than at the extreme ends; and then a thinning of the membrane supporting them; and, lastly, the formation of globular cells, as before noticed. After the animals have become of a considerable size, and forced their way from the interior of the primary fasciculi into the cellular spaces between the larger muscular fibres, they still continue to grow, especially in breadth; but they lose their cilia, and gradually acquire those parts which have been described as belonging to the neck. The first evidence of this addition is the appearance of inversion of the middle part of the cyst, forming a small hollow, the sides of which look as if thrown into folds containing granular matter, and the bottom presents a circular space in which are granular particles of various forms and sizes, but those in the centre are darker than the rest. It is from these particles that the suctorial disks, the hooklets, and the first of the laminated bodies are about to be formed, but as yet none of these parts are recognizable. At a stage a little more advanced, this apparent inversion of the cyst has increased, the neck has become longer, and the appearance of disks, hooklets, and laminated bodies is sufficiently distinct to be perfectly recognizable. The process of development is particularly apparent in the hooklets, and perhaps there is no other instance of the growth of an animal tissue which presents such facilities for the examination of the manner in which it is effected. First, because the part of the entozoon on which these organs are formed, is sufficiently transparent to admit of examination by the highest magnifying powers without any previous dissection. Secondly, because the material of which they are composed is so characteristic, and so dissimilar to the surrounding parts, that it can be detected in the minutest possible quantities. And, thirdly, as only a few of these hooklets are in progress of development at one time, and as these are in all stages of formation, every step in the progress of their growth can be traced from the merest molecule to a perfect hooklet. This is important in reference to the general theory of development, as it furnishes an example of the formation of a complete set of organs, on a plan more simple, and at variance with the cell-theory of Schwann and others. Before one of these hooklets takes on a recognizable form, it exists as a group of exceedingly refractive particles, all apparently of the same composition, and of a more or less globular form, but of very different sizes, some being so minute as scarcely to be visible by one-eighth of an inch lens, others being almost as large as the handle of a perfect hooklet, while the rest are of all dimensions between these extremes. The next condition of a hooklet is the apparent fusion or coalescence of some of these particles into the hooked part of the organ. Then the handle and tubercles are added, these having been previously formed by the fusion of the smaller particles, and these latter by the coalescence of the minutest and the minuter ones. Before the several parts are perfectly consolidated, their points of junction can be distinguished, and in other groups the fragments corresponding to those recently united can be recognized. Directly a hooklet is found, it is of its full dimension; and some of its parts are even larger and more clumsy-looking than in older hooklets. The substance of the particles entering into these organs, after they are once formed, undergoes no change in its microscopical characters, but is the same after as before their union. It is impossible to single out any one particle from the rest, which can be taken for the nucleus of a cell, or for what physiologists would call a nucleated cell; and thus there is nothing which indicates that these organs have been formed by transformation of previously existing cells, but, on the contrary, there is every appearance that their formation is due to the simple coalescence of homogeneous molecules.

Up to the present point, the facts which I have stated are so obvious, that their accuracy will, I think, not be questioned; also the interpretation of them is not only that which appears to me the most natural, but is almost self-evident. There remain, however, some considerations of a more theoretical kind, though not of less importance. It will be asked, how the entozoon, in its earliest condition, such as I have described it, finds access to the interior of a primary fasciculus. Before attempting to answer this question, I must observe that my description commences from a condition of this entozoon so complete, that no one, on examining it in this state with the microscope, will deny its perfect similarity to those of the higher form. But there are other links in the chain which I must now consider, and which so far have been omitted only because I wished to keep that which is certain distinct from that which is probable. Before the cells and molecules already described accumulate in sufficient quantity to present the undoubted character above mentioned, they are found aggregated in smaller groups, and even occurring individually in all the primary fasciculi of the diseased muscle; their quantity, and the size and form of these groups, present the greatest possible irregularity in the different fasciculi. In some the molecular deposit looks like an early stage of fatty degeneration, but it has characters very different; one is the shape of the molecules, which resemble in all respects those in the growing ends of an entozoon; and another is, their situation, which seems to be between the primary fibrillæ, tending to separate them longitudinally; however that may be, it is an abnormal condition, and always coexistent with the higher forms of the *Cysticercus*; and as the entozoon, as I have first described it, could not possibly have taken on that form all at once, these groups of molecules must therefore be looked upon as its antecedent stage, or as portions of *Cysticerci* in progress of development. But I also find in the specimens of muscle infested with these entozoa, many of the capillaries and smaller blood-vessels filled with organic molecules, which, so far as I am able to judge from the comparison of such extremely minute bodies, seem to resemble those molecules which are found in the primary fasciculi. The vessels filled with these molecules have their coats so thin as to be inappreciable, and some of the capillaries appear to be partially destroyed, and their molecular contents diffused among the sarcous elements. As this is an abnormal condition of the contents of these vessels, as well as of their coats, and, so far as my experience goes, is not found excepting in conjunction with the earliest stages of the *Cysticerci*, I am inclined to believe that the molecules in question are the same as those in the primary fasciculi, and that it is by their coalescence in these fasciculi that the formation-cells of the *Cysticerci* are formed.

Addendum, Dec. 6.—After an entozoon has left the interior of a primary fasciculus, and arrived at the space between the muscular fibres, it loses its ciliated investment, and increases in breadth. Its margin now seems to be formed entirely by the convexities of the globular masses of cells of which its body appears to be made up, causing it to present a crenate form similar to that of the ventral portion of the perfect animalcule, with this difference only, that these cells are compressed. The next change which is visible is the formation of folds, which become more perceptible as the animal increases in breadth, and which remain in the perfect entozoon so long as it is confined to a small space, but disappear when it gets to the space between the surface of a muscle and the fascia covering it. The unfolding in this last situation seems to be produced by the imbibition of fluid, and the consequent distension of the ventral part. These more advanced stages of the worm-form are best found in those specimens of diseased muscle in which the perfectly developed *Cysticerci* abound. Their number in proportion to that of the perfect animalcules varies considerably in different specimens.

I have always succeeded in finding some of those of the worm-form along with the perfectly developed ones; and in some cases there are as many of one kind as the other. After they have acquired a certain breadth—about one-twelfth, or the one-eighth of an inch,—the central part of the cyst appears to be drawn inwards, forming a hollow; at the bottom of which, the granular material is deposited from which the suckers, hooklets, and calcareous granules are formed, as above described.

MISCELLANEOUS.

Observations on the Structure of the Retina in certain Animals. By H. Müller.

I have shown in my work upon the Retina, that this part furnishes microscopic characters which may be employed in the systematic distribution of vertebrated animals, to such an extent, that it is often possible to determine the class, the order, and even the genus of an animal from a small fragment of its retina.

In general the more marked the systematic characters are in the different divisions of a class of Vertebrata, the more do we observe variations in the microscopic characters of the retina. The retina of the Sturgeon presents one of the most remarkable examples of this. In a recent examination I found that the layer of batons in this fish is constituted in accordance with a type foreign to the other Fishes, a type which occurs moreover in the class of Birds. There are two elements, the cones and the batons. The latter are truncated externally, whilst the internal part passes into a conical point. The fatty drops, which have been mentioned by other observers, do not belong to the batons but to the cones, which I had formerly suspected, and as may be seen in my work above referred to. The cones are composed of an internal thicker, and an external thinner part, as in Birds. At the extremity of the former part is the fatty drop, which, except in its less brilliant colour, exactly resembles those which are found in the cones of Birds. We do not at present know any other Fish, of which the retina exhibits this arrangement of cones and batons, exactly similar to that of Birds. But on the one hand it is very remarkable that this type of the retina, proper to Birds, also occurs in certain Reptiles, namely the Tortoises, which, themselves, in this respect differ widely from the other sections of the Reptiles. On the other hand, I may remark, that, amongst Fishes, it is exactly in the orders which also possess the most peculiar characters, that we find the most distinct variations in the elements of the retina. In the Sturgeons the layer of cones and batons is constituted in accordance with the type of Birds; in the Cyclostoma, as appears from my previous researches, there are only simple cones, without batons; in the Plagiostoma, on the contrary, I have only found batons and no cones. In the class of Reptiles, we also find very important differences between the Batrachia, the Sauria, and the Tortoises, whilst in the Birds and Mammalia there is a greater uniformity in the general type of the elements referred to, and only slighter modifications.

Another remarkable point is the presence of nervous fibres with double outlines in the retina in certain animals. It is well known that in the eye of the Rabbit there is a beautiful white radiation especially on the two sides of the entrance of the optic nerve, and many observers have remarked, that fibres are sometimes found elsewhere which contain a kind of medulla. But, besides the Rabbits, there are many animals in which the optic fibres present a medulla with dark outlines, in a very marked degree.

I have found that in the Sturgeon, the optic fibres which extend in a very elegant manner in the form of a double comb, possess very strong outlines in a great part of the retina. The retina of the Plagiostoma also, both Sharks and Rays, contains fibres of a breadth of as much as 0·01 mill., which exhibit all the characters of the varicose fibres with double outlines which occur in the nervous centres. Lastly, I have observed that in the eyes of many Dogs, the optic nerve is still white at its entrance into the eye, and that it is only in the retina that the nervous fibres become pale and transparent. But the change takes place very soon after the entrance of the optic nerve, whilst in the fishes just mentioned, the fibres with double outlines extend over a great part of the retina, and only pass by degrees to the aspect of the pale fibres. In a physiological point of view it is remarkable that in the Fishes of which I am speaking, notwithstanding the double outlines of the nervous fibres, the retina appears to be tolerably transparent during life, whilst in the Rabbits and Dogs it is opaque and white, in the whole extent of the fibres with double outlines. In the former case the influence upon the sight does not appear to be important, but in the latter the perception of light must be hindered or disturbed as far as this peculiarity of the fibres extends; and the ophthalmoscopic effect of the bottom of the eye, and especially of the entrance of the optic nerve, must present remarkable modifications in all the animals in which a state similar to that which has long been known in the Rabbit exists.—*Comptes Rendus*, Oct. 20, 1856, p. 743.

Remarks on Nika edulis, *Risso*. By William Thompson.

The possession of a healthy specimen of *Nika edulis* has enabled me to offer the following remarks, which, I trust, may add something new to what is already known of this species.

The first specimen I obtained by dredging on the 2nd July, 1853. I find by my notes, which were made at the time, that it was a female, and in spawn; the ova were darkish green, the animal itself was of a cream colour, and spotted with red dots; the spots were of different sizes, perfectly round, and rather thickly and regularly placed. This specimen was dead before I examined it, and this will account for the difference of colour as contrasted with the specimen, the more immediate subject of the present paper. I had previously obtained one specimen, and a third specimen, also in spawn, was brought to me on the 20th July, 1855; the ova were bright green, and the animal of a cream colour. This specimen was dead when examined.

The subject of the present paper was brought to me alive by my dredger on the 21st February in this year, and lived three weeks. It was dredged in Weymouth Bay, near the mouth of the harbour. The colour in this living specimen was very different from that of the dead specimens I had previously obtained. When first brought to me, the whole animal was a light greenish-drab, irregularly and thinly sprinkled with pure white stars; the carapace and covering of the abdomen were alike transparent, and the intestines could be easily seen beneath. I could also detect the breathing apparatus placed on each side at the back of the mouth; the movement was similar to that of a long rope when gently waved at one end. After a few days' confinement it changed colour: five or six broadish bands of a lovely rose colour appeared, the bands of colour being restricted to the back portion of each segment of the body; the tail also changed to the same rosy hue, but in the course of two or three days the animal again assumed its original colour. I have noticed this change of colour in many of the *Palæmonidæ* and *Crangonidæ*, and I believe it to arise from the transparency of the cuticle enabling any change in the body itself to be seen through it, and that the change of colouring of the body is occasioned by fear or some instinct. In all the specimens of *Nika* I have obtained the shell is soft as in a new-moulted Prawn, and in piercing them with a fine pin for preserving, the shell bends before it. Is this of any value as a generic character? M. Milne-Edwards says they resemble *Athanas* "in possessing but a small rostrum;" they also resemble them in their mode of locomotion, as they then carry the external pedipalps and first pair of feet extended before them in a line with their body; their movements are also slow and deliberate, and they appear to progress by walking and not by swimming; when alarmed they shoot backwards by striking forward with their tail, as is the habit of all the long-tailed Crustaceans.

I now proceed to lay before you the information I have obtained as to its habits.

I may assert that *Nika* is essentially a burrowing genus. I was not prepared to find it so, as I considered its slender limbs and its prominent eyes but ill-adapted for the purpose; however, we live and learn, and I have learned that practice is far better than theory; had I relied on the latter I should have insisted that *Nika edulis* was not a burrower.

In accordance with a plan which I have formed of attempting to study the habits of any of our rarer marine animals I may have the good fortune to meet with, I placed my prisoner in a vase with a few weeds and some pebbles, that being the nature of the ground on which it was dredged; I left it in this vessel for two days, and found out it was not at home, and, in fact, that a pebbly bottom was not its choice. I therefore removed it to a large earthenware pan in which I had previously placed a few weeds, having filled it also to the depth of three inches with coarse gravel; I then left it for an hour, and on examining the vessel I could not find my friend; I searched on the table, thinking it might have thrown itself out, but it was without success; I turned over the stones and weeds, and with the like result. I then commenced turning over the gravel, and at last found that *Nika edulis* was a burrowing Crustacean. I accordingly transferred it for facility of observation to a vase, and placing in it the same material, namely, the coarse gravel and weeds, in this gravel it buried itself three several times. Burrowing in this loose material was evidently a difficult matter; it required great patience and perseverance to overcome the difficulty occasioned by the loose gravel constantly falling in on the excavator: it took the animal ten minutes to burrow to about the depth of three parts of its length. I afterwards transferred it to a vase with sand to the depth of three or four inches at the bottom; in this it quickly disappeared, three minutes sufficing to completely cover itself. In this vase it was that I made the following observations on it.

Its mode of mining is extraordinary: lying at the bottom of the vase, it commenced proceedings by probing the sand around with its third pair of feet, and inserting them to some depth in it; when it found a spot suited for the purpose, that is, free from any large stones, it at once commenced excavating. These operations were carried out by the external pedipalps, which are very long and strong, and also by the first, third and fourth pairs of legs; the second pair of legs, as may be supposed, are for this purpose perfectly useless: they are as much as possible placed out of the way, being bent up snugly with the hand turned backwards: the only motion I could detect was a nervous action in the moveable finger, constantly attempting to clutch objects, but not seizing anything. The fifth pair of feet have a simple though useful office assigned them: it is to support the body in the proper position until the burrowing has progressed sufficiently to enable the burrower to do without their support; they are then immediately called into more active employment, and assist in the work of excavation. The spot for burrowing having been selected, the little animal steadies its body by means of its fifth pair of legs, and this allows the greatest freedom of action to the body. The pedipalps perform a prominent part in the burrowing; the nail on the last joint is curved slightly forward, and the advantage of this is clearly seen, as in digging, the pedipalps are forced into the sand or shingle, and are thus forced forward and outwards, and they prevent the side of the burrow from falling in; the third and fourth pairs of feet are in constant motion, probing the sand and loosening it, thus lightening the labour for the pedipalps; all these movements take place very regularly and at the same time. A small hollow having been made, the animal raises its body by means of its fifth pair of legs to nearly a right angle with the bottom; its eyes, which are very large and carried at right angles with the body, are thus suddenly thrown forward with a spring in a line with the rostrum, and the hollow is surveyed; should it not be of a sufficient depth the body is again lowered and the burrowing continues, the eyes resuming their original position; when the hole is sufficiently deepened, the eyes are again brought forward, the antennæ are thrown back in a line with the body, and the animal forces its head in the hole it has made; this is facilitated by the body being gradually raised by means of the fifth pair of legs; the head being inserted, the burrowing continues with increased energy, and the animal assumes the position as in photograph No. 2; this view shows the sand which has been thrown up accumulated in a heap under the body.

I have occasionally found it continue in this position, but generally it burrows perpendicularly, until only the tips of the antennæ are visible.

I placed my captive in a glass vase, and his having selected the side of the glass for burrowing (probably from the glass forming one firm side to the work), enabled me to watch every movement; the sand appeared to be passed to the mouth of the hole by the legs and false legs, when it filled round the body and filled in as the animal passed downwards. The antennæ are delicately sensitive. I believe this sensitiveness depends on the sense of touch: the slightest contact with them sets the animal in motion (and this when it is buried some depth), using every exertion to burrow deeper. It is evidently a night-feeding genus, as it remained buried and inactive during the day, but the state of the sand in the tank in the morning proved that it had not been idle during the night.

From these facts I am justified in stating that *Nika edulis* is a burrowing species (if not of a burrowing genus), and that its burrowing is only by day to hide itself from its enemies, and not to procure food.

The description I have given of the colouring of this species will be found to be different from that given by Risso, as stated by Mr. Milne-Edwards. I should have great diffidence in differing from these eminent naturalists had I not imagined that their descriptions might have been taken from cabinet specimens. Had I waited to describe my specimen until after its death, I must have described it as it now is, namely, *flesh-red*; I find all the thinner-shelled Crustacea change more or less of a flesh-red, with the exception of the *Crangonidæ*.—*Proc. Zool. Soc.*, April 22, 1856.

NAUCRATES DUCTOR.

To the Editors of the Annals of Natural History.

Falmouth, November 1, 1856.

GENTLEMEN,—A shoal of the *Naucrates ductor*, Cuv., made its appearance in shallow water, Custom House Pier, on Friday afternoon, Oct. 31, 1856, and more than three dozen of them were caught in nets, baskets, &c., by persons on the beach. I have procured species of this interesting fish every year during my residence in this neighbourhood.

I am, Gentlemen, yours truly,
W. P. COCKS.

On Peculiar and Quasi-spontaneous Movements of the Plasmatic Cells of certain Animals. By Prof. KÖLLIKER.

I have just observed at Nice, upon a fine animal of the family of the compound Ascidians, which according to M. Milne-Edwards has not yet been described, a very peculiar fact, namely, movements of the cells which occur in great number in the gelatinous substance common to the whole bunch and formed of cellulose. These cells, which are round or stellate and of very various forms, have, in the living animal, a slow, but easily perceptible movement, consisting in a constant change of form, so that the same cell, which was at one time round, becomes stellate or fusiform in different degrees, by the formation of two or several prolongations, often very long and even branched, returning subsequently to the round form which it had at the commencement. This movement, which is constantly observed in all these cells, although slow, is nevertheless pretty strong, and I have even several times observed cells which changed their position by the formation of processes, the whole presenting a considerable resemblance to the movement of an *Actinophrys* or *Amœba*. As in these animals, the contents of the cells also took part in the movement, and it was easy to see that these granulations passed sometimes into the processes, returning afterwards into the body of the cells, so that the change of form of the cells is accompanied by a movement of all the parts of which they consist, which may probably be intimately connected with the chemical and vital phænomena which are accomplished in these cells as well as in all the others.

Having observed these movements, it occurred to me that it was possible that many stellate cells exhibited similar movements, especially as something of the same kind has already been seen in the pigmentary cells of the Frog, and I set myself to examine the plasmatic cells or corpuscles of the conjunctive tissue. As these observations were made during the last days of my stay at Nice, I cannot give them the extent which I desired; however, I was fortunate enough to see that the plasmatic cells of the gelatinous conjunctive tissue of the head of the Torpedo, and the stellate cells of the gelatinous substance of the body of *Cassiopeia borbonica*, also exhibit movements similar to those which I have just described, and I do not doubt that it will be found that this phænomenon has a considerable extent, and even some physiological importance.—*Comptes Rendus*, Oct. 27, 1856, p. 794.

Description of a New Species of Actinia *from the Devonshire Coast.* By E. W. H. Holdsworth.

When contracted, the body forms a rounded button about $\frac{3}{4}$ of an inch in diameter, but in full expansion it is generally elongated to the extent of $2\frac{1}{2}$ inches, and terminates in a somewhat cup-shaped disk about $1\frac{1}{4}$ inch wide, and having its extended edges frequently thrown into irregular festoons. The tentacula, about 150 in number, are arranged in four or five series, as in most of the group to which this species belongs; the first row contains twenty-five arms, about half the length of the diameter of the disk, and moderately stout; the others gradually diminish in size as they proceed outwards, their numbers at the same time increasing; but the irregular manner in which they are placed renders it difficult to enumerate the contents, or to determine the limits of any one of the series. The disk is of a uniform olive-brown without any superficial markings,—the appearance of radiating lines, sometimes visible, being only the upper edges of the internal septa showing through the transparent skin; the mouth opens transversely, and displays a regular crenation of its pink lining membrane. The tentacula are of a reddish purple, and entirely destitute of rings or other marking; they present a remarkable contrast to the body of the animal, which at its upper part is of a dark orange colour, gradually assuming a paler tint towards the base; numerous white sucking-pores are disposed over the upper surface, and afford points of attachment to surrounding substances, when required to conceal the body; they also give exit to the convoluted filaments, which are abundantly thrown out from them and the mouth, when the animal is irritated. Its natural haunts appear to be narrow crevices of rocks, into which it can retire when alarmed, and I was prevented obtaining many specimens by their having chosen such inaccessible hollows for their residence. Four or five examples were, however, procured at extreme low-water mark, from the very productive rocks outside Dartmouth harbour, and, excepting in size, presented no points of difference. I propose for this species the name of *vinosa*.—*Proc. Zool. Soc.*, June 10, 1856.

METEOROLOGICAL OBSERVATIONS FOR OCT. 1856.

Chiswick.—October 1. Exceedingly fine. 2. Cloudy. 3. Cloudy and fine: rain. 4. Rain: cloudy: rain. 5. Rain: cloudy: fine: lightning at night. 6. Foggy: rain: cloudy. 7. Hazy and drizzly: rain at night. 8. Heavy rain: densely overcast. 9. Overcast. 10. Hazy: fine. 11. Heavy rain: uniform haze: slight rain at night. 12. Foggy: uniform haze. 13. Dense fog: very fine: cloudy. 14. Foggy: overcast: fine. 15. Rain. 16. Overcast: showery. 17. Fine: overcast: hazy. 18. Very fine. 19. Dense fog: very fine. 20. Foggy: very fine. 21. Foggy: exceedingly fine. 22. Very dense fog: exceedingly fine. 23. Foggy: very fine. 24. Fine. 25. Foggy: heavy clouds: fine. 26. Hoar-frost: hazy: very fine. 27. Frosty: haze: fine. 28, 29. Very dense fog. 30. Hazy clouds: overcast: fine. 31. Uniform haze: rain: cloudy.

Mean temperature of the month	51°·28
Mean temperature of Oct. 1855	50 ·28
Mean temperature of Oct. for the last thirty years	50 ·00
Average amount of rain in Oct.	2·802 inches.

Boston.—Oct. 1, 2. Fine. 3. Fine: rain P.M. 4. Rain A.M. and P.M. 5. Cloudy. 6. Fine. 7, 8. Rain A.M. and P.M. 9—12. Cloudy: rain A.M. and P.M. 13. Cloudy. 14. Fine. 15. Fine: rain A.M. and P.M. 16. Cloudy: rain P.M. 17. Fine. 18. Cloudy. 19. Fine. 20, 21. Cloudy. 22, 23. Foggy. 24. Fine. 25—28. Cloudy. 29. Foggy. 30, 31. Cloudy: rain A.M.

Sandwick Manse, Orkney.—Oct. 1. Bright, fine A.M.: cloudy, fine P.M. 2. Bright, fine A.M.: drops P.M. 3. Hazy A.M.: drops P.M. 4. Hazy A.M.: drops, showers P.M. 5. Showers A.M.: clear, aurora P.M. 6. Clear, fine, hoar-frost A.M.: clear, aurora P.M. 7. Clear, fine, hoar-frost A.M.: cloudy P.M. 8. Bright A.M.: cloudy P.M. 9. Cloudy, fine A.M.: clear P.M. 10. Cloudy, fine A.M. and P.M. 11. Bright, hazy A.M.: cloudy P.M 12. Clear, fine A.M. and P.M. 13. Bright, fine A.M.: cloudy P.M. 14. Damp A.M.: clear P.M. 15. Damp A.M.: cloudy P.M. 16. Showers A.M.: drizzle P.M. 17. Cloudy A.M.: rain, clear P.M. 18. Bright A.M.: drizzle P.M. 19. Bright, fine A.M.: drizzle P.M. 20. Bright, fine A.M.: clear, aurora P.M. 21. Fog A.M.: cloudy P.M. 22. Cloudy, fine A.M.: showers P.M. 23. Clear, fine A.M.: clear, aurora P.M. 24. Clear, frost, fine A.M.: clear, aurora P.M. 25. Damp A.M.: rain P.M. 26. Drizzle A.M.: damp P.M. 27. Drizzle A.M. and P.M. 28. Damp A.M.: cloudy P.M. 29. Hazy, fine A.M.: clear P.M. 30. Cloudy, fine A.M.: cloudy P.M. 31. Cloudy, fine A.M.: clear, fine P.M.

Mean temperature of Oct. for previous twenty-nine years ...	47°·57
Mean temperature of this month	48 ·84
Mean temperature of Oct. 1855	45 ·72
Average quantity of rain in Oct. for previous sixteen years ...	5·09 inches.

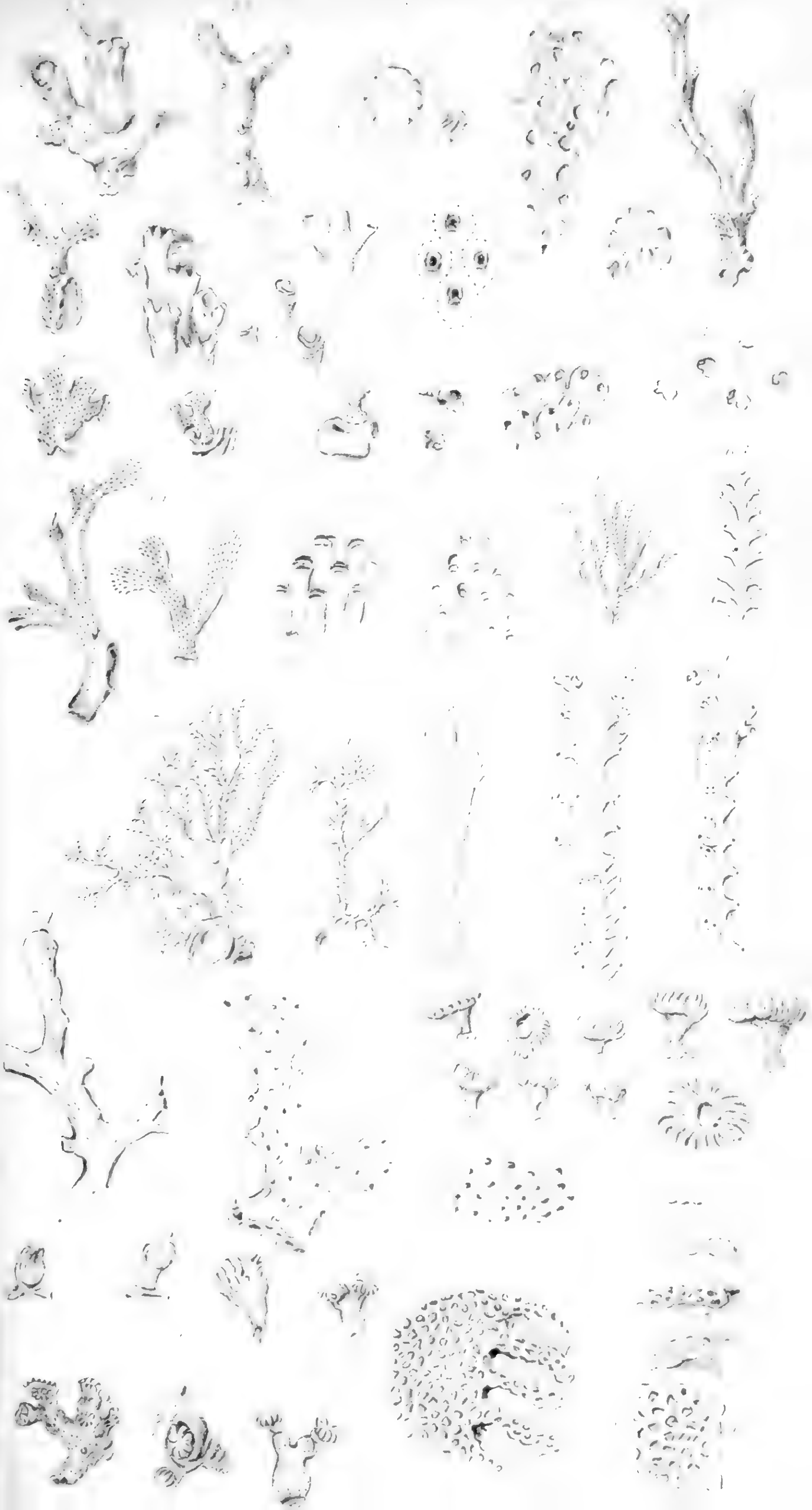
Days of Month.	Barometer.					Thermometer.					Wind.			Rain.		
	Chiswick.		Boston. 8½ a.m.	Orkney, Sandwick.		Chiswick.		Boston. 8½ a.m.	Orkney, Sandwick.		Chiswick. 1 p.m.	Boston.	Orkney, Sandwick.	Chiswick.	Boston.	Orkney, Sandwick.
1856. Oct.	Max.	Min.		9¼ a.m.	8½ p.m.	Max.	Min.		9¼ a.m.	8½ p.m.						
1.	29·818	29·796	29·40	29·67	29·68	64	42	45	48	48	sw.	sw.	e.	....	....	....
2.	29·820	29·758	29·32	29·66	29·67	67	50	54	52	52	s.	sse.	se.	....	....	....
3.	29·803	29·737	29·35	29·65	29·60	66	55	57	53½	52	s.	s.	s.	·10	....	....
4.	29·735	29·637	29·11	29·54	29·55	66	56	60	51	50	sw.	s.	nw.	·11	·24	·02
5.	29·884	29·807	29·30	29·83	29·99	63	42	60	47½	40½	sw.	w.	ne.	·03	·08	·02
6.	29·944	29·922	29·52	30·16	30·25	57	55	55	42	36½	e.	ne.	calm	·06	....	·02
☽ 7.	29·926	29·897	29·53	30·17	30·12	59	52	52	44½	45	ne.	ne.	ssw.	·36	·28	....
8.	30·060	29·904	29·48	30·06	30·05	58	49	53	50	49½	ne.	n.	wsw.	·50	·20	....
9.	30·211	30·122	29·70	30·08	30·16	60	49	50	52	48	ne.	n.	s.	....	·08	....
10.	30·199	30·106	29·75	30·22	30·22	62	43	55	52½	49½	ne.	e.	calm	·30	·68	....
11.	30·039	29·972	29·62	30·16	30·09	60	52	56	50½	49½	ne.	ne.	se.	·12	·06	....
12.	30·160	30·045	29·57	30·03	30·01	64	42	55	49½	47	s.	w.	s.	·02	....	....
○ 13.	30·193	30·108	29·70	30·08	30·05	67	44	56	52½	50	s.	s.	se.	....	·21	....
14.	29·945	29·694	29·52	29·93	29·76	60	48	57	50	49½	se.	se.	se.	·20	....	....
15.	29·654	29·389	29·04	29·57	29·53	61	47	53	51½	51½	s.	s.	sse.	·21	·13	....
16.	30·262	29·985	29·50	29·50	29·79	59	43	52	53	49	nw.	wnw.	se.	·06	·05	·09
17.	30·318	30·308	29·83	29·67	30·00	59	46	50	55½	46	sw.	sw.	w.	....	....	·21
18.	30·310	30·270	29·84	30·22	30·19	63	32	53·5	42½	48	sw.	sw.	e.	....	....	·02
19.	30·286	30·237	29·84	30·11	30·16	60	42	43·5	52	52	e.	e.	sse.	....	....	·02
☾ 20.	30·181	30·143	29·78	30·22	30·15	63	39	55·5	49	46½	e.	e.	sse.	....	....	....
21.	30·290	30·190	29·75	30·05	30·05	64	36	52·5	45½	49½	sw.	calm	sw.	....	....	·01
22.	30·308	30·282	29·90	30·11	30·15	68	42	48·5	53	50½	e.	s.	w.	....	....	·05
23.	30·417	30·304	29·85	30·33	30·42	62	50	52	48	43	sw.	calm	calm	·01	....	....
24.	30·484	30·411	30·00	30·48	30·42	58	39	52	39	40	ne.	ne.	calm	....	....	....
25.	30·471	30·444	30·05	30·31	30·28	56	26	50	50	51	e.	nw.	sw.	....	....	·19
26.	30·424	30·365	30·00	30·24	30·23	52	25	50	52½	52½	e.	calm	wsw.	....	....	·01
27.	30·345	30·321	30·00	30·17	30·26	55	25	41	53	51½	e.	nw.	w.	....	....	·05
● 28.	30·329	30·268	29·90	30·26	30·16	51	26	49	51	49½	e.	se.	se.	·01	....	....
29.	30·230	30·184	29·84	30·06	29·96	45	37	41	49½	43	ne.	se.	se.	·01	....	....
30.	30·156	30·130	29·74	29·77	29·75	58	35	42·5	50	49½	s.	ssw.	s.	·02	....	·15
31.	30·313	30·097	29·66	29·91	30·29	58	46	50	52	46	s.	sw.	sw.	·28	·07	·15
Mean.	30·149	30·059	29·66	30·010	30·030	60·16	42·41	51·6	49·76	47·93				2·40	2·08	[illegible]

INDEX TO VOL. XVIII.

END OF THE EIGHTEENTH VOLUME.

PRINTED BY TAYLOR AND FRANCIS,
RED LION COURT, FLEET STREET.

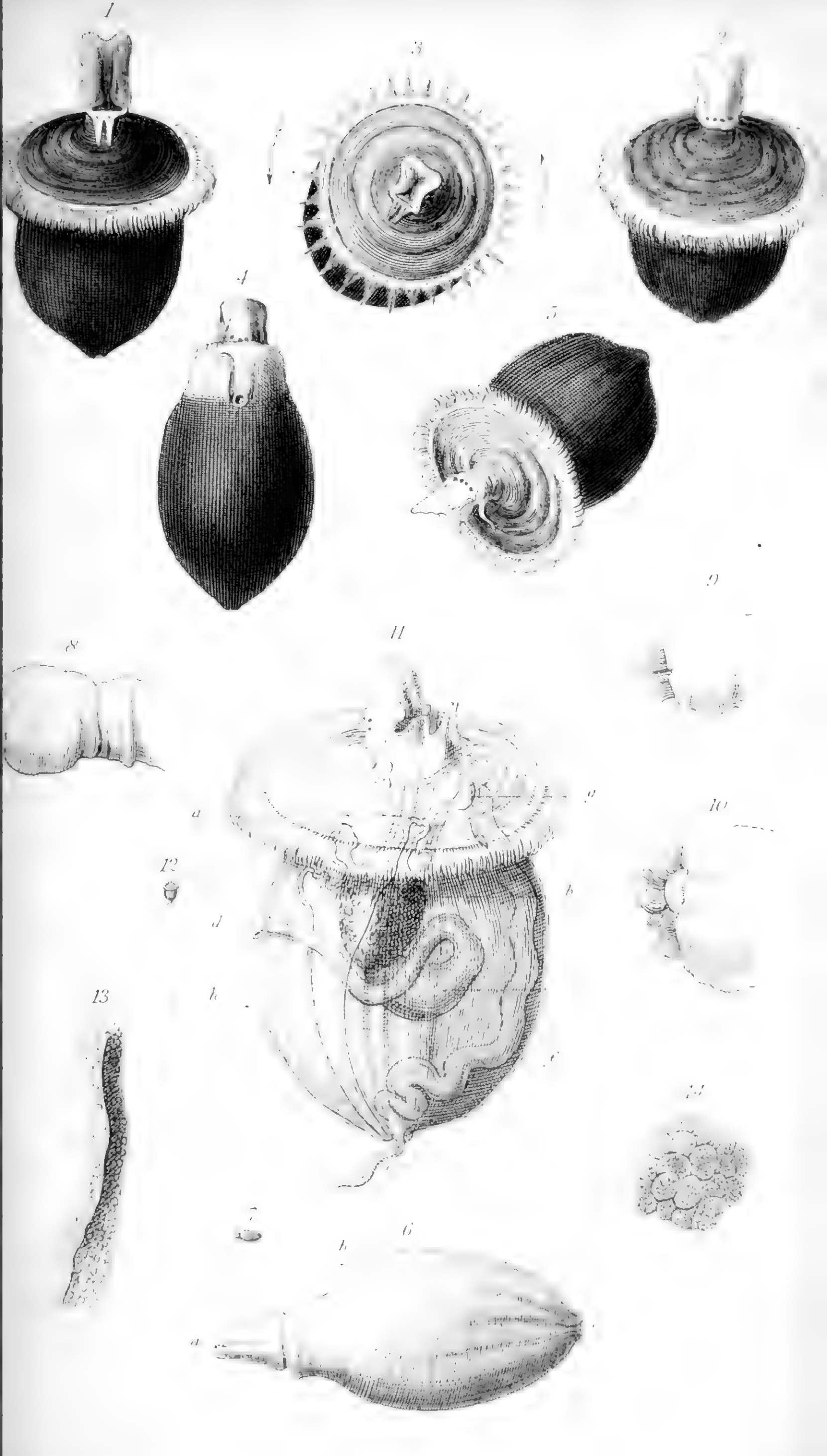
ALERE FLAMMAM.



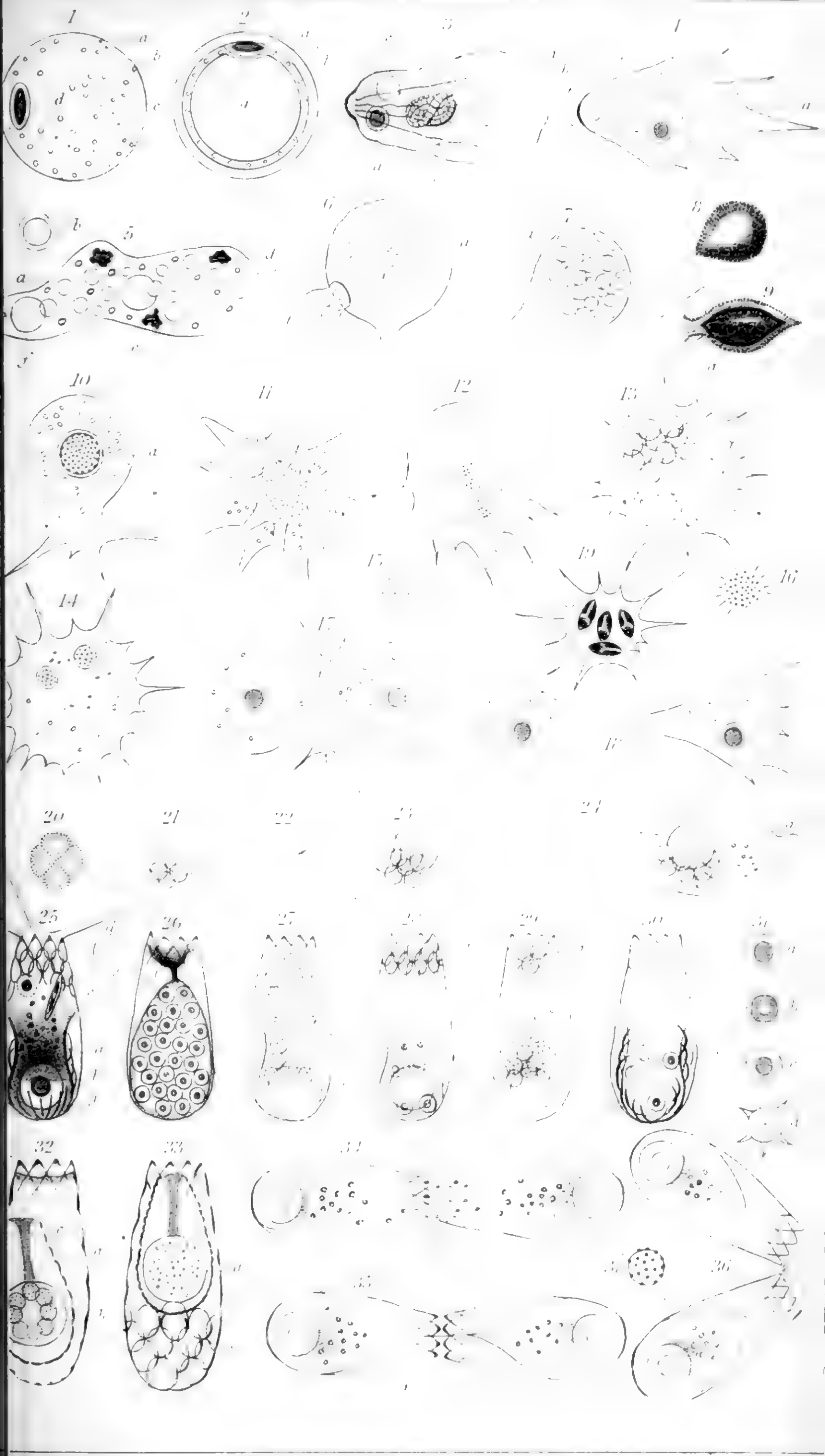

1
2
3
4
5
8
6
a
7
a
10
9
11
12

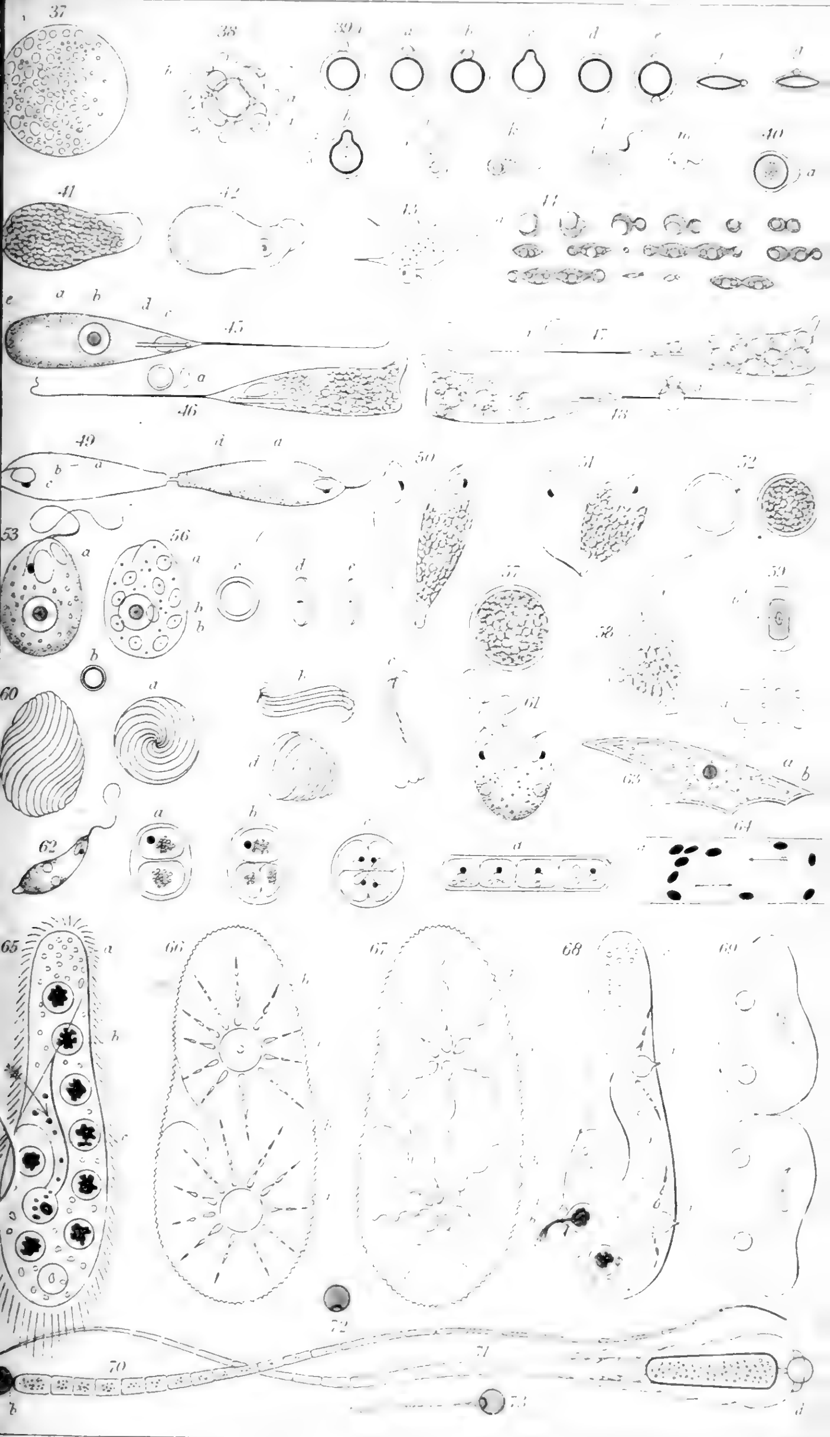
Schmidt ad nat. del.

Jobson sc.

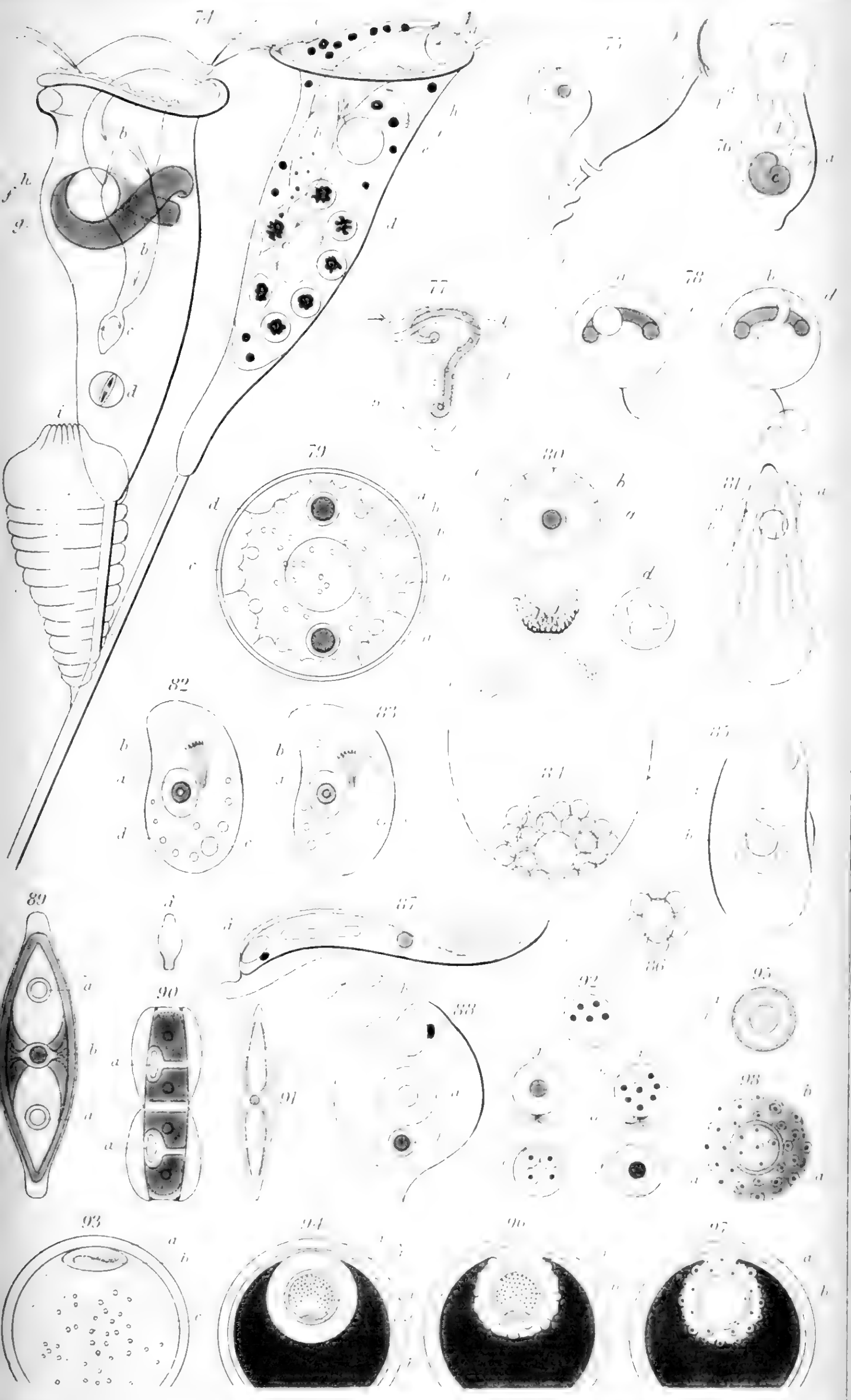


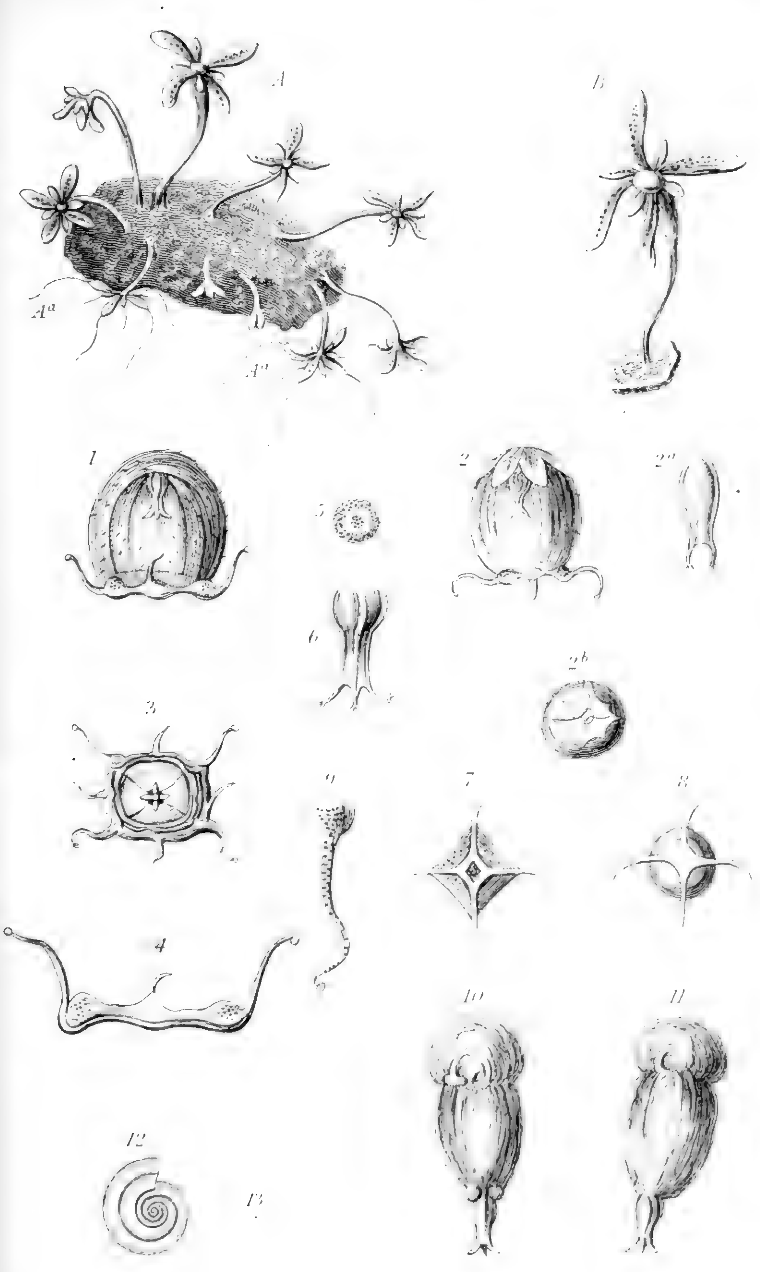
cdonald, ad nat. del. J. Basire,





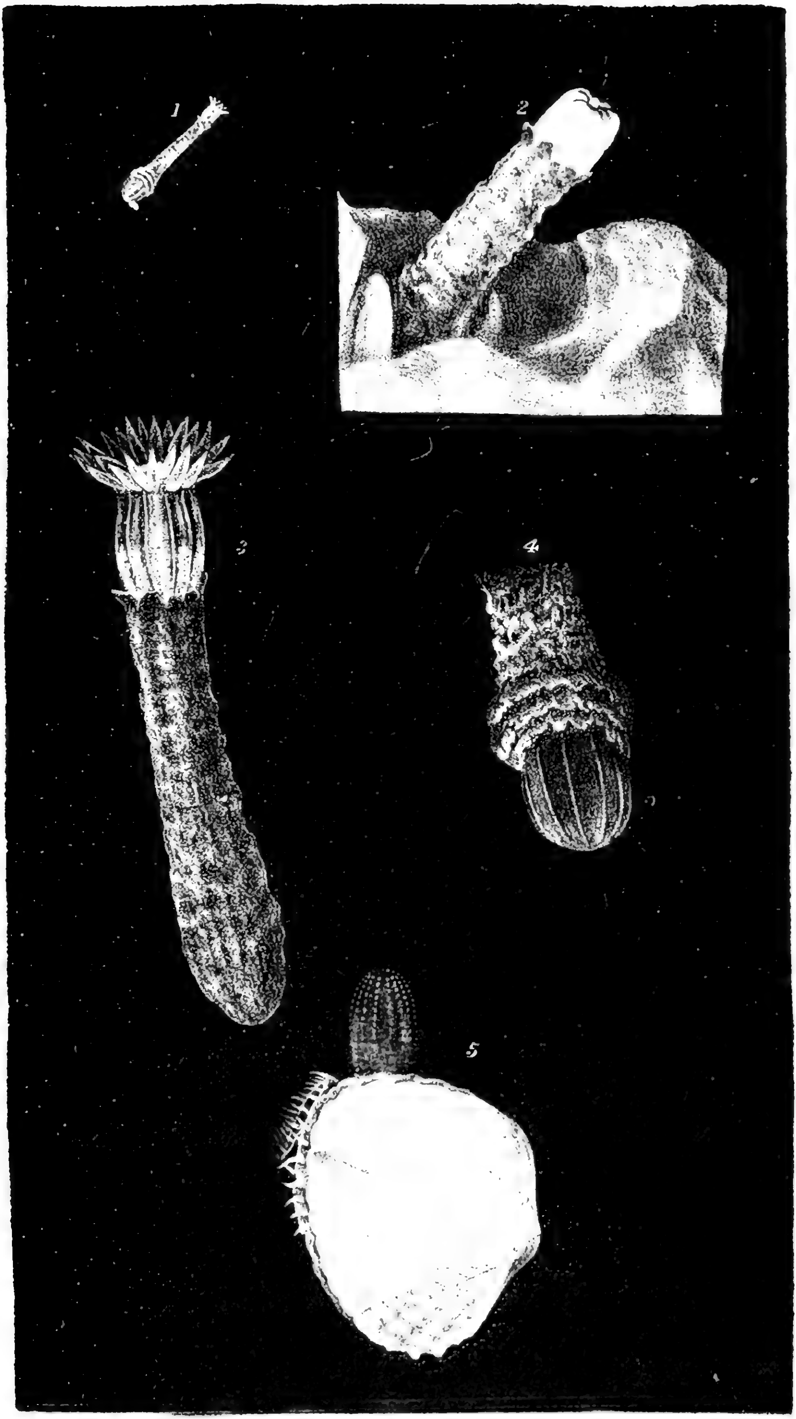
del.

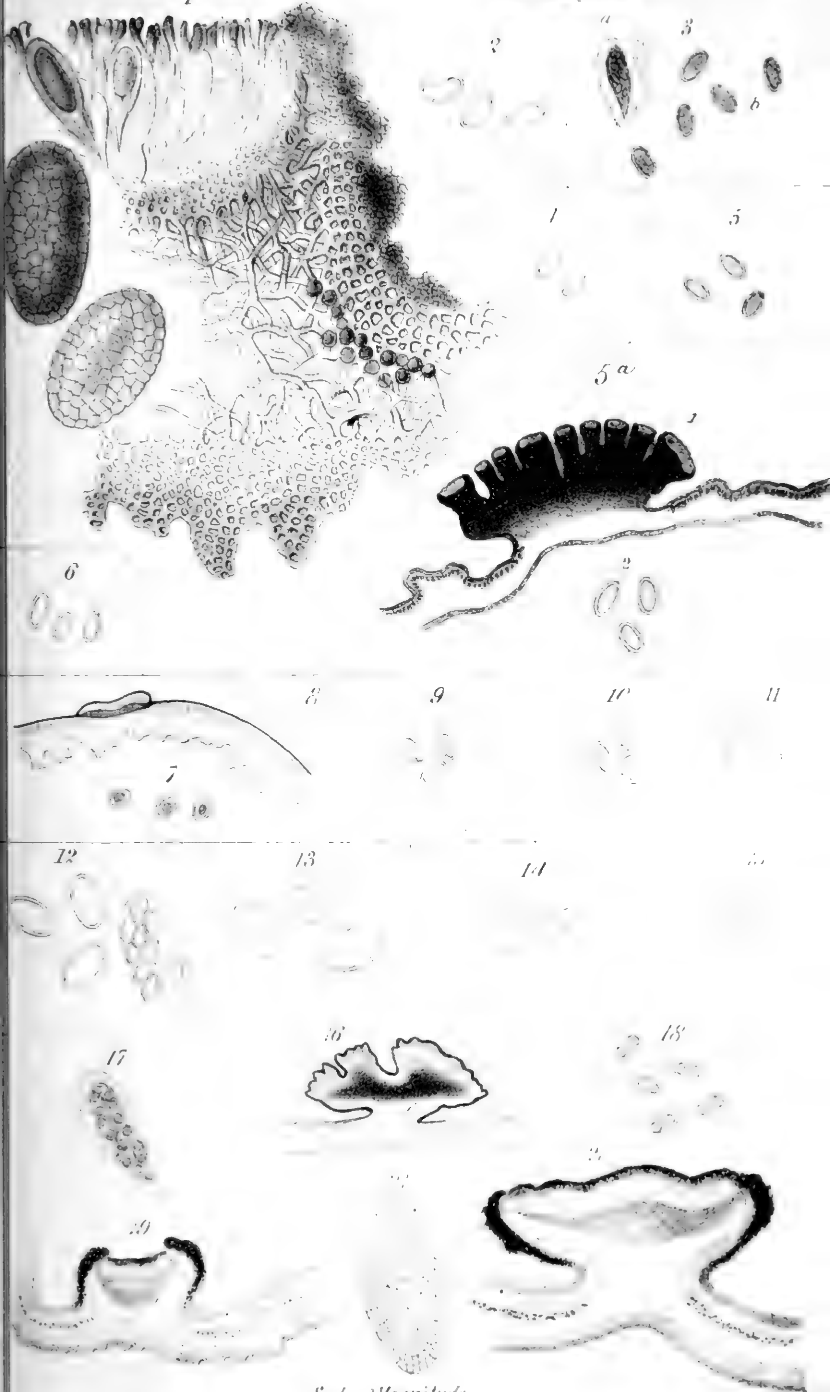

74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98



Peach, del.

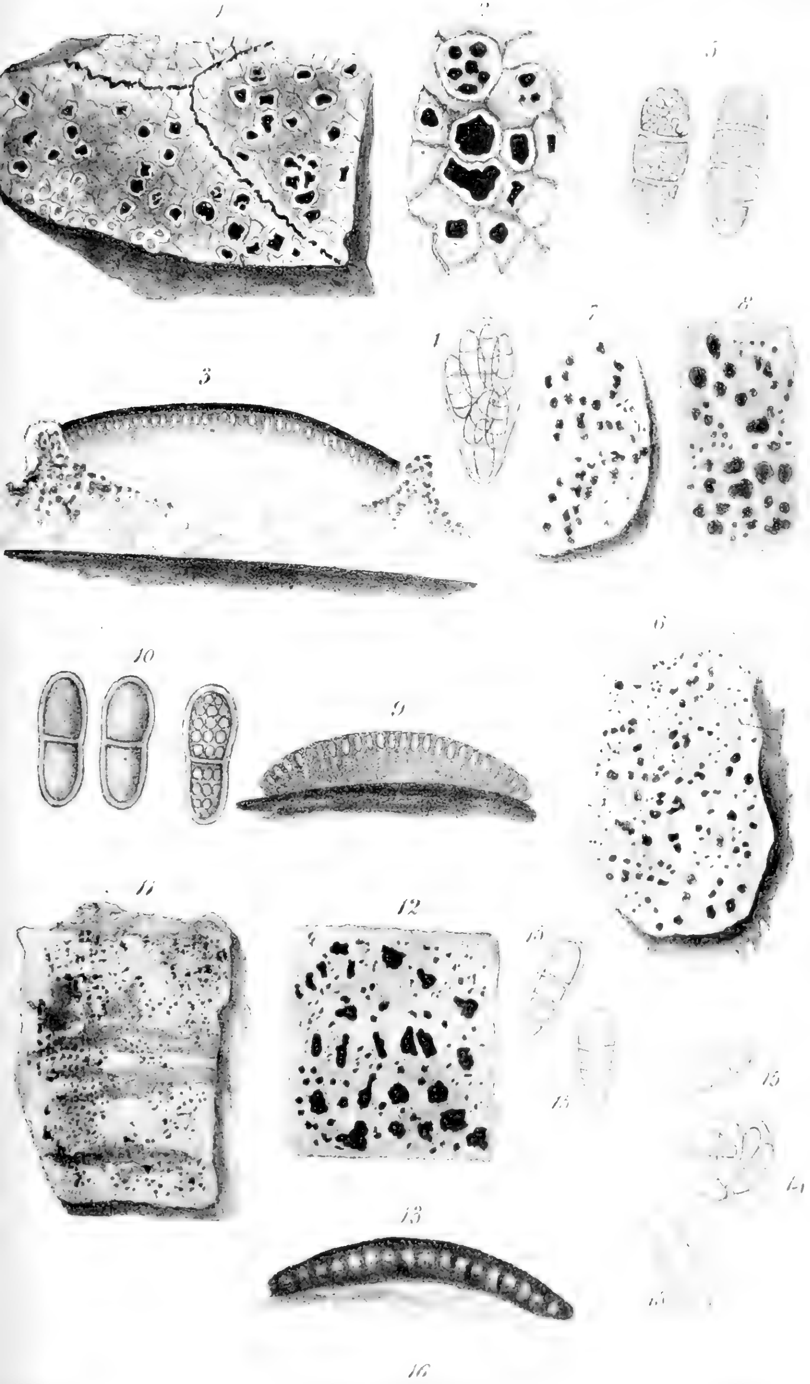
sc.


1
2
3
4
5



Scale of Magnitude
1/100 of an Inch

W. A. Leighton del. J. Basire lith.



Revd W. A. Leighton del.


3
2
1
7
5


a

0