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OF THE

ARTS AND SCIENCES

In India.

GEOLOGY AND ZOOLOGY,

CONDUCTED

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PREFACE TO THE FIFTH VOLUME.

It becomes our duty again to return thanks to the supporters of this Journal. The present volume contains a larger proportion of original matter, devoted to the investigation of natural productions before undescribed, than any of its predecessors.

If upon this criterion, the value of the work is to be estimated, it will be found to have greatly improved.

Since the publication of the last Volume, the Honorable the Court of Directors, always the munificent Patrons of Science, have become subscribers for 50 copies.

During the past year, we have lost the services in India of two of our contributors, Mr. B. H. Hodgson, of the Civil Service, and Mr. David Liston, by their return to Europe.

We have also to regret the loss of another of our contributors by death, Dr. J. G. Malcolmson, of whom a short notice will be found, p. 282.

To compensate for these losses, we have been favoured with three new contributors,—promising supporters of the rising science of India.

The departure of Mr. Griffith, late Officiating Superintendent of the H. Co.'s Botanic Garden, to Malacca, though a severe loss, considering the extent of his contributions during the past two years, will in no way interfere with his connection with the work, as Joint Editor, now essential to its character.

Whatever may be thought of the practical applications of Natural History, they ought to assume a very important character in this country at the present crisis, whether we regard them as accessory to improved education, or as a means of improving the national resources.

In our last Number, we referred to the employment of magnesian limestone,—a common mountain rock in certain parts of the country,—as a material for the production of Epsom Salt. We have since become acquainted with the fact, that in consequence of the comparatively high price of the imported article, Glauber Salt is largely introduced to India, crystallized in imitation of Epsom Salt, for which it is sold by wholesale, a circumstance which (although there may be nothing very dissimilar in the properties of the two articles) in our opinion, ought to weigh greatly in determining the adoption of such measures as may be reasonably suggested for improving the supply of such things from our own resources, were it for no other reason than to check such practices as the one adverted to.

The question presents itself to us in a different point of view from that of its mere relation to medicine.

Thus in the article Epsom Salt, its production here would improve the demand for sulphur, as well as the local consumption of nitre; while it would afford carbonate of magnesia, a more costly and portable article, which might thus probably become an export; at the same time it would promote the demand for the impure native carbonate of soda, another natural production that might thus become much more valuable than it is at present.

Again, to take another instance, and not a theoretical one, for the object has been tried; we allude to the distillation of oil of turpentine from the resin of *Pinus longifolia*, which constitutes extensive forests now useless in the hill provinces of this Presidency. It is we believe the *Gunda Berosa* of the Bazars. We do not know that it has ever yet been exported; but 12,000 tons of a corresponding article are annually imported into England from the United States.

We have ascertained, that the resin of *Pinus longifolia*, affords on distillation one-eighth part of its weight of pure oil of turpentine, leaving a residuum of seven parts of *resin*. The former, in addition to its demand as an article of medicine, is extensively used by house painters; the latter is indispensable in the manufacture of hard yellow soap, which is made by boiling 9.75 cwt. of tallow with 3.25 cwt. of resin, and 2 cwt. of soda with a due proportion of water.

Thus we see how one thing depends upon another, and how the manufacture of medicine on the spot (itself a great object), would promote other results of still greater importance.

The same forests, (equal we should say to any even in Russia or America,) to which we should be thus directed for turpentine, would also be found to supply *tar*.

Four-fifths of the tar employed in Great Britain comes from Russia, the remainder is imported equally from Sweden and the United States. England is therefore dependent on foreign nations for an article not only essential to, but characteristic of her navy, while exhaustless supplies may be had in her own Bengal provinces, from boundless pine forests, some of which approach to within twenty miles of Sylhet.

Up to within the last three years, Isinglass, the various kinds of Gum Arabic, Myrrh, &c. together with glazed earthen pottery, were annually imported from Europe to supply the public expenditure, and would probably have continued to be so furnished for the next half century, had not the Governor General in Council, as we understood, expressed a determination, without reference to the quarters from which such requisitions were made, to strike them out of the list of imported supplies. It was then found not only to be unnecessary to import these articles from Europe, but that India herself was the source from whence Europe and other parts of the world had been supplied with some of them for centuries past.

Let this principle be generally acted upon, and the same course be adopted with regard to Epsom Salts, and we are equally prepared to say, coal Coke, wrought Iron, Tar, Resin, Turpentine, and a hundred other articles which we have good reason to know may be had cheaper and better in India than any where else, and the effect will soon become perceptible on the productive resources and improvement of the country.

The Palms of India, to which so large a proportion of the present volume is devoted, although constituting one of the chief features of the vegetation of this country, and contributing so largely as they do to the shelter and employment of the native population, are as yet imperfectly known.

How greatly this important family of plants may be made to contribute to the exports of the country, and comfort and wants of the people, when the properties and uses of the various species of which it is composed become fairly and fully known, we may infer from a few instances.

Amongst those described by Mr. Griffith in the present volume, the *Phœnix sylvestris*, Roxb., or *Khujjoor*, affords a wholesome drink, ' palm wine,' when fresh. Fermented, this becomes vinegar; fermented and distilled, *arrack*, an ardent spirit, which on redistillation becomes pure alcohol. The fresh juice boiled down affords 1-12th of its quantity of treacle, which again yields ¼ of pure white sugar. Each tree yields during the cold season ten gallons of juice, from which eight pounds of sugar, or an equivalent proportion of spirit or vinegar is obtained.

Besides this, the fibres of the leaves are wrought into mats and baskets.

Another species, *Sagus Konigsii*, Griff. affords sago, upon which a large proportion of the inhabitants of some of the Eastern Islands subsist; a third, *Calamus Draco*, Willd. affords the peculiar Balsam, Dragon's Blood, an article of considerable commercial importance; others, the *Licula peltata*, Roxb. and *L. Jenkinsii*, Griff. afford covering for boats, dhoolies, and material for chattahs and umbrella-hats, which last are indispensable to the natives of Assam and other eastern parts of Bengal, where the periodical rains are heavy and incessant for seven or eight months of the year.

From the fibres of *Phœnix farinifera*, a kind of flour or meal is obtained, which on boiling becomes a kind of *conjee*, or sago, that might be rendered of the utmost importance in times of scarcity, while the leaflets are made into mats for sleeping upon, and the fibres of the petioles are made into baskets.

Arenga saccharifera, a stately palm, the fibres of which afford material for cables and cordage, celebrated both for strength and resisting wet, while its juice is either drank as toddy or made into sugar. Its pith is used as sago, and the young albumen affords a well-known preserve.

Caryota urens, another handsome species, has been known to yield above 100 pints of palm wine, or toddy, *per diem*. The pith or farinaceous parts of the old trees are equal to the best sago, and are either made into bread, or boiled into gruel. During a famine, adverted to by Dr. Roxburgh, the people suffered nothing as long as these trees lasted.

Yet the distinguishing characters of the species composing this important and characteristic family of Indian plants, are only for the first time collected together, and made known in a connected shape. The number of new genera and species collected chiefly in the course of Mr. Griffith's unimposing, but really useful and important services in Assam, the Mishmee, Boutan, Khassya, and Himalaya Mountains, Affghanisthan, Burma, Tenasserim provinces, and the Straits, affords a gratifying instance of the successful exertion of one individual in the cause of science.

It is not generally known that several of these palms contribute largely to the produce of sugar in Bengal; Dr. Roxburgh mentions in his time, the probable produce to be 100,000 mds. from these trees in Bengal alone; but the question has never we believe been examined either as to what the produce actually is, or how it might be improved. But while so much yet remains to be investigated relative to the properties and uses, not merely of this particular family of plants, but the vegetable kingdom generally, it is a subject of deep regret, not on his own account so much as on that of the resources of India, that our colleague to whom so much is due, and from whom so much more is to be expected on this subject, should have occasion to return to a limited field in the Straits.

We are indebted to Captain Campbell of the Madras Service, for a second valuable communication on the important manufacture of wrought Iron in India. In his first paper, Captain Campbell points out the expense of transmitting iron into the interior, adverting to the fact of an iron suspension bridge having cost 80 rupees a ton for carriage alone. On the other hand, it would seem from subsequent correspondence with Captain Campbell, that good wrought iron may be made in any part of India where ore and fuel are plentiful, for 38 rupees per ton, being less than half the above charge for transport alone. The practical importance of this subject requires no comment. Captain Campbell advocates the improvement of the native process of making wrought iron, rather than the introduction at once of the high blast furnace for the production of cast iron.

On this point we must for the present submit to the recommendation of Captain Campbell whether we will or not, for there are difficulties which, until the nature of the ores of the country become better known, must retard their employment for the production of cast iron. These difficulties are only to be overcome by preliminary investigation on a small scale. In the mean-time it is satisfactory to know, from the papers of Captain Campbell, that good wrought iron may be produced from the native ores at the low rate above stated.

J. M.

Calcutta, January, 1845.

THE

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OF

NATURAL HISTORY.

The Palms of British East India. By W. Griffith, *Esq. F. L. S. Memb. Imp. Acad. Natur. Curios., Royal Ratisb. Botan. Soc., Asst. Surgeon, Madras Establishment.*

PALMIDÆ.*

Diagnosis.

Truncus lignosus, cylindricus, sæpissime simplex. *Folia* vernatione plicata, coriacea, flabelliformia vel pinnata. *Flores* monoici, dioici, vel polygami, rarius hermaphroditi. *Perianthium* duplex, utrumque triphyllum. *Stamina* hypogyna, sæpius 6, rarius indefinita, rarissime tria. *Ovarium* unicum, liberum, triloculare (raro 1-2-loculare), aut tria

* *Families to end in* idæ, *and Subfamilies in* inæ. Report on Zool. Nomenclature—1842, p. 45.

It is to be regretted that Dr. Lindley's Nomenclature†, which went so far as to reform the variation that marked the nomenclature of families, (even when there was no variation in the terminations of the supposed typical genera) stopped short of that general uniformity, obtainable by the adoption of the above rule, which is sufficiently prominent in most of the popular writings of Mr. Swainson. The value of that general uniformity will only be denied, I imagine, by those, who believe that there is one Natural Law for plants, another for animals.

† Introd. Nat. Syst. ed. 2nd 1836.

unilocularia. *Ovula* sæpissime solitaria, erecta, anatropa. *Fructus* solitarius vel triplex, baccatus vel drupaceus, sæpius monospermus. *Albumen* corneum vel cartilagineum, solidum vel centro cavum, æquabile vel plus minus ruminatum. *Embryo* monocotyledoneus, teres vel trochlearis, in foveola peripherica situs, plus minus vagus.

DESCRIPTIO.

Flores monoici vel dioici, vel polygamo-monoici dioicive, rarius hermaphroditi.

Perianthium plus minus coriaceum, glumaceum, rarius coloratum, persistens. *Calyx* trisepalus, sepalis distinctis vel plus minus coalitis. *Corolla* tripetala, petala sepalis subsimilia, distincta vel plus minus coalita, æstivatione sæpius valvata.

Stamina hypogyna, vel ob cohæsionem cum corolla quasi perigyna, sæpissime 6, quorum tria sepalis, tria petalis opposita, rarissime tria et tunc sepalis opposita, in paucis indefinita, floris fœminei sæpius rudimentaria. *Filamenta* sæpe basi monadelpha. *Antheræ* introrsæ, biloculares, longitudinaliter dehiscentes. *Pollen* ellipticum v. ellipsoideo-sphæricum, longitudinaliter rimatum, interdum echinulatum.

Pistillum liberum, sæpissime tricarpellare: carpella plus minus coalita, floris masculi rudimentaria. *Ovarium* unicum et sæpissime triloculare, aut tria unilocularia. *Ovula* sæpissime solitaria, anatropa, ascendentia. *Styli* tot quot carpella, (interdum deficientes,) plus minus coaliti. *Stigmata* simplicia.

Fructus baccatus vel fibroso-drupaceus, interdum trilobus, solitarius, et sæpissime unilocularis, vel carpellis tribus fecundatis ternatus vel triplex, in tribu una squamis retrorsis loricatus, in altera putamine triporoso præditus. *Semen* sæpius solitarium, erectum.

Albumen copiosum, cartilagineum vel corneum, ruminatum vel superficie foveolatum vel excavatum, solidum vel centro cavum.

Embryo in lectulo proprio albuminis inclusus, sæpius ab umbilico remotus dorsalis et papilla indicatus, teres v. trochlearis. *Plumula* inclusa ægre conspicua, extremitate cotyledonea germinatione aucta et cavitatem, præexistentem vel liquefactione medii albuminis formatam, replente.

Plantae lignescentes, perennes, haud raro monocarpicæ, gemma terminali crescentes.

Radix palaris, mox evanida : radiculæ plurimæ cylindricæ, simplices v. ramosæ, fibrillosæ, in molem conicam sæpe exparte hypogæam dense compactæ.

Truncus arboreus, simplex, rarissime dichotomus, sæpe scandens, nudus et annulatus, vel basibus dilatatis semivaginantibus petiolorum earumve vaginarum cicatricibus scaber : in Nipa rhizoma. *Folia* sæpius in coronam terminalem conferta, in scandentibus distantia ; *vaginae* sæpe in reticulum quasi solutæ, cum petiolo sæpe armatæ ; *petioli* in quibusdam apice in flagello producti ; *laminae* maximæ, flabelliformes vel pinnatæ, vernatione plicatæ, demum secundum venas secondarias longitudinaliter fissæ, venis interdum filorum specie persistentibus ; pinnæ longitudinaliter venosæ, coriaceæ, indumento plerumque pannoso-tomentoso, aut lepidoto, rariusve simpliciter piloso aut nullo. *Inflorescentia* terminalis vel axillaris, varia, sæpius spadicosa. *Spadix* sæpius ramosus, nunc spatha una completa inclusus, nunc pluribus incompletis imbricatim plus minus tectus, nunc apice in flagellum extensus, vel abortivus flagelliformis. *Flores* parvi inconspicui, sæpius glumaceo-coriacei, solitarii vel binati (ambobus masculis) vel ternati, (fœmineo nempe inter duos masculos,) vel aggregati, in quibusdam in foveolis spadicis sub-immersi, in speciebus monoicis fœminei versus bases ramificationum, masculi versus apices siti. *Fructus* quandoque maximus.*

* The characters are chiefly taken from the writings of Mr. Brown, and MM. Martius and Endlicher.

Sub-Familia,—CALAMINÆ.*

Ovarium squamosum vel strigosum. *Fructus* squamis retrorsis loricatus.

Frutescentes et sæpius scandentes, vel arboreæ. Foliorum vaginæ petiolique *spinis plano-subulatis vel aculeis*† *sæpissime armati;* laminæ *pinnatæ (generis unici orbis novi flabelliformes), pinnis saepissime linearibus, margine et superficie saepius setigeris.* Spathæ *(Ceratolobo excepto) plures incompletæ.* Inflorescentia *spicato-vel racemoso-paniculata.* Flores *polygamo-monoici vel dioici, utriusque sexus valvati, tribracteati, solitarii, vel binati, ambobus masculis, vel altero fœmineo, altero neutro, vel masculo?* Perianthium *striato-venosum.* Corolla *indurata, saepe cuspidata.* Stamina 6, *raro* 12, *unius indefinita.* Ovarium *triloculare.* Ovula *solitaria.* Fructus *solitarius,* 1-3 *spermus, squamis corneis loricatus, saepius exsuccus.* Albumen *ruminatum, excavatum, vel aequabile.* Embryo *dorsalis vel prope basin seminis.*

Sub-familia e maxima parte gerontogea, perpaucis Americanis typi aberrantis hucusque detectis. Vita plerumque perennis, Sagi monocarpica. Limes borealis specierum Indicarum 29° 30′.

Usus.—Trunci paucarum arborescentium farina, Sagum dicta, locupletissimi: frutescentium graciliorum aliquarum præbent bacula, scandentium plurium viminibus et funibus

* This name is here proposed, because Calamus appears to have the best claims to be considered the typical genus. Lepidocaryum moreover, which has hitherto given its name to the division, is not, I think, distinct from Mauritia. The termination is in accordance with the practice of some Zoologists, and the Report of the British Association, the universal adoption of which is highly desirable.

† The terms here applied to the armature of these plants are not to be taken in their strict sense, which is not properly applicable to the general Monocotyledonous structure. If the thorns are of considerable size I call them spines; if small, and especially if hooked, I call them aculei.

sunt quam maxime idonei. Foliis præparatis (Atup editis) tecta domorum struuntur. Fructus nonnullorum ob saporem acidum quæsiti sunt.

FOLIA PINNATA.

1. ZALACCA.—Inflorescentia spicato-paniculata. *Spicæ amentiformes; bracteolæ villoso-paleaceæ. Flores binati. Seminis tegumentum baccatum. Albumen vertice excavatum.* Palmæ perennes, subacaules. Flagelli o.
2. SAGUS.*—Inflorescentia spicato-paniculata. *Spicæ amentiformes; bracteolæ villoso-paleaceæ. Flores binati. Albumen ruminatum.* Palmæ *arboreae, monocarpicae.* Flagelli o.
3. CALAMOSAGUS.—Inflorescentia spicato-paniculata. *Spicae amentiformes; bracteolae villoso-paleaceae. Flores solitarii? Albumen ruminatum et vertice excavatum.* Palmæ perennes, scandentes. *Pinnae cuneiformes, supra medium erosae. Ligula maxima, sursum scaphoidea.* Petioli flagelliferi.
4. CALAMUS.†—Inflorescentia spicato-v. racemoso-paniculata. *Spicae* (interdum racemi) *filiformes, masculae compressae, distichae. Flores solitarii. Bracteolae imberbes, floris masculi in cupulam coaliti. Albumen superficie excavatum vel ruminatum.* Palmæ perennes, sæpius scandentes, et sæpius, vel spadice vel petiolo extenso, flagelliferæ.
5. PLECTOCOMIA.—Inflorescentia racemoso-paniculata, *ramis caudiformibus. Spathæ distichae, imbricatae, persistentes. Spicae filiformes. Flores solitarii.* Fruc-

* *Raphia.*—Inflorescentia spicato-paniculata *(thyrsoidea). Spicæ compressæ, distichæ. Bracteolæ imberbes. Flores solitarii.* Cætera Sagi.

† *Ceratolobus**.—Inflorescentia racemoso-paniculata. *Spatha unica, completa, siliquæformis,* persistens. Palma perennis, fruticosa, calamosa, flagellifera.

FOLIA FLABELLIFORMIA.

Mauritia.—

* Char: e Martio.

tus ramentaceo-hispidi. *Albumen aequabile.* Palmæ perennes, scandentes. Petioli flagelliferi.

6. EUGEISSONA.—Inflorescentia *paniculata. Flores solitarii, terminales, bracteolis pluribus imbricantibus stipati. Stamina indefinita. Albumen solidum, extus sulcis sex exaratum.* Palma perennis, subacaulis. Flagelli o.

CALAMINÆ.

Ovary covered with scales or stiff hairs. Fruit covered with imbricated scales. *Spathes several incomplete.*

Stamens indefinite... { Flowers terminal with many imbricating bracteæ. Albumen 6-grooved, ... EUGEISSONA.

,, 6 *or* 12, .. { Spikes compressed. Flowers distichous, solitary, with two smooth bracteoles. Albumen ruminate, ... RAPHIA.

,, *always six.*

Spikes round. Bracteoles woolly.

Flowers in pairs. Seed berried. Albumen hollowed out at the apex ZALACCA.

———— Seed dry. Albumen ruminate, ... SAGUS.

Flowers solitary? Seed dry. Albumen hollowed out at the apex and ruminate. Pinnæ cuneiform, jagged, CALAMOSAGUS.

{ *Spikes filiform, male only compressed, distichous. Bracteoles without wool. Sexes almost always on different spikes. Flowers solitary.*

Spadix an expanded panicle, rarely confined by boat-shaped spathes. Spathes not persistent. Fruit with smooth scales. Albumen pitted on the surface or ruminate, ... CALAMUS.

Spadix with tail-shaped pendulous branches. Spathes persistent, concealing the flowers. Fruits hispid. Albumen with an equal surface, not ruminate, .. PLECTOCOMIA.

Spathe one complete, ... CERATOLOBUS.

ZALACCA.

Rumph. Hb. Amboin. 5. *p.* 115. *t.* 57, f. 2. *Reinwdt. Blume in Syst. Veget. ed. Schultes* 7. *pt.* 2. *p.* 1333. *Wall. Pl. Asiat. Rar.* 3. *t.* 222—224. *Martius Palmae. p.* 200. *t.* 118. 119. 123. 136 et 159, f. 2. *Endl. Gen. Pl. p.* 249. *No.* 1737. Calamus Zalacca. *Gœrt.* 2. *p.* 267. *t.* 139.

Char. Gen.—*Spicæ* teretes, amentiformes. *Flores* in gremio bracteolarum 2 villoso-paleacearum, masculi binati, fœminei solitarii vel neutro hinc adjecto binati. *Stamina* 6. *Ovarium* squamosum vel strigosissimum. *Fructus* 1-3-spermus. *Semen* baccatum. *Albumen* apice excavatum. *Embryo* basilaris.

Habitus.—Palmæ *subacaules, eflagelliferæ, cæspitosæ.* Foliorum vaginæ petiolique *spinis seriatis horridæ,* pinnæ *sæpius fasciculatæ, directione variæ, apice nutantes, in una strictæ et ordine regulari alternantes.* Spathæ *incompletae, scariosae, striatæ, varie fissæ et laceræ.* Spadicis *rami florigeri simplices vel ramosi.* Spicæ *sessiles spathis subinclusæ, vel pedicellatæ exsertæ.* Bracteolæ *in cupulam coalitæ, vel parte disrupta septiformi inter flores interposita quasi ternatae.* Flores *dioici, vel polygamo-monoici.* Fructus *saepius squamarum apicibus longis retrofractis hispidi.* Sapor *seminis tegumenti acidissimus.*

Genus Sago proximum, discrepans habitu (Z. conferta quadantenus excepta,) semine baccato, et albumine vertice excavato cæterum æquabili. Ad Calamum variis modis accedit.

In sectiones 2 (artificiales) commode dividi potest; hæc polygamo-monoica vel dioica? Flori fœmineo flos neuter hinc adjectus; illa dioica flore fœmineo solitario.

Characteres auctorum citatorum ad Z. edulem et Blumeanam tantum spectant.

* *Flores dioici, fœminei solitarii.*

1. (1) Z. *edulis,* petiolis infra medium pinniferis, spinis robustis (fuscescentibus,) pinnis fasciculato-interruptis setoso-acuminatis margine spinuloso-setosis, spadicibus masculis nutantibus ramosis, ramis elongatis alternatim spicigeris, spicis sessilibus sæpius distantibus quam spathæ fere duplo brevioribus, fructibus hispidis obovato-pyriformibus vel ovato-cuspidatis.

Zalacca edulis. Reinwdt. Syst. Veget. ed. Schultes. 7. pt. 2. p. 1334.—Wall. Pl. Asiat. Rar. 3. p. 14. *(sine charac-*

tere) t. 222-224, (sub nomine Z. Rumphii.) Z. Wallichiana. Mart. Palm. p. 201. t. 118. 119. 136.* Calamus Zalacca. Roxb. Fl. Ind. 3. p. 773.

Common in swampy places, Malacca, Tenasserim Provinces, Burmah. Sulak-koombar of Penang, according to specimens received from Mr. Lewes. Male specimens exist in the Botanic Garden.

Descr.—A tufted short stemmed Palm. *Leaves* varying in size, in marshy shady places being 18-20 feet in length, in dryer places not exceeding 10-12 feet. *Petiole* for five or six feet from the base only bearing spines, which are large and generally palmate, the spines of the upper leaf-bearing part often solitary. *Pinnæ* interruptedly fasciculate, first ascending then curved downwards, oblong-spathulate, lanceolate, tapered into a long subulate bristle, 3-keeled above, margins with distant setæ. Length of the largest 16-18 inches, breadth 4-5 inches.

Spadices axillary, about 2 feet long, nodding, branched, covered with scarious, split and lacerate spathes. Each branch and each spike suffulted by a spathe, the main ones being longer than the branches, the partial shorter than the spikes, which are about two inches long. *Bracteæ* rounded, short, striate. *Bracteolæ* densely villous.

Flowers (male) pink. *Calyx* tripartite below the middle. Segments of the *corolla* oblong, mucronate, patent.

Filaments white, adnate to the corolla as high up as the sinuses of its segments, then free, short, and stout. *Anthers* attached near the middle. Rudiment of *female* of three oblong processes.

Female flowers not seen. *Fruit,* which is generally sparingly produced, sessile, sub-ovate, with a stout conical point, of a reddish brown colour. The spadix in fruit is very ragged from the remains of the spathes, and if many fruits are developed is decidedly nutant. *Seeds* three, or by abortion two or even one. The shape varies with their number. The covering or coat is baccate, and is covered by a thin membrane, which belongs to the fruit. *Albumen* horny, with a pit at the

* Gærtner's figure as well as that of Rumph. cited under the generic character, belong according to Martius (Palmæ p. 202) to his Z. Blumeana.

apex, the surface wrinkled and fuscescent from adhering tissue; on one of the sides is a round umbilicus, to which the terminal cavity or pit will be found to point. *Embryo* basilar, the apex of the cotyledon reaching nearly to the lower part of the terminal cavity.

The Malacca plant will probably be found different from Z. edulis, when sufficient attention has been paid to the female inflorescence, the shape and surface of the fruit, and structure of the seed.*

Supposing that there be only one species, three varieties appear to be presented.

Var. *A.* Spadices very long and attenuated almost into a flagellus, lower spathes large, distichously imbricate. Branches of the spadix a good deal divided, their spikes or aments alternate, approximated but not confluent; their spathes about equal in length to their aments.

B. Spikes (male) distant, half enclosed in ventricose spathes, equalling them in length.

Koombar of Penang.

C. Spadices (male) a good deal elongated without being attenuate, much branched, branches sometimes distant, sometimes crowded, occasionally assuming the form of var. *B;* sometimes proliferous at the apex. The lower spathes of moderate size, spikes or aments twice as short as their spathes.

Z. Wallichiana of the H. C. Botanic Garden.

2. (2) Z. *affinis*, (*n. sp.*) petiolis a medio supra pinniferis, spinis longis gracilibus albis, pinnis interrupte fasciculatis spathulato-lanceolatis acuminatis apicem versus et margine setigeris, spadice masculo inferne ramoso spathis distichis imbricato, ramis abbreviatis quam spathæ brevioribus, spicis

* It is doubtful whether the direction of the pit of the apex does not depend upon the shape of the seed, which depends again on the number developed.

ramorum congestis distichis, fructibus ovatis mammillato-cuspidatis (glabris.)

HAB.—Ching near Malacca, Emanuel Fernandez.* *Salak Batool,*† of the Malays of Malacca.

DESCR.‡—The *leaves* are altogether smaller, and the stalk slenderer than in any of the other species: their length is twelve, thirteen feet: the pinnules being confined to the upper half or thereabout of the stalk. *Spines* very long, comparatively slender, and in irregular, incompletely transverse sets, the longest deflexed, the others spreading in various directions; those of the pinniferous portion solitary, and somewhat deflexed. *Pinnæ* interrupted, subascending, otherwise with the ordinary direction, those of each fasciculus rather crowded, often almost opposite, outline decidedly falcate, spathulato-lanceolate, acuminate,§ scarcely cirrhose, acumina with few setæ, upper surface with three stout prominent veins; under with about twelve, all much less prominent.

The male *Spadix* appears to be about one and half feet in length, it is imbricated with the usual scariose, mealy, variously split and lacerated spathes: the general form being subulate. The lower axes of inflorescence are branched, those above the middle simple. *Spikes* generally under an inch in length, (those of the branches crowded together) with about twelve rows of small flowers disposed in pairs, their lower halves immersed in the tomentum of the spikes. *Bractes* roundish-cordate, membranous, distinct, comparatively small. *Flowers* two to each bracte, both male, separated from each other by a membranous vertical septum, (part of the bracteoles) penicillate at the apex. A narrower, conduplicate, equally penicellate one on the outer side of each flower.||

* An intelligent Portuguese of Malacca, now in my employ as collector.

† The meaning of which is true Salak.

‡ Specimens, two entire leaves, a male spadix, part of a female spadix in flower and two fruits.

§ The uppermost are not uncommonly incised at the apex, when both margins bear the setæ. This is also the case with Z. edulis.

|| The bracteoles in this also appear to be originally united into a bilocular cupula, in one of which a flower exists, the arrangement described appears to be the result of pressure and distention.

Calyx tripartite nearly to the middle, segments oblong, concave. *Corolla* attenuate at the base, tripartite below the middle, segments oblong-lanceolate, acute. *Stamens* six, united to the corolla (and each other) to the base of the segments : *filaments* (free) very short, subulate. *Anthers* oblong. A rudiment of a *Pistillum*.

Female inflorescence (in the specimen) about three inches long, suffulted by a much longer lacerated spathe, and also to a considerable degree covered by the spathelles, which are much longer than their respective spikes, much imbricated, and lacerated. The lowermost *spikes* appear to be three-four flowered, the uppermost one flowered, at the base of each, within the spathelle, is a broad close-clasping bracte. And round the base of each flower is also a deeper, more concave *bracte* and two *bracteoles*, the margins of which posteriorly are united into a short cup with very villous margins ; part of them distinct, forming a septum, and much less villous.*

Flowers large, solitary, in bud ovate, with a hard thorny point. *Calyx* (of the bud) almost ovate, tridentate, afterwards split irregularly. *Corolla* a little longer than the calyx, tripartite to the middle, segments very pointed and pungent.

Sterile stamina six, adnate to the corolla as high as the sinuses of the segments.

Ovarium oblong, with retrorse scales ; parietes thick, succulent, 3-celled. *Ovules* solitary, erect, anatropous. *Style* short. *Stigmata* 3, connivent into a cone.

Fruit ovate, two and half inches long, one and three-quarter broad, perhaps somewhat compressed, surrounded at the base by the corolla variously flattened out and split, apex distinctly mamillate-cuspidate ; the scales very many, more highly imbricate than ordinarily, more pointed, furrowed along the centre, rich chesnut coloured, browner towards the margin, towards the base or where they become recurved on either side with a convexity more prominent than usual. (Pulp destroyed by insects.) *Seeds* one-three, small in comparison with the size of the fruit, being about nine lines long, seven broad, and five in thickness, oblong, plano-convex, umbilicate at the apex, black on the surface, without any lateral umbilicus, cavity or pit vertical.

* But these parts seem to vary much, as also the length of calyx in Z. edulis.

3. (3) **Z.** *secunda,** (*n. sp.*) petiolis—, spinis—, pinnis—, spadicibus masculis sub-nutantibus spathis undique vestitis, spicis pedicellatis exsertis secundis, pedicellis spathis vaginantibus imbricatis, bracteis (spicarum) distinctis supremis et infimis vacuis.

HAB.—In forests about Kujoo, Upper Assam. Mishmee Mountains on the lower ranges.

DESCR.†—*Spadices* about two feet long slightly curved, closely imbricated with the scarious, striate, split spathes. *Spikes* stalked, exserted; stalks nearly as long as the spathes, also covered with imbricating spathes, the uppermost of which resemble those of the flowers, except in not producing any villi. The spikes themselves are two-half and three inches long, scarcely half an inch in diameter, the bracteæ both of the apex and base appearing to be empty.

Bracteæ rounded distinct, on the outer side of each flower a tuft of hair.

Flowers densely crowded, so that their disposition is not at first apparent, the buds depressed at the apex.

Calyx tripartite to about the middle, scarious, striate, segments oblong, concave. *Corolla* (not seen expanded,) about the length of the calyx, divided not quite to the middle, the segments oblong, concave.

Stamina united to the petals, as high as the base of the segments.

Filaments (free) obsolete. *Anthers* oblong.

I have no information regarding the leaves, but the habit was noted to be that of Z. edulis.

This species in the character of the stalked spikes approaches to Z. Blumeana, Martius. Dr. Martius however states, that his plant has the spadix alternately and distichously branched, that the pedicels are from one to two inches long, furnished at the base with *a spathe.* The flowers

* Placed here provisionally.

† The specimens consist of male spadices before the opening of the flowers, and a spadix without flowers from the Mishmee Hills. This last has the spikes slenderer, often more exserted, and the villi more developed.

also are described as scarcely exserted, and the bracteæ as confluent at the base.

II.—*Flores polygamo-monoici, vel dioici, flori faemineo flos neuter adjectus.*

4. (4) Z. *macrostachya*, (*n. sp.*) pinnis interrupte fasciculatis (fasciculis distantibus) lanceolato-spathulatis acuminatissimis infra medium setoso-serratis, spadicibus elongatis apice nutante humifusis, spathis distantibus, spicis (fæmineo-neutris) pedicellatis, ovario strigosissimo, fructibus irregulariter oblongo-ovatis cuspidato-rostratis hispidis.

Hab.—In marshy, exceedingly shady places, Ching near Malacca. *Rungum* of the Malays of Malacca.

Descr.—Habit of Z. edulis, like which it forms tufted plants. It is, however, a stouter species. *Petioles* stout, for seven or eight feet above the base not bearing pinnæ, but more highly armed than usual with the characteristic spines, the larger of which are in oblique, nearly complete verticils. *Pinnæ* more interruptedly fasciculate, their direction (always curved or nutant) however, and shape are much the same; on the whole perhaps they are larger.

Spadices very long, so much so in fact as to reach the ground, on which, and often immersed in water, which abounds in the localities, the spikes of flowers will be found. *Peduncles* in the part not covered by the spathes covered with thick brown wool. *Spathes* of the usual nature, but much more distant; they are generally longer, except the lowermost, than the solitary amenta. *Spikes* three inches long, an inch nearly in diameter, stalked; the stalks of the lowermost very long, and all provided with smaller spathes. *Bracteæ* rounded, tinged with pink. *Bracteolæ* at least of the hermaphrodite flower, rounded, distinct, villoso-ciliate.

Flowers lilac-pink; in the axil of each bracte one large one female, and on one side of this a much smaller one, neuter. *Calyx* of the larger flower 3-partite to the middle, the segments oblong, concave, not very rigid. *Petals* united to their middle, (below which they are white,) oblong, erect or nearly so, very rigid and almost siliceous.

Stamina effete, the filaments united to the corolla high up.

Ovarium oblong, very strigose with subulate erect hairs, towards the base covered with pointed fleshy scales, 3-celled, substance thick and fleshy. *Ovulum* one in each cell, erect, anatropous. *Style* short, 3-partite to the middle, branches irregularly ob-cuneate, stigmatic surfaces blood-coloured.

The Smaller or neuter flowers* present a small rudiment of a pistillum, the stamina are reduced almost to the filaments, those opposite the petals being much larger.

Fruit obliquely oblong-ovate, attenuated into a rostrum or cuspis, three inches long, one and a quarter in diameter, covered with scales with hispid recurved points. *Pulp* white, more spongy than in Z. edulis. *Seeds* large, more deeply furrowed than in Z. edulis: all those examined were abortive, not even presenting any albumen, though otherwise perfectly formed: the cavity was found filled with a fetid fluid; like those of Z. edulis they are covered with a fine membrane which belongs to the fruit, since it forms the septa round the barren ovula.

The fruit is eaten like that of *Salak Batool* The petioles of the leaves when split are used for tying *Artup* (Nipa fruticans leaves) on, and are also made into baskets.

This very distinct species will be at once recognised by its spadices, by the distant solitary spikes, not altogether exserted from the large scarious spathes, which resemble those of Z. edulis. The fruit resembles in shape that of the same species, as represented in the *Pl. Asiat. Rariores.*

5. (5) **Z.** *glabrescens* (n. sp.) pinnis continuis anguste-lanceolatis cirrhoso-acuminatis, spadice ramosissimo, spicis secundis (masculis et fæmineo-neutris) longe pedicellatis, bracteis latissimis undulatis villum parcum obtegentibus, ovario strigosissimo.

* They appear to be irregular in situation, and not unfrequently wanting.

HAB.—Penang, Mr. Lewes, who sent it to me under the name *Salak.*

DESCR.*—*Petioles* slender, trigonal even below the pinnæ, with appearances of having been armed with a simple row of spines on either face. Uppermost spines of the under face slightly curved upwards, short and stout, on the upper triangular part lower down is a row of larger solitary spines. *Pinnæ* not interrupted, narrow lanceolate, twenty and twenty-two inches long by two and a half broad, cirrhoso-acuminate, margins towards the apex with a few setigerous teeth, veins as in Z. edulis; terminal part of the leaf bilobed, each lobe deeply four and five divided.

Spadices much branched, less covered than in most of the other species by the primary spathes, the branches entirely covered with loosely sheathing spathes, generally with one terminal spike, sometimes themselves branched, each branch bearing a spike. Young *spikes* or aments slender, owing to the broad shallow bractes looking as though they were annulate. Mature *female-neuter* ones stout, three-four inches long, with an obvious spiral arrangement. *Bractes* of apex, (which is attenuate cuspidate,) and base, empty, broad, margins undulate. *Bracteolæ* and septum large, shortly woolly at the points. No wool visible externally.

Male spikes cylindrical, about the same length, but much smaller in diameter, wool very little developed. *Bracteoles* obsolete or nearly so.

Male flowers in pairs, both of equal size, projecting very little beyond the bracteæ. *Calyx* three-toothed, teeth rounded. *Corolla* tripartite nearly to the middle, tapering below, (a considerable part of this taper portion is torus, or rather internode,) segments broadish, oblong.

Stamina united to the corolla as far as the base of the segments. *Filaments* (free) short. *Anthers* oblong. No rudiment of a *Pistillum.*

Flowers of female neuter spikes in pairs, one large, and one small.

Smaller flower neuter, longer and larger than the male flower, and more oblique, but otherwise much the same. Barren stamina six, united high up to the petals, filaments (free) of middling length,

* Specimens, portion of a leaf and spadix in flower.

subulate. Anthers small effete. Within the attenuate base, an ordinary rudiment of the female.

Female flowers large, also oblique.

Calyx not quite divided to the middle, scarious, very striate, segments oblong obtuse. *Corolla* (expanded not seen,) a little longer than the calyx, tripartite nearly to the middle, segments broad ovate.

Barren stamina six, much like those of the neuter flower.

Ovarium very densely strigose with erect stout hairs,* (of which the lower are the shorter,) ovate conical, with a stout neck similarly covered with hairs, 3-celled. *Ovula* solitary, erect, anatropous. *Style* stout, thicker than the neck of the ovarium, tripartite, segments lanceolate, stigmatose inside.

This species, would appear to approach Z. secunda in the branching of the spadix. It is the only species I am acquainted with in which the wool of the bracteoles is so little developed, as not to be visible externally. The spikes consequently have a smooth aspect.

6. (6) Z. *conferta* (n. sp.) pinnis lineari-ensiformibus strictis margine setoso-spinescentibus, spicis (masculis vel fæmineo-neutris) confertis, fructibus (confertis) turbinatis glaberrimis.

Hab.—In very shady wet places in the great forests of Malacca, as at Ching and Katawn, in flower and fruit most of the year. *Assam Kaloobee*, *Assam Paiah* of the Malays of Malacca.

Descr.—Stout, less tufted than any of the others I have seen, forming an impenetrable jungle.

Petioles 10-12 or 18-20 feet long, without pinnæ for about half their length, roundish but flattened above, stout, armed, except on upper flat part, with fasciculate, white, slender spines. *Pinnæ* regularly alternating, *quite straight*, almost ensiform, two feet

* These hairs are flattened and a little dilated at base, upwards they become subulate and have a fibrous appearance.

long by two and a half inches broad, rigid, 3-carinate or veined above, subulate, acuminate; margins and apex very bristly; the upper pinnæ have bristles also on the three primary veins or carinæ of upper surface.

Spadices about a span long, sometimes a foot long, crowded with cylindrical spikes about six inches long, 7-8 lines broad, among which occur spathes of the ordinary structure, but more lanceolate than usual. *Spikes* polygamous on different individuals.

Male flowers in pairs, with the usual bracte and bracteoles, the last being exceedingly villous, and connate into a sort of bilocular cup. *Calyx* of 3 oblong sepals, distinct nearly from the base. *Corolla* of 3 petals, hard, almost woody, about twice as long as the calyx. *Stamens* 6, united below to the corolla. *Filaments* short, robust, sanguineous. *Anthers* oblong-ovate, large. Rudiment of a *Pistillum* not observed.

Female-neuter spikes more lengthened, the bracteæ more acuminate, each of these suffults two flowers, one smaller neuter, generally alternating in each series, the other larger female. *Sepals* oblong roundish. *Corolla* tripartite below the middle, segments acuminate. Rudiments of six subulate *stamina*.

Ovarium, with the style, obturbinate, scaly, 3-celled. Ovula solitary. Style short, stout, with 3-acute, recurved branches, the inner surfaces of which are transversely lamellar.

Fruits crowded into an irregular, formless mass sometimes of considerable size. Each is turbinate, the scales perfectly smooth, with irregular denticulate margins, and a waxy shining aspect. Colour a light tawny-greenish tint: mesocarp white, spongy-cellular. Seed broadly turbinate. *Albumen* adhering strongly to the pulp, which is thick and very sour. Embryo basilar.

This species is distinguished even out of flower by the habit, direction of the pinnæ, bristly carinæ and slender short white spines. In flower or fruit it is at once known by the crowded thyrsiform spadices.

I have not yet ascertained what distinction is indicated by the two Malayan names, from which it is probable, at least so experience tells me, that there are two distinct species with this unusual inflorescence analogous to that of Elæis.

I have specimens marked doubtfully Assam Paiah, in which the leaves are three feet long, sub-opposite, and closer together, with the central carina of the upper surface bristly above the middle, the spines of this are fuscescent. And I have others, marked also doubtfully, in which the pinnæ are much smaller, distinctly alternate and distant, with appearances of being interrupted, otherwise agreeing with those described in Z. conferta.

SAGUS.

Rumph. Hb. Amb. 1. *p.* 72. *t.* 17. 18 *(partim)* Metroxylon. *Rottb. Konig in Ann. Bot.* 1. *p.* 193. *pl.* 4. *Martius. Palmæ. p.* 214. *t.* 102. 159. *Endlicher. Gen. Pl.* 250. *No.* 1742.

CHAR. GEN.—*Spicæ* teretes, amentiformes. *Flores* hermaphroditi, masculi, vel polygami, binati, bracteola villoso-paleacea utrinque stipati. *Stamina* 6. *Ovarium* squamis obtectum. *Stylus* (sæpius) conico-triangularis, tridentatus. *Fructus* exsuccus, squamis loricatus, 1-spermus. *Albumen* ruminatum. *Embryo* dorsalis.

HABITUS.—Palmæ *Archipelagico-Asiaticæ, monocarpicae, trunco robusto saepius elato, corona ampla terminali.* Folia *pinnata:* vaginae et petioli *spinis rectis saepius armati;* pinnæ *lineari-ensiformes.* Inflorescentia *terminalis, plerumque pyramidalis.* Spathæ *plures, incompletæ, inermes vel spinis rectis obsitae.* Flores *plerumque rubescentes.* Ovaria *(monente Jack) unius fere distincta, aliarum coadunata.*

A Zalacca, cui proxima, differt habitu, semine exsucco et albumine ruminato.

7. (1) S. *Konigii*, petiolis armatis, spadicibus inermibus, floribus exsertis hermaphroditis vel masculo et hermaphrodito, dentibus calycis cordato-rotundatis, stylo conico elongato.

Metroxylon Sago. *C. Konig. Annals of Botany.* 1. 193. *pl.* 4. M. læve. *Mart. Palm.* 215. *(excl. syn. Rumph. et Roxb.)* Sagus Rumphii. *Hort. Kew.* 5. 281?

Hab.—Cultivated about Malacca, generally on the edges of Paddy swamps. Is very common about Rumbiya, between Malacca and Ayer Punnus, whence the name of the place.

Descr.*—*Panicle* alternately branched, branches spreading, covered with appressed spathes. *Spikes* amentiform, alternately bracteate, about a span long, somewhat recurved, surrounded at the base by broad imbricating bractes. Peduncles included, bearing a bicarinate spathe with very woolly margins. *Bracteolæ* very woolly.

Flowers, in pairs, one male, one female, subsessile, upper third exserted from the bractes and wool.

Calyx infundibuliform, striate, attenuate at the base into a short pedicel, tridentate, margins of the teeth sub-membranaceous: the teeth themselves tinged with reddish brown. *Corolla* about one-third longer than the calyx, striate, coriaceous, the exserted part reddish.

Stamina of the male flower the largest. *Filaments* flat, broadly subulate, monadelphous to some distance upwards, united also to the corolla. *Anthers* large, attached high up their backs. Rudiment of a *pistillum* of three oblong bodies, precisely like very rudimentary carpel leaves.

Hermaphrodite flower of each pair situated on the right (looking at the spike in front.) *Stamens* smaller than in the male, united to the corolla up to the base of its segments. *Ovarium* roundish-oblong, the upper half covered with a few large scales. The lower

* Specimens of spadix just before expansion of the flowers.

half naked and very thin. In this part there are three ovula, ascending, anatropous, but it is difficult to ascertain whether the ovary is three-celled from its great tenuity. *Style* conical, 3-gonal, tridentate at its apex, the teeth ovate, stigmatose on the inner surface.

Fruit (very immature) between top-shaped and globose, pointed by the style, covered with scales of a green colour with ciliated edges. Seed (very immature) erect.

This species was brought to me when at Malacca, with the name Rumbiya. No leaves came with it. It appears to differ sensibly from S. lævis, Jack, in the pairs of flowers consisting of a male and a hermaphrodite, in the size and exsertion of the flowers, the coadunate ovaria and the comparatively long style. I may also mention that the common Rumbiya of Malacca, which is I believe identical with this, has distinctly calamine spines on the petioles.

From S. Rumphii,* Martius, it appears to differ chiefly in the spadices being smooth, and in the teeth of the calyx; but taking the phrase "spadicibus lævibus" in what appears to have been the general acceptation, it may be the S. Rumphii of Willdenow, the Hortus Kewensis, and Blume.†

Rumph's figure of Sagus, Hb. Amb. 1. t. 17. quoted by all authors as S. Rumphii, gives a very fair idea of this species: the habit of these Palms is somewhat peculiar, and not like that of Cocos nucifera.

8. (2) S. *lævis*, inerme, floribus minutis villo obtectis hermaphroditis, ovariis tribus medio cohærentibus, stylo nullo, fructu globoso vertice depressiusculo.

* S. *Rumphii*, petiolis spadicibusque armatis, floribus exsertis masculo et fæmineo, dentibus calycis ovatis acutis, staminibus floris fæminei anantheris, fructu depresso globoso.

S. Rumphii. *Wild. Sp. Pl.* 4. 404? *Roxb. Fl. Ind.* 3. 623? Sagus seu Palma farinaria. *Rumph.* 1. 72. *t.* 17. 18. *Ham. Comm. Hb. Amb. in Mem. Wern. Soc.* 5. 318. Metroxylon Rumphii. *Mart. Palm.* 214. *t.* 102. 159.

† In adnot: Mart. Palm, 215.

S. lævis. *Rumph. Hb. Amb.* 1. 76. *fide Jack. Jack. Mal. Misc. Mem. 3rd in Hook. Comp. Bot. Mag.* 1. *p.* 266. *Ham. Comm. in Hb. Amb.* 5. 320. Sagus inermis. *Roxb. Fl. Ind.* 3. 623 ?

HAB.—Sumatra and Malacca, W. Jack.

"This valuable *Tree* rises to the height of about twenty feet, and is generally surrounded by numerous smaller and younger plants which spring up around it after the manner of the Plantain *(Musa sapientum)*. The *stem*, which is about as thick as that of the Cocoa-nut tree, is annulated by the vestiges of the fallen leaves, and the upper part is commonly invested with their withered sheaths. The *leaves* resemble those of the Cocoa, but grow more erect, and are much more persistent, so that the foliage has not the same tufted appearance, but has more of the graceful ascending curve of that of the *Saguerus Rumphii:* they are pinnate, unarmed; the leaflets linear, acute, carinate, and smooth. The tree is from fifteen to twenty years in coming to maturity, the fructification then appears, and it soon after decays and dies. The *inflorescence* is terminal; several *spadices* rise from the summit of the stem, enveloped in sheaths at their joints, and alternately branched. It is on these branches that the *flowers* and *fruit* are produced, and they are generally from five to eight inches in length. They are of a brown colour, and closely imbricated with broad scariose scales, within which is a quantity of dense ferruginous wool, in which the minute flowers are imbedded and completely concealed. Each scale supports two *flowers*, which are hermaphrodite, and scarcely larger than a grain of turnip-seed. The *Perianth* is six-leaved, of which three are interior, the leaflets nearly equal. *Stamina* six; *filaments* very short; *anthers* oblong, two-celled. *Ovaria* three, connected together in the middle, each monosporous. *Style* none. *Stigma* small. *Fruit* single, nearly globular, somewhat depressed at the summit, but with a short, acute, mucro or point in the centre; it is covered with scales which are imbricated from the top to the bottom, and are shining, of a greenish straw-colour, of a rhomboidal shape, and with a longitudinal furrow down their middle. Below the scales, the rind is of a spongy consistence, and the fruit contains a single *seed*, of rather an irregular shape, and having the *umbilicus* situated laterally a little above the base of the fruit. The progress of the fruit to maturity is very slow, and is said, according to the best information I can obtain, to occupy about three years from the first appearing of the spadices to the final ripening of the fruit. During the period of inflorescence, the branches of the spadix are brown, and apparently quite bare. Afterwards a number of small green knobs appear above the brown scales, which go on enlarging, till they at length acquire the size of a small apple. But few fruit come to maturity on each branch.

In habit and character this tree recedes considerable from the true *Palmæ.* Its propagation by radical shoots, exactly in the same manner as the common cultivated Plantain, is peculiar, and is not observed in the true Palms. The terminal inflorescence and death of the tree after fructification is another peculiarity. It is allied to *Calamus* by its retroversely imbricated fruit.

This species of Sago is abundant in many parts of Sumatra and at Malacca, and is employed in the preparation of Sago for food. Considerable quantities are made at the Poggy Islands, lying off the west coast of Sumatra, where it in fact forms the principal food of the inhabitants. The Sago of Siak is remarkably fine, and is also, I believe, the produce of this species. At the Moluccas the spinous sort is considered superior to this, but I am doubtful whether it exists in Sumatra. For making the Sago, the tree must be cut before fructification commences, as it then becomes hard and dry. The process of making it has been so often described, that it is needless to repeat it here."—W. Jack. loc. cit.

CALAMOSAGUS.

Char. Gen.—*Spicæ* teretes, amentiformes. *Flores* hermaphroditi, solitarii, villis semi-immersi. *Stamina* 6. *Ovarium* squamis obtectum, triloculare. *Stylus* subulatus, tridentatus. *Fructus* exsuccus, squamis loricatus. *Semen* vertice excavatum. *Albumen* ruminatum. *Embryo* vagus.

Palmæ *scandentes, perennes, incolæ Peninsulæ Malayanæ.* Folia *pinnata;* vaginæ petiolique *aculeis conicis rectis armati:* ligula *maxima, pari modo aculeata, sursum ventricoso-*

scaphoidea et vaginam contiguam semi-amplectens; pinnæ *alternæ, cuneatæ, inæquilateræ, a medio supra (vel margine terminali) erosæ, subtus glaucæ.* Inflorescentia *Sagi vel Zalaccae.* Spathæ *plures incompletæ inermes.* Bracteolæ *in villos fere omnino solutæ.*

Genus foliis Caryotæ vel Wallichiæ, habitu quodammodo Calami, inflorescentia et semine Sagi et Zalaccæ, insigne forma et evolutione ligulæ.

Character (posthac emendandus) haustus est, quoad flores, e C. laciniosa, quoad organa vegetationis e C. wallichiæfolia. Huc verisimiliter referendus Calamus caryotoides, A. Cunningham. Martius, Palmæ. p. 212, et forsan Calamus rhomboideus, Blume. Syst. Veget. ed. Schltes. 7. pt. 2. p. 1332.

9. (1) C. *laciniosus*, (n.sp.) petiolo (partis lamelliferæ) aculeis sparsis uncinatis armato, pinnis petiolulatis cuneato-obovatis medium supra varie et argute inciso-dentatis, spicis patentissimis palmaribus gracilibus, pedicellis spatha inclusis apicem supra vaginulam brevem ferentibus.

Hab.—In woods along the sea-shores of the Islands of the Mergui Archipelago, March 1835. Herb Mergui, No. 1104.

Descr.*—Diœcious? Flagelliferous, climbing to a great extent. *Petiole* angular above, below slightly convex and armed with scattered, hooked, short thorns, white with a dark point. *Pinnæ* attached by distinct stalks, (which are much compressed, and about half inch long,) about seven inches long by three and half broad, plicate, below the middle distinctly cuneate and quite entire, above the middle half-ovate and variously jagged, point prolonged into a long acumen, glaucous, coriaceous, the under surface with as many distinct veins as larger, incisions.

Spadix much branched, covered with imbricated, smooth, spathes, with short, oblique, acute, suberect limbs. Branches axillary, very spreading, similarly covered with spathes from which the spikes

* Specimens consist of a portion of a leaf and of a spadix.

project. *Spikes* cylindrical, three or three and half inches long, three or four lines broad, having a woolly appearance; their pedicels are almost entirely enclosed. *Bracteæ* rounded, imbricating, lowermost empty ; wool appears altogether to take the place of bracteolæ.

*Flowers** solitary, half immersed in the wool, which is exceedingly dense. *Calyx* short, quite immersed in wool, with three broad, acute teeth. *Corolla* deeply tripartite, segments oblong, spreading, exserted. *Stamina* six, united to the corolla to the base of its segments. *Filaments* (free) broad, very short, united into a very short annulus. *Anthers* large, linear, subsagittate at the base.

Ovarium occupying the tube of the corolla, surrounded by the filaments, covered with toothed scales, after fecundation becoming quite exserted. *Style* subulate, rather long, minutely three-toothed at the apex. *Fruit* turbinate, apiculate, scales greenish with brownish margins. *Seed* with a large, superior excavation filled with brown cellular substance.† *Albumen* horny, ruminate. *Embryo* vague, obconical.

This species appears to be osculant between Calamus, Sagus, and Zalacca, having the habit of the former, the inflorescence of the second and in some measure the seed of the last genus, to which it also approaches, as does the succeeding, through Zalacca glabrescens and secunda.

I observe that a gummy matter has been secreted from wounds in the spadix.

10. (2) C. *wallichiæfolius,* (n.sp.) petiolo (partis lamelliferæ) aculeis sparsis uncinatis armato, pinnis cuneato-obovatis medium supra obtuse dentatis et erosis, spicis spithamæis directione irregularibus, pedicellis paullo exsertis apice vagina ore lacera obtectis.

* The flowers appear to be solitary, for they correspond with the central line of their bracteæ, and I have not seen any rudiment of others in the very dense wool surrounding the base of the flower.

† My MSS. written on the spot say, "Excavatio supera maxima, materie cellulosa brunnea repleta."

Hab.—Malacca, brought to me from a place called Kussan, with the name Rotang Simote.*

Descr,†—The *leaves* resemble those of the preceding, but the teeth and incisions are less deep and are obtuse, in which respect it presents the same difference from the preceding, that Caryota obtusidentata does from Caryota urens. The shape of the *spadix* is much less like that of a genuine Sagus than that of the preceding, the branches are more slender, covered with long, smooth spathes with lacerated mouths.

The *spikes* are a span long by four lines in diameter, though they seem very immature; generally they are just exserted from the sheath, but occasionally the pedicel is lengthened; the lateral pedicels are plano-convex, bearing a long spathe about the middle, reaching to the base of the spike. The *Bracteæ* are broad and longer than the very dense wool.

Although very closely allied to the preceding, I have no doubt but that this species when better known will be found quite distinct. At present the differences are confined to the obtuseness of the teeth of the pinnæ, the direction

* I subjoin a description of the upper part of a specimen not in flower, sent with this name, from which part of the generic character has been taken. It appears to differ from the above in the shape of the pinnæ which are sessile, and the smooth petioles.

Stem slender, three-four lines in diameter. *Sheaths* in the exserted part about six inches long, armed with a few scattered conical prickles, generally split along the back into a rete, between the petiole and next sheath prolonged into a large *ligula* of the same coriaceous texture and similarly armed, in its upper two-third boat-shaped and closely half embracing the next sheath. *Petiole* two and a half feet long, young ones prolonged into a flagellus, below the pinnæ fifteen or seventeen inches long, roundish, armed on the back with a few scattered prickles, these among the pinnæ are more hooked and in a single row. *Pinnæ* distant, the lowermost approximated, sessile, general shape distinctly cuneate, above the cuneate part generally inequilateral and eroso-dentate, of a thick substance, many veined, glaucous underneath, altogether much like some forms of Wallichia caryotoides; upper ones more elongated, terminal sub-equilateral, bilobed below the middle, truncate, along which margin they are erose.

† Specimens consist of a portion of a leaf and an immature spadix.

and length of the spikes, and the large bracte on their pedicels.

I have never seen living plants, my specimens were procured by my Malay Collector from the interior of the Province of Malacca.

CALAMUS.

Linn. Gen. ed. 6. *p.* 173. *Gaertn. fruct. et sem.* 2. *p.* 267. *t.* 139. (*excl. C. Zalacca.*) *Roxb. Fl. Ind.* 3. *p.* 773. (*excl. C. Zalacca.*) *Icones.* 14. *t.* 28-29. *Suppt.* 5. *t.* 16. 17. 18. *Juss. Gen. Pl. p.* 37. *Syst. Veg. ed. Schultes.* 7. *Pt.* 2. *No.* 1496. *p.* 1332. *Martius Palm. p.* 203. *t.* 112. 113. 116. *f.* 2. 3. 4. 128. 160. *Endl. Gen. Pl. p.* 249. *No.* 1736. *Lam. Enc. Meth. t.* 770 (*excl. C. Zalacca.*)

Palmijuncus. *Rumph. Hb. Amb.* 5. *p.* 97—120. (*excl. Palmijunco laevi*) *t.* 51—56. 57, *f.* 1. 58.

Tsjéru-tsjúral *et* katú-tsjúrel. *Rheede, Hort. Mal.* 12. *t.* 64. 65.

Dæmonorops. *Blume in Syst. Veg. ed Schultes.* . *pt.* 2. *p.* 1333, *obs.* 1. *Martius Palmæ. p.* 198. *t.* 117 *et* 125, *f.* 1. *Endl. Gen. Pl. p.* 249. *No.* 1740 (*excl. syn. Rumphii ?*)

Char. Gen.—*Spicæ* (interdum racemi) filiformes (paniculatæ.) *Flores* mono-dioici, (sæpissime) solitarii, *masculi* bractea et cupula (bracteolis duabus coalitis) suffulti, *faeminei* tribracteati. *Stamina* 6. *Ovarium* squamis plus minus tectum. *Fructus* subexsuccus, squamis retrorsis loricatus, mono-raro dispermus. *Albumen* ruminatum vel superficie foveolatum. *Embryo* hilo approximatus.

Habitus.—Palmæ *perennes, caespitosae, frutescentes, vel arbusculoideae, erectae vel saepius scandentes.* Caulis (*saltem partis foliiferæ*) *vaginis obtectus.* Foliorum vaginæ *varie armatæ spinis saepissime seriatis,* (*in una verticillatis,*) *plano-subula-*

tis, colore saepe variegatis, interdum longissimis ; petioli *spinis supradictis vel aculeis vario modo armati, saepe apice extensi in flagellis subtus aculeis palmatis uncinatis prehensilibus ;* pinnæ *alternantes regulari ordine, vel fasciculatae, lineares, vel lineari-lanceolatæ oblongaeve, in paucissimis cuneato-lanceolatæ, in paucis directione variae, saepius subulato-acuminatae, sæpius hispidae setis subpungentibus secus margines et venas dispositis.* Spadices *axillares, plerumque diffusi, pedunculo saepius cum dorso vaginae contiguae cohaerente ideoque pseudo-extra-axillari, saepius armati, saepe apice in flagello isto petiolorum simili extensi, vel abortientes omnino flagelliformes.* Spathæ *extimae spinis, aculeis, vel setis varie armatae, vel plures deciduae infima persistente, vel omnes per anthesin persistentes planæ vel cymbiformes, vel tubulosæ cum fructubus permanentes.* Spicæ *masculæ sæpe scorpioideae, compressae.* Flores *parvi inconspicui, masculi distichi.* Styli *rami plerumque revoluti.*

SECT. I.—(Coleospathæ) *Scandentes vel erectae.* Spadices *diffusi.* Spathæ *omnes persistentes, tubulosæ limbis parvis vel obsoletis.*

* *Erectae. Flagelli O.*

Species 1-4.

** *Saepius scandentes. Flagelliferae, vel spadice abortivo, vel fertili apice extenso.*

Species 5-19.

*** *Scandentes. Petioli flagelliferi.*

Species 20-21.

SECT. II.—(Piptospathæ). *Scandentes. Petioli saepius flagelliferi.* Spadices *mutici, diffusi.* Spatha 1, *(rarius 2,) infima tantum per anthesin persistens, spathis ramorum omnino deciduis.*

Species 22-26.

Sect. III.—(Platyspathæ.) *Scandentes. Petioli flagelliferi* (*an semper* ?). Spadices *diffusi.* Spathæ *omnes per anthesin persistentes, planae, vaginis parvis vel obsoletis.*
Species 27-30.

Sect. IV.—(Cymbospathæ.) *Scandentes vel erectae. Petioli saepius flagelliferi.* Spadices *contracti.* Spathæ *cymbiformes, rostratae, diu persistentes, duæ externæ alias involventes, vaginis obsoletis.*
Species 31-38.
Dæmonorops. *Blume, Martius.*

Sec. V.?—Ceratolobus *Blume.*

Genus intricatum, imperfecte cognitum, characteribus auctorum plerumque inextricabilibus, forma partium fructificationis, Cymbospathis forsan exceptis, potius quam vegetationis meo sensu dividendum.

Limites ambigui: Sago appropinquat tribus viis per Calamosagum, Raphiam, et Zalaccam; Plectocomiæ per Cymbospathas ?

Calamus secundiflorus, Pal. Beauv. Fl. d'Owar. Benin.* habitu, foliis Desmonci, floribus hermaphroditis, et statione geographica differt.

Sec. I.—(COLEOSPATHÆ).

* *Erectae. Flagelli O.*

11. (1.) C. *castaneus*, (n. sp.) humilis, spinis petiolorum plurimis valde inæqualibus parum seriatis, pinnis æquidistantibus (plurimis) linearibus (long. bipedalibus lat. uncialibus) vena centrali superne dentato-setigera centrali et lateralibus utrinque inferne setigeris, spadicibus sæpius inermibus, mas-

* 1. *p.* 15. *t.* 9. 10.

cûlo supra-decomposito elongato apice pendulo-nutante fructûs quasi ambitu flabelliformi, calyce bracteam triplo-superante corollam subæquante, staminibus distinctis, floribus fæmineis conico-oblongis, fructibus rotundis vel oblongis (castaneo-rubris,) cuspidatis.

HAB.—In thick jungles about Malacca, as at Pringitt, Ayer Punnus (Rhim.) Sent by Emanuel Fernandez with the name Rotang Chochoor.

DESCR.*—A Palm with a short erect or decumbent stem, forming thick tufts. Diameter of stem with sheaths three inches. *Sheaths* rather short, highly armed with spines, disposed in very long lines, the longest spines nearly two inches in length. *Petioles* channelled rather high up, three to five feet long before they bear pinnæ, angular rounded, armed, especially on upper side, with stout, very unequal spines. Margins of channelled part densely armed with bristles, disposed in short oblique lines. Pinniferous part nine-ten feet long, convex, trigonal, the convex side armed with stout solitary distant spines pointing downwards, the upper angular part smooth, or armed about the middle with short teeth. *Pinnæ* very numerous, alternate, generally approximate, often nearly opposite, linear, two feet long, nine-ten lines broad, subulate-acuminate, above carinate by the prominent mid-vein, which bears bristles towards the point, below the bristles are confined to the central and a lateral vein on each side, in some the bristles are very long; margins cutting from appressed bristle-teeth; the apex which is strong, and very acuminate, hispid with bristles.

Spadices axillary, peduncle in one specimen armed, as are likewise some of the spathes slightly, but generally unarmed, concealed by spathes, much branched, the male decompound. Spathes scarious, not much split, generally quite smooth; limbs erect.

* Specimens: entire of male plants, several portions of male and female spadices, and an entire ditto. in fruit.

Male spadix two-three feet long, branched, branches variously nutant or pendulous, slender. Flower bearing branches compound, spikes bifarious, lateral ones one inch long, terminal two-three inches, often scorpioid. Uppermost branches simple, or nearly so.

Male spikes much flattened, quite distichous, bracteæ highly imbricated, roundish-cordate, amplectent. Concealed inside is a cup with two evident teeth posticously, where it is also bicarinate from pressure. *Calyx* long, sub-cylindrical, angular slightly (from pressure), with three, rather short, half-ovate, acute teeth. *Corolla* a little longer than the calyx, divided below the middle into three linear-lanceolate, somewhat spreading segments. *Filaments* united to each other and to the corolla up to the base of its segments: free, as long as or longer than the petals, points introflexed in bud. *Anthers* linear, exserted. Rudiment of the pistillum large, oblong, of three abortive carpels.

Female spadix rather broader than long, (especially in fruit,) in length about one foot, in breadth one and a half foot. Flower bearing branches simple, about six inches long, rather stout. Spathes less imbricating, because more distant than in the male, larger and more leathery. *Flowers* solitary, each with two unequal amplectent bracteoles, the outer of which, from not being appressed to the inner, leaves on one side a small niche.

Calyx as in the male, but more cylindrical. *Corolla* scarcely longer than the calyx, of the same shape, divided below the middle into three linear-lanceolate, acute, erect segments. *Stamina* much developed, but included, and with effete anthers.

Ovary attenuate at base, where it is smooth, at the apex attenuated into a stout, cylindrical, rather long style, divided nearly to middle into three, spreading or recurved branches, very pappillose inside, scales small with irregular margins. *Ovula* lodged in the smooth base.

Fruit (immature) chocolate coloured, round or oblong, (seven lines long by five and half broad,) with a stout cuspis, the upper half of which is grey, one-celled. Scales small with pale edges, central furrows of scales much pronounced, and appearing to form as many continuous longitudinal furrows. Seed (very immature) plano-convex with a depression on the flat face; tegument black, fleshy.

Var. *A.*—Upper angle of the petiole armed with short thorns, fruit oblong.

B.—Upper angle of the petiole unarmed, fruit roundish.

This species appears to vary a good deal, both as regards the arming of the petiole, the male spadix, which is not always decompound, and the fruit.

It may be at once known by the strong, very unequal, solitary spines of the petiole; the long linear pinnæ, which have a tendency to become red in drying; by the short, much compressed, scorpioid, red-brown male spikes, the flowers of which are very close together, and by the expanded flabelliform shape of the fruit-bearing spadix.

Fig. 2, t. 58 of Rumph.* gives a fair idea of its fruit, as does that of the end of the female spadix, fig. 1, t. 55, of the same part of the male spadix.

It possibly may be C. ruber, Reinw. Martius Palmæ. 209.

12. (2) C. *collinus* (n. sp.) pinnis (apicis) lineari-lanceolatis (long. 15-uncialibus, lat. 1½-uncialibus) supra tricarinatis carinis setigeris subtus lævibus et glabris, pedunculo spadicis decompositi spathaque infima armato, calyce bracteam longe superante corollam subæquante, fructibus oblongis apice mammillatis.

Hab.—Khasya hills, near Mahadeb, alt. 18-2000 feet, and Upper Assam.

Descr.†—*Petiole* roundish, unarmed. *Pinnæ* alternate or nearly opposite, largest fourteen-fifteen inches long, nearly one and a half inch broad, linear-lanceolate, with a tendency to be spathulate, upper surface distinctly tricarinate, carinæ setigerous, lower surface smooth; margins bristly ciliate, especially towards apex, which appears to be obtuse.

* Hb. Amb. 5.

† Specimens: portion of the end of a leaf, an entire spadix in fruit, and a portion of another.

The entire specimen of the *spadix* is about twenty inches long,* branches distant, and with the exception of the lowermost, which has two branches, simple. Peduncle below the first spathe or branch rather compressed and armed with the usual form of spines, slender and deflexed. Above this the spadix presents no armature. *Spathes* smooth, except the lowest, the remains of which present spines, its tubular part about an inch long, limb lacerated and truncate.

Spikes three-five inches long, flexuose. *Bracteæ* not very closely imbricating, with limbs shorter than usual and almost annular; upper *bracteole* annular, under adnate behind to the spike and bicarinate. *Fruit* about twelve lines long, by seven in diameter, surrounded at the base by the calyx and corolla nearly equal in length, and much longer than their respective bracteæ, apex obtusely mammillate; scales chesnut brown, very large, with pale membranous margins; central furrow broad and well developed. Seed one. Albumen ruminate.

This species appears to be closely allied to the succeeding, the terminal part of the leaf of that differs however in the pinnæ presenting only one carina above, and being smooth on both sides. Its spathes too are always much lacerated, whereas in this they appear to become truncate.

13. (3) C. *schizospathus*, (n. sp.) pinnis equidistantibus lineari-lanceolatis (long. bipedalibus lat. 1½ uncialibus) supra 1-carinatis subtus secus venam mediam setigeris, spathis omnibus inermibus primariis varie fissis et fibroso-laceris, ramis approximatis inferioribus decompositis, floribus distantibus, calyce bractea duplo longiore quam corolla duplo breviore, staminibus distinctis inclusis.

Hab.—Khasiya Hills; also Darjeeling, whence it was procured by the Seharunpore Collectors.

Descr.†—*Petiole* triangular, under flat face armed with ternary or solitary stout deflexed spines, whitish with black points.

* By this specimen it would approach the Piptospathæ, but the spathes are evidently not deciduous, the tubular bases remaining.

† Specimens; parts of leaves and male inflorescence.

Pinnules alternate, rather distant, largest two feet two inches long, one and a half inch broad, linear-lanceolate, coriaceous, subulato-acuminate, paler but not glaucous below; mid vein prominent above, below bearing towards the apex a few large bristles; margins with bristly teeth; points as usual hispid.

Spadix (entire ?) one and a half or two feet long. *Peduncle* covered with spathes, with long, very lacerated, striate limbs. *Branches* approximated, suffulted by short lacerated split speathes, longer than the internodes, and distichously branched; the upper simple.

Spikes four-five inches long, with a tendency to gyration, scarcely compressed. *Bracteæ* amplectent, also split, each concealing a short three-toothed cup, broadly-emarginate behind, anteriorly oblique. *Flowers* distichous, comparatively distant. *Calyx* oblong-ovate, longer by half than its bractea, with three, rather short, broad ovate, acute teeth, very striate. *Corolla* twice as long as calyx, divided almost to the base where it is attenuated, segments oblong lanceolate, sub-acute. *Stamina* shorter than the corolla. *Filaments* united to the corolla as far as the base of it segments, distinct, rather long, subulate, flattened, smooth. *Anthers* large, linear-oblong, about as long as the filament. Rudiments of the Pistillum of three narrow carpels scarcely at all united.

This species is closely allied to the succeeding, from which it differs in the armature, which also appears to be of pale colour, the larger pinnæ green underneath, the split lacerated sheaths, and the flowers, which are less closely and strikingly bifarious than in any of the others of this section.

It also approaches in its leaves to C. longisetus.

14. (4) C. *arborescens*, (n. sp.) trunco erecto nudo 15-20 pedali, pinnis æquidistantibus lineari-lanceolatis (long. 13 uncialibus lat. 1 uncialibus) subtus albidis, vena centrali utrinque setigera, spadicibus supra decompositis longe pendulis, spathis primariis armatis, calyce bracteæ longitudine quam corolla triplo breviore, staminibus basi monadelphis.

HAB.—Pegu. Revd. F. Carey. Male plant introduced into these Gardens in 1810, in which Buxoo informs me it has been called C. hostilis.

DESCR.—A very elegant Palm (in some cases stoloniferous,) forming at the base, apparently from off-sets, very thick leafy tufts from which arise elegant *stems,* fifteen-twenty feet high, 2½ inches in diameter, annulated; internodes seven inches long, green. *Crown* elegant, of ascending, gracefully curved leaves.

Petioles for two or three feet from the base highly armed with large black flat spines, intermixed with small ones in oblique often nearly complete series, spreading in every direction; in the pinniferous part trigonal, covered with whitish scurf, armed underneath with nearly complete verticils of spines. Spines, solitary or in pairs, also exist on the upper angle towards the base of the pinniferous part. *Pinnæ* very spreading, alternate or often sub-opposite, rather distant, linear-lanceolate, largest eighteen-twenty inches long, ten-eleven lines broad, acute, or acuminate into a cirrhose bristle, dark green, shining above, white below; central vein above sub-carinate, from the middle upwards on both sides furnished with distant stout bristles, margins very bristly and pungent, as also are the points, which are sometimes bifid.

Spadices about five feet long, pendulous; much attenuated towards the apex, peduncles, where naked, smooth, compressed, greenish, shining. *Spathes* four-six inches long, tubular, clavate, with split erect limbs two-three inches long, often blackened, withered, armed with scattered spreading black spines, except the uppermost which are nearly or quite unarmed. Lower flowering branches often decompound, 2-3 feet in length, upper simple, their spathes short, unarmed, split, blackened. *Spikes* five-six inches long, (younger ones rather flattened,) with a tendency to be gyrate; direction of flowering inverted. *Bracteæ* rather closely imbricated.

Flowers rather large, greenish, oblique, surrounded at the base by a short cup concealed in the bracte, oblique in front, emarginate and sub-bicarinate behind. *Calyx* scarcely longer than the bracte, ovate, and 3-partite to the middle, not striate; segments slightly scurfy. *Corolla* three times longer than the calyx, down to which it is divided into three oblong-lanceolate, acute, ascending segments: where it is enclosed in the calyx, fleshy. *Stamina* united to the corolla up to its segments. *Filaments* thence shortly monadelphous, (sometimes two filaments are united to each other nearly to the anthers,) angular, smooth, as long as the corolla. *Anthers* linear, exserted.

Rudiment of the *pistillum* long, angular, of three abortive carpels united to the middle, often with bifid points.

Female unknown.

This is a very handsome species, and well marked by its erect stems, dark brown almost black spines, leaves, which are white underneath, and long, pendulous male spadices, with the primary spathes armed. I should have been inclined to refer it to Roxburgh's C. erectus,* had the white-

* I subjoin Roxburgh's description of this species and of his C. humilis, probably referrible to this section; also Martius's character, etc. of C. scipionum.

C. *erectus. R.*

Shrubby, erect, no flagelli. *Leaflets* rather remote, equidistant, opposite and alternate, linear-lanceolar. *Spines* subverticelled. *Spadix* compound. *Berries* oblong.

Sun-gotta, the vernacular name in Silhet, where it grows with an erect trunk, like the true palms, of about fifteen feet in height; when divested of the sheaths, from three to four inches in circumference; and the joints from two to three inches long. The poorer natives use the seed as a substitute for areca.

C. *humilis, R.*

Shrubby, not scandent nor flagelliferous, *Leaflets* lanceolar, smooth, many-nerved. *Spines* few, but long and strong.

A native of Chittagong.

C. Scipionum: caudice robusto, articulis tripedalibus subulatis rutilis nitidis; frondibus breviusculis, vaginis rhachibusque aculeatis, pinnis —— ——; spadice crasso decomposito, ramulis brevibus paucifloris; baccis ——

C. Scipionum, Lour. Flor. Cochinch. I. p. 210. No. 3. Edit. Willd. I. p. 260. Lam. Encyclop. VI. p. 304. No. 3. Rees. Cycl. No. 3. Schult. Syst. Veg. VII. 2. p. 1326. No. 2, (exclusis synonymis Pluk., Rheed., Rumph.) Spreng. Syst. Veg. II p. 17. No. 9. *Arundo Rotang,* Pis. Mant. p. 188. c. icone (fide Loureiri.)

Haec species scipiones suppeditat omnium elegantissimos, colore rutilo vel obscurius lutescente ac nitore insignes, unico plerumque articulo constantes.

In sylvis Peninsulae Malaianae ex utraque parte freti Malaccensis, unde abundanter in Sinas et in Europam exportatur: Loureiro. In Cochinchina dicitur "Heôtau." Martius.

This I imagine is the well known Malacca cane. The Plant does not appear to occur about Malacca itself, and I was informed that the canes are imported chiefly from Siak, on the opposite coast of Sumatra.

ness of the under surface of the pinnæ been mentioned in his description. It is closely allied to the succeeding species.

** *Saepius scandentes. Flagelliferae vel spadice abortivo vel fertilis apice extenso.*

15. (5.) C. *longisetus,* (*n. sp.*) Subacaulis erectus, spinis petioli rectis (nigris) inferioribus seriatis, pinnis fasciculatis linearibus (long. bipedalibus lat. $1\frac{2}{3}$ uncialibus) plurifariis supra nitentibus 1-carinatis, vena centrali subtus setas longissimas gerente, spadice decomposito longissimo nutanti-pendulo spathis primariis infimis armatis secondariis glabris abbreviatis quasi truncatis, spicis rectiusculis compressis.

HAB.—Male Plant said to have been introduced from Pegu with C. arborescens. Flowers in the cold season.

DECR.*—A tufted stemless palm, with the habit of young specimens of C. arborescens. *Leaves* slightly arched, often with the blade turned edgeways, total length 11-12 feet. *Petioles* armed throughout the lower naked part, which is about three and half to four feet in length, with seriate, unequal, flat spines, black from a white base. The vagina has them longer but less seriate, and presents also especially towards the margins lines of bristles. Towards the apex of the petiole the spines are solitary, and confined to the lower convex face. *Pinnæ* fasciculate, but from the fascicles not being distant, this is not so apparent at first sight as in some others, plurifarious, some crossing over the others, all are arched and nodding, two feet in length, one inch seven lines in breadth, coriaceous, convex and shining above and with one carina, and occasionally a lateral bristle-bearing vein on each side, underneath the central vein presents very long bristles; margins setoso-dentate, apex hispid.

Spadices very long, whip-shaped, nodding-pendulous, flagellus humifuse or trailing over the neighbouring shrubs, armed with the usual aculei. *Branches* pendulous, distant. *Spathes* with very long

* The flowers are described from dried specimens.

sheaths, and lacerated scarious limbs, primary ones armed below with stout aculei like those of the spadix, above with a few slender straight spines, those of the branches truncate and unarmed.

Spikes about six inches long and about two inches distant, distichous. *Bracteæ* annular, amplectent, with scarcely any limb. Cup concealed by the bractea, oblique, emarginate behind, where it adheres to the spike.

Flowers closely bifarious, oblique and curved. *Calyx* a little longer than the bractea, with three, short, half ovate teeth. *Corolla* nearly three times longer, tube narrow, nearly as long as the calyx; segments linear oblong. *Stamina* six, apparently* attached to the faux, *filaments* about as long as the petals. *Anthers* deeply sagittate, versatile. *Rudiment* of a *pistillum* cylindrical, tripartite, nearly as long as the tube of the corolla.

This species is closely related to C. arborescens, from young specimens of which it is scarcely distinguishable at first sight. The armature is much the same, otherwise its pinnæ, which are never white underneath, and the flagelliferous spadix abundantly distinguish it. In these Gardens, it appears to have been always confounded with the above-mentioned species, so much so, that although it is very ornamental and easily propagated by its off-sets, from which (as in C. arborescens,) its densely tufted appearance arises, there does not appear ever to have been more than one plant in the Garden.

From the succeeding species, with which it agrees in the great length of the spadix, it is abundantly distinct.

16. (6) C. *ornatus*,† spinis (inferis) petioli pinniferi uncinatis (albis,) pinnis æquidistantibus lineari-lanceolatis (long. $2\text{-}2\frac{1}{2}$ pedalibus lat. $2\frac{1}{4}$ uncialibus) supra 3-5 carinatis carina cen-

* In reality only adhering as usual to the cohering parts of the corolla.

† There is another Malacca species found about Ching, which appears to approach this. The following is a description from living specimens out of flower.

A large climber. *Sheaths* green, armed on the dorsa with very broad deflexed seriate or solitary spines. *Flagellus* very long. *Ligula* distinct. *Petiole* near the trali versus apicem setigera, spadice longissimo 16-18-pedali, spathis tubulosis longissimis armatis, ramis paucis (subquaternis) distantibus, spicis scorpioideo-reflexis.

C. ornatus. *Blume in Syst. Veg. ed. Schultes. 7. pt. 2. p.* 1326. *Martius. Palm. p. 204. t.* 116. *fig. 2.*

HAB.—In forests Malacca, as about Durion Toongull, E. Fernandez. Malayan name, Rotang Suga Budak.

DESCR.*—A stout species, the diameter of the sheaths being about two inches. *Sheaths* swollen under the base of the petiole, armed with rather complete series of flat spines, rather short and much broader than usual. Naked lower part of the *petiole* about three feet long, somewhat flat, and channelled broadly towards the axil, much armed, the spines of the lower face resembling those of the vaginæ, but being smaller; those of the upper face irregular subulate from a stout base; of the pinniferous part, which is nine or ten feet long, and convex-trigonal, the under convex face is armed with stout hooked aculei. *Pinnæ* rather distant, large, linear-lanceolate, two or two and quarter feet long by two and a quarter inches broad, rather obtuse, generally bifid or bi-partite at the apex, underneath glaucescent: upper surface tricarinate, mid vein with stout pungent setæ towards the apex, as have also the margins; apex hispid.

Spadix of great length (sixteen to eighteen feet long) as usual adhering to the next sheath, of these the lowest one in the specimen is abortive, flagelliform, the one immediately above flower-bearing and produced into a long flagellus seven or eight feet long, armed with the usual aculei. It bears four branches, about two and half feet distance from each other, the two lowest internodes are entirely covered by the long tubular sheaths, the two uppermost with the peduncle exposed for a few inches at the base, and there unarmed and plano-convex.

base, armed with marginal, straight, distant solitary spines: otherwise armed along the dorsum, with a row of distant solitary hooked aculei. Pinnæ alternate or sub-opposite, linear lanceolate, two feet long, two and half inches broad, acute, with five prominent bristle-bearing veins above.

In dense forests, Ching.

* Specimen; an entire, flowering apex of a female plant in flower.

Spathes without limbs, those of the flagellus inconspicuous, all armed, the spines on the lower face being like those of the vaginæ but smaller, the rest deflexed, not very strong, and subulate from a stout oblique base.

Branches of the spadix erect, bases concealed in the orifices of the sheaths, bearing alternate, scorpioid, stout spikes, two to three inches in length. Spaces between the spikes occupied by short, lax, truncate, smooth spathes.

Spikes stout, somewhat compressed. *Flowers* in bud distichous, but not flatly bifarious; under each is a laxly sheathing bracte with a short limb with shortly ciliate margins; outer *bracteole* obliquely cup-shaped, emarginate behind, inner with a conspicuous disk-like oval space on one side.

Calyx of stout texture, oblong, ovate, suboblique, shortly three-toothed. *Corolla* ovate, tripartite below the middle; segments ovate-lanceolate. Stamina six, large, effete, united as usual to the corolla, and above this monadelphous. *Ovarium* oblong obconical, with numerous rows of very minute scales. Style stout, conical, divided nearly to the base into three stout, lanceolate, inwardly stigmatic branches. Ovules solitary.

A very well marked species, especially by its stature and inflorescence; it appears to be more nearly allied to C. schizospathus than any other.

17. (7.) C. *acanthospathus*, (n. sp.) spinis petioli——pinnis ——spadicis (6-pedalis) pedunculo basi compresso spinis et aculeis subulatis armato cæterum inermi, spatha infima dorso carinata aculeis basi conicis sparsis valde armata reliquis parce armatis seu inermibus ecarinatis, ramis distantibus infimis compositis, fructubus elliptico-oblongis apice mammillatis, (castaneis.)

Hab.—Khasiya Hills.

Desc.*—*Spadix* about six feet long, tapered at the end into a flagellus. *Peduncle* short, compressed, armed on the edges, and lower

* Specimens (two) of entire fruit bearing spadices.

face with unequal, straight, subulate spines and prickles, those of the edges being the longest, otherwise in the parts not covered by the spathes unarmed.

Spathes with obsolete limbs, lowest about a span long, compressed, keeled along the centre of the back, excepting the short erect half lanceolate limb, armed with straight prickles with conical bases. The other spathes are shorter, more clavate, without an obvious carina, and only slightly armed, or (as the uppermost) quite unarmed.

Branches just exserted from the spathes, erect, a foot or a span distant, lowest about a span long, decompound. Spathes sheathing, rather lax, smooth, lowest about an inch long. Lower divisions compound, with several spreading spikes, with similar but much smaller sheathing spathes, uppermost internode often abortive as in certain Grasses.

Fruits apparently terminating short stout stalks, suffulted by three annular amplectent bractes, and surrounded at the base by the spreading portion of the perianth, elliptic-oblong, with the mammilliform apex seven lines long, four broad, chesnut coloured. Scales with a broad shallow central furrow, and dark edges. *Seed* (apparently berried,) erect, convex on one face, and conspicuously areolate with foveolæ, on the other convex with a central umbilicus, from which the areolæ seem to radiate. *Albumen* horny, cartilaginous, on a long section reniform, with as many stout entering processes as join areolæ, that from the umbilicus much the largest and filled with a mass of cellular substance. *Embryo* basilar.

This species does not appear to me allied to any others I have met with. In the division and direction of the branches of the spadix, it approaches to the Piptospathæ This and the very frequent, conical aculei on the lower spathes seem to me its chief characteristics.

18. (8) C. *Royleanus*, vaginarum spinis solitariis compressis petiolorum superioribus uncinatis, pinnis æquidistantibus linearibus angustissimis (long. 10-11 uncialibus lati-

tudine uncialibus,) superne carinis 3 longe setosis, spadice nutante aculeato, spathis parce armatis, corolla calycem subæquante, fructibus pisiformibus cuspidatis (albis.)

HAB.—In the denser, moister parts of the jungles of Dehra Dhoon, chiefly towards the eastern extremity of the valley, as at Kurruck.

DECR.*—A small elegant species forming impenetrable patches.

Sheaths bi-auriculate at their mouths, armed with solitary long subulate spines, less flat than usual. *Petiole* in the lower part armed with similar but smaller spines, in the pinniferous part these become aculei. *Pinnæ* numerous, approximated, often nearly opposite, linear, acute, ten or eleven inches long by half an inch broad, above tricarinate, the carinæ bearing distant long bristles; margins with frequent short, appressed, bristle teeth.

Spadix nodding or pendulous ? plano-convex where not concealed by the long, tubular, limbless, slightly armed spathes; convex face armed with solitary aculei. *Branches* a span or foot distant, about a span long, expanded, owing to the very spreading spikes. Spaces between these covered with lax, truncate, submucronate smooth spathes. From above the apex of these arise the spikes, which are rather slender, two or three inches long, loaded with fruit.

Fruit (immature) ovate-roundish, with a distinct cuspis, about the size of a large pea: scales white, rather large, with an indistinct central furrow, paler margins and brown points; each is suffulted by a minute scale-shaped bracte and two minute bracteoles, of which the inner is the larger; by the *calyx* with a short cylindrical solid base, divided to the middle into three oblong segments, the *corolla* with three lanceolate segments equal in length to the calyx, and six *stamina*.

I am in considerable doubt regarding this species, which is that alluded to by Dr. Royle as agreeing with Roxburgh's

* Specimens; an entire young mutilated leaf, portions of perfect parts of leaves, and of a spadix in fruit.

C. Rotang.* But it differs from Roxburgh's drawing of that species in the arming of the petioles and sheaths, the spines being solitary and long, not mere aculei, in the shape of the leaves, which are more linear, in the corolla, which appears to be of the same length as the calyx, and the fruit which is pisiform, not ovate. It cannot be referred to C. Pseudo-Rotang of Martius,† because that is described

* Illustr. p. 396.

† C. *Pseudo-Rotang*, aculeis vaginarum et petiolorum albido-tomentosorum subulatis rectis, pinnis lineari-lanceolatis fasciculato-aggregatis, spathis aculeis reduncis armatis, baccis pisiformibus apice breviter rostratis.*

C. Pseudo-Rotang. *Mart. Palmæ. p.* 209. *t.* 116. *f.* 6.

Hab.—Throughout India in wooded places.

Martius, whose description I subjoin, states that this differs chiefly from C. Rotang by the broader fasciculate pinnæ, the whitish tomentum of the petiole and the straight aculei, half an inch or an inch long, spreading or recurved, and the smaller, globose, shortly beaked fruits. It agrees in armature and fruit with C. Royleanus, from which it differs chiefly in the fasciculate pinnæ, and the tomentose petioles. This last character however is (perhaps) a doubtful one, and dependent on the degree of exposure of the part to external agencies. I am moreover in possession of a specimen I believe from Assam, which I am disposed to consider Roxburgh's C. Rotang, in which, the younger petioles, and especially the sheaths, are covered with a brown tomentum.

" *Calamus Pseudo-Rotang* : *caudice scandente ; frondium ecirrosarum pinnis lineari-lanceolatis, fasciculato—aggregatis, aculeis vaginarum rhachiumque albido-tomentosarum subulatis rectis, spatharum lororumque reduncis ; spadicibus composito-ramosis, abortivis loriformibus ; baccis globosis (magnitudine Pisi.)*

Differt a Calamo Rotang praesertim pinnis fasciculatis latioribus, rhacheos tomento albido-fuscidulo et aculeis rectis (unguem ad pollicem longis) patentibus vel reversis, baccis minoribus globosis, apice breviter rostratis. Squamae baccarum testaceo-lutescentes, imo margine exarido ferrugineae. Nucleus fere dimidiato-globosus, hinc convexus, leviter gyroso-tuberculatus, inde planiusculus atque in areolam profunde depressus. Embryo basilaris. Albumen cartilagineum aequabile.

Crescit per vastam Indiae orientalis plagam, locis sylvestribus e. gr. in Coromandelia : ad Moalmyne in Martabania, ad fluvium Irawaddi, prope rupes Pingyi in Pegu." Martius.

I add Martius's character, etc. of another Indian species of this intricate part of the genus.

" *Calamus Guruba, Hamilton : caudice scandente ; frondium ecirosarum pinnis aequidistantibus concinnis linearibus acutis, rhachibus ferrugineo-villosis,*

* Character e Martio.

as having the sheaths and petioles covered with white tomentum, fasciculate pinnæ and spathes armed with hooked spines. In fruit it appears to be similar.

Under these circumstances, I have considered the species a distinct one. It is I believe the only species that extends so far north as to come within the limits of the Seharunpore and Dhoon Flora, and I have therefore dedicated it to a well-known investigator of that region.

19. (9.) C. ***Roxburghii***, vaginarum petiolorumqûe glabrorum aculeis parvis solitariis sparsis, petioli faciei inferioris uncinatis, pinnis æquidistantibus lineari-lanceolatis, spadice basi et flagello excepto inermi nutante, spatha infima parce aculeata, corolla calycem duplo superante, stylis sub-clavatis, fructibus oblongo-ovatis apice in cuspidem attenuatis (albis.)*

C. Rotang. *Roxburgh. Fl. Ind. 3. p. 777. Icones. 14. t. 28.*

Hab.—Bengal and the Coromandel Coast: flowers during the rains; fruit ripens during the cold season; Roxburgh.

" *Sans.* Vetra, vetus.

Beng. Bet, or Sanchi-bet.

Root fibrous. *Stem* jointed, climbing to a vast extent, enveloped in the thorny sheaths of the leaves; with them it is about as thick as a man's little finger; when they are removed, it is in thickness, and every other respect, a common ratan. *Leaves* pinnate, from eighteen to thirty-six inches long. *Leaflets* opposite or alternate,

aculeis rhachium spadicumque masculorum decompositorum reduncis, calycibus campanulatis trifidis, quam petala lanceolata duplo brevioribus; loris ?—; baccis.

Species praecedenti et C. Rotang prae aliis affinis, sed villo rhachium et floribus minoribus facile distinctu.

Prope Jelpigori in Indiae provincia Rungpaor, lat. bor. 26° 30′, *Aprili* 1809, *detexit Cl. Hamilton.*" Mart. Palm. p. 211.

* Char. ex. Icone. Roxb. citata

sessile, linear-lanceolate, armed in the margins with minute bristles pointing forward, and a few distinct, long, erect bristles on the upper surface, from six to twelve inches long. *Sheaths* cylindric, armed with numerous, strong, straight, compressed thorns. *Petioles* sheathing, the leaflet-bearing portion compressed, channelled, and armed with both straight and recurved thorns on the under side. *Flagelli*, one from the sheath of each leaf near its mouth, they are very long, slender, drooping or waving, and well armed, resembling the slender lash of a whip; many of Rumphius's figures of these plants have such terminating the rib or rachis of the leaves. MALE. *Calyx* universal; *spathe* none; partial many scattered. *Spadix* supra-decompound, drooping, being the above-mentioned flagellus much enlarged, with numerous, partial, truncate spathes, with alternate, decompound, bifarious, recurved spikes therefrom, the ramifications thereof recurved, bearing in two rows on their convex sides numerous minute greenish flowers. *Perianth* 3-parted, smaller than the corol, permanent. *Corol* 1-petalled. *Tube* imperforated. *Border* 3-parted; divisions oval, permanent. *Filaments* six, thick at the base, tapering, nearly as long as the corol and inserted on the mouth of its tube. *Anthers* incumbent. *Germ* none, but there is the rudiment of a 3-cleft stigma. FEMALE. *Sheaths* as in the male. *Spadix* decompound, *perianth* and *corol* as in the male. *Filaments* six, united at the base round the germ. *Anthers* arrow-shaped, abortive. *Germ* round. *Style* short, 3-cleft, divisions or stigmas recurved. *Berries* round, of the size of a small gooseberry, imbricated backward with barky scales, 1-celled, 1-seeded, between the bark and the seed there is a considerable portion of whitish juicy pulp of a sharp acid taste. *Seed* solitary, marked with many irregular depressions and elevations, and on one side there is a large, deep, roundish pit, a little below it near the base is lodged the monocotyledonous embryo." Roxburgh.

As none of the synonyms assigned usually to this species appear to have sufficient reference to it*, and as the figures

* Thus Calamus petræus. Loureiro, is considered by Martius to be a distinct species: Tsjeru Tsjurel of Rheede is the C. gracilis of Roxburgh, Palmijuncus calapparius. Rumph, is the Calamus calapparius of Martius, and the Phæniscorpiurus, etc. of Plukenet is referred by Hamilton to his C. Heliotropium.

of Rheede* and Plukenet,† which represent two distinct species, have been always referred, except by Martius, to C. Rotang, a species founded on the Palmijuncus Calapparius of Rumph. (now Calamus calapparius, Martius); it is perhaps advisable to abolish the name C. Rotang, which is besides a generic not a specific name, and the whole of the synonymy given by Willdenow and succeeding authors.

The synonymy given by Dr. Martius‡ is perhaps only correct in the citation of Lamark's figure, (t. 770 f. 1.) referred by Lamark to Loureiro's C. scipionum. For Plukenet's figure is cited by Hamilton under his C. Heliotropium, and Roxburgh's drawing represents the fruit of his C. Rotang oblong-ovate, and white, not round with chesnut coloured scales as Martius§ describes it. This same drawing does not agree in the spathes with Lamark's figure sufficiently well to convince me of their representing the same species.

It is to be regretted that Roxburgh quoted Willdenow as the authority for this species, his definition not being in any way applicable to it, and being evidently drawn up from Palmijuncus calapparius of Rumph. none of whose figures would Dr. Roxburgh quote. Of the Hb. Amboinense, the only figures that resemble the species under consideration are t. 53 (Palmijuncus albus,) which however is not of this section, and especially t. 55. f. 2. A. B. (Palmijuncus viminalis,) which is of this section.

20. (10) C. *tenuis*, vaginarum aculeis solitariis paucis rectiusculis, petioli (pinniferi) anguli superioris rectis faciei inferæ uncinatis, pinnis æquidistantibus lineari-lanceolatis (long. pedalibus lat. 7-8 linealibus) supra nitentibus tricarinatis (carinis setigeris) subtus secus venam centralem setulosis, spadice nutante spathisque primariis parce aculeatis,

* Hort. Malab. 12. t. 64. 65.
† Alm. t. 106. f. 1. 2. Hb. Amb. V. p. 98. t. 51.
‡ Palmæ. 209,
§ Op. cit. loc. cit. t. 116. f. viii.

spicis bifariis recurvato-patentibus sæpius simplicibus floribus binatis altero superoque pedicellato masculo, altero sessili fœmineo, calyce urceolato breviter tridentato, stylis sub-ternis filiformibus longis patenti-revolutis.

C. tenuis. *Roxb. Fl. Ind.* 3. *p.* 780. *Icones. Suppt.* 5. *t.* 18. *(bona)—Mart. Palm. p.* 212.

Hab.—Eastern Bengal as at Sillet; Assam, where it is known as the "Bet" proper. Major Jenkins. Bandhari-bet of Chittagong. Roxburgh.

Roxburgh says, "it is a beautiful, delicate species; when divested of the sheaths of the leaves, and cleaned, it is not thicker than a common quill, and of the colour of the common ratan. Flowering time, the rainy season.

"*Stems* simple, perennial, climbing to a great extent; the extremities inserted in the armed sheaths of the leaves, including these, it is scarcely so thick as a common ratan. *Leaves* oblong, equally pinnate, nearly two feet long. *Leaflets* from twenty to thirty on each side, equi-distant, alternate, linear, polished, three-nerved; *margins, apices,* and *nerves* bristly; six inches long, and scarcely half an inch broad at the broadest part. *Petioles* armed. *Flagelli* from the sheaths, simple, armed, as in the other species. *Spathes* numerous, sheathing, sub-cylindric, one for each division of the spadix, even to the pairs of flowers. *Spadices* occupy the place of the flagelli on a few of the spathes, decompound; primary branches, four, five, or six, remote, flexuose, with about half a dozen alternate, recurvate branches on each side. *Hermaphrodite* and *male flowers* in alternate pairs, the latter short-pedicelled. Male. *Calyx* shorter than the corol, unequally 2-3-toothed, corol supported on a fleshy gibbous receptacle, border 2 or 3-cleft. *Filaments* four, five, or six. *Anthers* sagittate. Hermaphrodite. *Calyx* and *corol* equal, gibbous, with a contracted, 3-toothed mouth. *Filaments* six, united in a ring round the lower half of the germ; *anthers* sagittate, large, and seemingly fertile. *Germ* ovate, 1-celled, containing three seeds attached to the bottom of the cell. *Style* scarcely any; *stigma* 3-cleft; *segments* rugose and recurvate." Roxburgh.

I subjoin my own description of the leaves, and inflorescence:*—

Petiole in the pinniferous part with the upper angle armed with straight conical subulate prickles, the usual row of hooked ones along the centre of the under face, and similar ones about the margins often close to the pinnæ; towards the apex it only presents the under central series. *Pinnæ* alternate, equidistant, linear lanceolate, acuminate, ten-twelve inches long, seven-eight lines broad; above with three carinæ bearing long bristles, underneath with shorter bristles along the mid vein; margins setoso-serrulate.

Spadix of considerable length. *Branches* just supra-axillary, very flexuose, about a span distant; spaces between covered, except perhaps the lower two inches, by the tubular *spathes,* which are green, armed toward the upper ends with scattered curved prickles. The upper spathes appear to be the most armed. Naked parts of the spadix also armed on one face with stout hooked aculei. The spathes (of the spikes,) rather laxly sheathing, subtruncate, sprinkled with brown scurf, margins ciliate. *Spikes* also supra-axillary, bi-farious, about two inches long, recurved spreading, also scurfy.

Flowers distichous on the outside, on the inside tetrastichous, in pairs, the larger conical, sessile, female, the smaller ovate oblong, shortly stalked, male, always on the upper or posterior side of the spike. *Bractes* like the spathes of the spikes, but less ciliate. *Bracteolæ* two, broad, the inner one on the inner side is bicarinate and emarginate, and to the centre of the bicarinate part the male flower corresponds, being adnate as it were to its base. *Calyx* of the female thickened at its base, whence its conical shape, of both sexes suburceolate with three short teeth, often divided to the middle. *Corolla* slightly longer than the calyx, divided below the middle into three erect, oblong, lanceolate segments. *Stamina* as usual adnate to the corolla, then monadelphous; *filaments* (free) short; *anthers* sagittate, of the female flower effete. *Ovarium* as long as the corolla, oblong, rather attenuate to the base where it is 3-celled, ovules erect. *Style* of three

* From specimens communicated by Major Jenkins.

broadish immediately recurved segments, which are pappillose inside, and in the bud lanceolate and erect.

This species is closely allied in the pinnæ to C. Royleanus and Roxburghii, especially to the former. An obvious difference, however, exists in the small recurved deflexed spikes of this species. In the pairs of flowers, one hermaphrodite, and one male, it appears, so far as we know at present, to stand alone. The presence of the male may, however, judging from the similarity of the inner bracteola to those of certain other species, which appear discoid, be expected to occur in other instances. The minute examination of these bracteoles in order to ascertain whether there is a scar of a fallen flower becomes therefore necessary. So far as can be judged from Roxburgh's short notice of C. monoicus,* it would appear to resemble that species closely.

* C. *monoicus.*

Monoicous, scandent. *Leaflets* numerous, alternate, lineari-lanceolate, polished, and bristly ; *sheaths* flagelliferous ; *stamens* monadelphous.

Native place uncertain. It grows in the Botanic Garden to about the size of the common ratan, and differs from it only in being monoicous, the divisions of the corol lanceolate, and in the *filaments* being very completely united. Flowering time, the rainy season.

It is needless to give a full description of this plant, which is exactly like C. *Rotang*, except in the above-mentioned circumstances. The *male* flowers are about as numerous as the *female* ones, generally one of each from each of the annular scales of the branches of the spadix. The common ratan (C. *Rotang*) I have always found completely dioicous; this must therefore be considered a distinct species."

C. monoicus. *Roxb. Fl. Ind.* 3. *p.* 783. *Mart. Palm. p.* 209.

I subjoin Roxburgh's description of C. polygamus, and three of Martius's species, all which appear to me to belong to this part of this section.

" C. *polygamus, R.*

Scandent. *Spines* sub-verticilled. *Sheaths* flagelliferous. *Inferior leaflets* in remote fascicles of three or four, above single and alternate, or opposite, all linear, with a few bristles on the margins and nerves underneath. *Male* and *hermaphrodite flowers* on the same supra-decompound spadix.

Hoodoom Bet of the people of Chittagong, where it is indigenous, and a most extensive rambler; the general thickness when cleaned is that of a stout walking

21. (11) C. *leptospadix*, (n. sp.) spinis petioli (pinniferi) solitariis uncinatis ?, pinnis approximatis æquidistantibus linearibus (long. 10 uncialibus lat. 4-5 linealibus,) supra carinis tribus setigeris subtus setulosis secus venam mediam, spadicis attenuati aculeati ramis filiformibus, spathis primariis aculeatis secondariis lamina conspicua lanceolata, spicis simplicibus abbreviatis scorpioideis, bracteis apice pennicillatis, floribus oblongis, calyce corolla duplo breviore, fructibus globoso-turbinatis (albis.)

cane. Its growth is exceeding slow, for in ten years it had acquired a stem of only five feet in length, and the leaves from ten to twelve more."

C. polygamus. *Roxb. Fl. Ind.* 3. *p.* 780. *Mart. Palm. p.* 210.

It appears to differ from C. monoicus in the lower pinnæ being fasciculate, and in the flowers being male and hermaphrodite, not male and female.

" C. *nitidus : caudice ; frondibus ecirrosis glabris nitidis, pinnis approximatis aequidistantibus lineari-lanceolatis marginatis, aculeis rhacheos recurvis sparsis et confluentibus ; spadicibus foemineis compositis ; julis horsum vorsum flexis, baccis (ovato-globosis,) squamis fuscis.*

Pinnae spithamam longae, unguem latae, firmulae, venis statu sicco vix conspicuis, setulis non solum in margine latiusculo sed etiam in nervis utriusque faciei. Calamo tenui Roxb. multis modis affinis, sed diversus videtur praesertim sexus distributione.

Crescit in Tenasserim, prope Tavoy, W. Gomez." Martius. Palm. p. 211.

C. *concinnus :—frondium rhachi ferrugineo-tomentosa, subtus aculeis rectis reversis, pinnis sub-aequidistantibus concinnis lineari-lanceolatis ; spadicis (monoici ?) compositi spathis aculeis rectiusculis reversis ; baccis magnitudine. Pisi minoris, squamis flavidis margine inferiore latius fuscidulo.*

Pinnae, quas vidi, fere sesquipedales, ultra pollicem latae. Juli fructiferi bipollicares, non nihil recurvi. In calycum fructiferorum uno eodemque per cujusvis seriei flores latere conspicitur spathella valde contracta, cujus basis cicatricula parva notatur, quam ob causam conjicio, huc flores masculos aut eorum rudimenta in florente spadice excidisse."

Hab.—*Tavoy. Wallich.* Martius. Palm. p. 208.

" C. *melanacanthos : caudice scandente ; frondibus ecirrosis, pinnis aequidistantibus concinnis lineari-lanceolatis acuminatis, margine nervisque tribus primariis setis longiusculis nigricantibus ; aculeis antice nigris, vaginarum subverticillatis rectis, rhachium spadicum compositorum lororumque recurvis ; baccis oblongis octolinearibus, squamis pallide fuscis spadiceo-marginatis.*

Crescit in insula Pinang et in ora Tenasserim prope Chappedong : Wallich." Martius. Palm. p. 211. t. 116. f. 13.

HAB.—Khasiya Hills, between Nunklow and Naogong, in flower and fruit, November 1835. Herb. Assam Deputation. In the same locality Areca gracilis, Wallichia caryotoides, and Caryota urens were observed.

DESCR.*—*Petiole* (in the pinniferous portion) triangular, under surface rather convex, with scars of solitary spines or prickles, the two side faces somewhat channelled, and presenting especially towards the insertion of the leaves dark filamentous tomentum. *Pinnæ* many, crowded, regularly alternating, linear, very narrow, ten inches long, four four-and-half lines wide, subulato-acuminate, or even perhaps cirrhoso-acuminate, upper face with three bristle-bearing carinæ, a few smaller ones on the midvein underneath: margins rough with very frequent ascending bristles.

Male *Spadix* apparently nodding, long, slender, distantly branched, (in the parts not covered by the very long, narrow, tubular spathes with largish lanceolar nearly unarmed limbs) frequently armed with short acute stout thorns, solitary, or in twos or threes. *Branches* filiform, a foot long, apparently secund, with frequent alternate, simple, bifarious, short, scorpioid recurved simple spikes, each of which is suffulted by a spathe with a rather larger, lanceolate, acute, erect limb. The lowest branch in the specimens is inserted about an inch above the mouth of its spathe. *Spikes* about an inch long, nearly twice the length of the limbs of the spathes.

Flowers distichous, oblong, with an amplectent bracte with a sublanceolate rather long limb, pennicillate at the apex. Inside this bracte is a short cup emarginate behind. *Calyx* oblong, divided nearly to the middle in three half-ovate segments. *Corolla* twice the length of the calyx, divided nearly to the base into three oblong-lanceolate rather obtuse segments. *Stamina* united to corolla to base of its segments; *filaments* (free) long, subulate, about $\frac{1}{3}$ shorter than the corolla. *Anthers* attached above the middle, linear sagittate, slightly mucronate, versatile. *Pollen* yellow, with one longitudinal furrow.

* Specim: Portions of a leaf, of male spadix in flower, and female spadix in fruit.

The *fruit spadix* ends in a long flagellus armed as usual, the spikes appressed to the filiform branches. *Fruit* globoso-turbinate, apex cuspidate, looking rather downwards, scales rather lax, whitish, with conspicuous brown margins and points. Its base is surrounded by the flattened perianth, (the calyx with three oblong segments, the corolla with three segments a little longer and narrower,) and by two bracteolæ, of which the inner bears a disc on one side, and forms a cup; they do not appear to be pennicillate. *Seed* one, roundish, with a foveola on one side. *Albumen* solid with a pitted areolar surface, and a cavity corresponding to the foveola filled with the tegument, which is blackish-brown. *Embryo* basilar.

The male spadix of this resembles in some respect that of C. palustris.

In the leaves it approaches C. tenuis, Roxburgh: it is distinguished from all the others by the long filiform distant branches of the spadix, the lanceolate rather large limbs of the primary, and especially of the secondary spathes, and the pennicillate bracteæ, the cellular hairs or processes forming the tufts of which are not altogether unlike the bodies forming the tufts at the ends of the leaves in certain mosses.

Plukenet's figure of Phænicoscorpiurus, etc. resembles this in many respects.* Hamilton† quotes the same figure for his C. Heliotropium, to which I should have referred this, had the relative lengths of the calyx and corolla agreed with Martius's character of that species.‡

* Phytogr. t. 106. fig. 2.

† Cat. Dried Plants, p. 90.—No. 877.

‡ "*C. Heliotropium Hamilton: caudice scandente; frondium ecirrosarum pinnis æquidistantibus concinnis lineari-lanceolatis acuminatis, aculeis rhachium spatharumque recurvis; spadicibus masculis decompositis, calycibus urceolatis breviter dentatis, petala subæquantibus; loris ?—; baccis.— —.*

Frondium forma et verosimiliter caudice affinis est C. Rotang, sed differt spadicum masculorum julis laxioribus, spathellularum apparatu minore, calycibus multo longioribus, ore contracto breviter tridentatis.

In Goyalpara, Indiæ Orientalis, Augusto, 1808, *legit Hamilton.*" Martius. Palm. p. 211.

22. (12) C. *fasciculatus*, spinis vaginarum et petiolorum albido-furfuraceorum longis rectis subulatis fasciculatis vel solitariis, pinnis egregie fasciculatis subquadrifariis linearibus (long. 9-10 uncialibus lat. vix uncialibus), marginibus et carina centrali supra spinoso-setigeris subtus venis tribus setulosis et sæpe furfuraceis, spadice aculeato, spathis infimis primariis bicarinatis secus carinas aculeatis superioribus ecarinatis aculeatioribus, spicis compositis, spiculis brevissimis scorpioideis, bracteolis distinctis, corolla calycem triplo superante, stylis clavatis reflexo-patentibus, fructibus oblongo-ovatis breve cuspidatis (albis), albumine æquabili hinc umbilicato.

C. fasciculatus. *Roxb. Flor. Ind.* 3. *p.* 779. *Mart. Palm. p.* 209.

Hab.—Bengal: (common about Calcutta in Bamboo jungles,) Cuttack, and many other places; Roxburgh says he never saw it to the southward of Ganjam. *Bura-bet* of the Bengalees.

Flowers during the rains.

Descr.—Grows in small thick tufts. *Stems* rather slender, and not very long: sheaths at first covered with white meal, afterwards smoother and green, armed with spreading strong flat spines, solitary or in short series. *Petioles* (pinniferous part) convex trigonal, covered with brownish white meal, as also are the bases of the spines, under flat face armed with long flat spreading very sharp spines generally fascicled, sometimes solitary, upper angle with solitary or binary similar, but smaller ones. *Pinnæ* in fascicles of threes, occasionally four, all slightly arched, convex on the upper face, the lowest of each fascicle ascending patent, and crossing obliquely over the others, so that they are nearly tetrastichous. They are linear, eight or nine inches long, about one inch broad, upper surface with one carina armed, as also are the margins, with whitish thorny teeth: midvein underneath with a few bristles; under surface mottled.

Male *Spadix* several feet long, ending in a long flagellus, aculeate in the part not covered by the spathes. Lower *spathes* long, compressed, almost two-edged, owing to a dorsal and ventral carina, the former armed especially towards the apex with a few short subulate spines; upper without carinæ armed with many aculei. Branches of the spadix adnate to the peduncle as high as the mouths of the spathes, thinly branched, slightly and distantly flexuose, upper half of the internodes covered with spathes with small acute limbs. Branchlets bearing the spikes four or five inches long, generally slightly scorpioid.

Spikes very short not exceeding half an inch in length, scorpioid, suffulted by broad short spathes, crowded with distichous flowers. Each male *flower* is suffulted by a scale-shaped bracte, amplectent, with comparatively very spreading oblong ovate limbs. *Bracteolæ* small, especially the inner one, not united into a cup! *Calyx* broad, angular, divided to the middle, segments half ovate, slightly keeled. *Corolla* three times the length of the calyx, broad, angular in bud, divided nearly to the base, segments oblong, spreading. *Stamina* six, as usual united among themselves and to the base of the corolla. *Filaments* (free) subulate, moderately long, anthers rather short, sagittate. Rudiment of the *Pistillum* of three small bodies.

I have not yet seen the female flowers or fruit. According to Roxburgh's figure they are very like those of his C. Rotang, (C. Roxburghii,) the chief difference represented being the greater length of the corolla in this species compared with that of the calyx. The shape and colour of the fruit is exactly the same. Roxburgh represents the albumen almost without ruminating processes, but with a conspicuous lateral foveola or umbilicus.

This species is easily distinguished from all the others by its habit, by the direction of the pinnæ in which respect it approaches to most Zalaccæ, and by their spinous margins and keels. The male spikes are shorter and broader than in any other species I am acquainted with, and in the distinctness of the bracteolæ it appears to be singular.

23. (13) C. *gracilis*, aculeis vaginarum et petiolorum solitariis sparsis, pinnis fasciculatis (fasciculis distantibus ternis suboppositis) lanceolatis (long. 3-5 uncialibus lat. subuncialibus) cuspidato-acuminatissimis utrinque triveniis, venis setigeris, spadice subfiliformi spathisque aculeatis, ramis distantibus, spicis paucis simplicibus obsolete scorpioideis, corolla calycem triplo excedente.*

C. gracilis. *Roxburgh. Flor. Ind.* 3. *p.* 781. *Icones Suppt.* 5. *t.* 16. *Mart. Palm. p.* 210. Tsjeru-tsjurel. *Rheed. Hort. Mal.* 12. *t.* 64.

HAB.—Chittagong. Mapoori Bet of the Hindoos of that district.

"A native of the forests of Chittagong, where Mr. W. Roxburgh found it climbing over trees and bushes to a great extent, and in flower in the month of May. This species is uncommonly slender, when divested of the sheaths of the leaves and dry, scarcely as thick as a common quill, in texture firm and elastic, covered with a smooth, straw-coloured crust as in the common ratan.

Stems simple, perennial, climbing to a great extent; all the tender or younger parts toward their extremities invested in the armed sheaths of the leaves, including these about as thick as a man's little finger. *Leaves* alternate, recurved interruptedly pinnate, if I may be allowed to call a pinnated leaf so, which is destitute of smaller leaflets between the principal ones, from one to two feet long. *Leaflets* collected in three opposite bundles of from two to four pair each, with much more of the rachis left naked between them than the spaces they occupy, sessile, doubled backwardly at the base, linear-lanceolate, bristly, pointed, both surfaces lucid, three-nerved; nerves on the upper side as well as the margins bristly, from three to five inches long, and less than one inch broad. *Rib* or *rachis* carinated along the upper side, when young covered with ferruginous dust, rounded underneath, and armed with recurved prickles. *Flagelli* or *tendrils* issue single as in the other species,

* Character ex Icone Roxburghiana citata.

from near the mouths of the sheaths of the leaves; they are long, jointed, slender as a pack-thread, drooping, sheathed, armed with numerous, very sharp, recurved prickles. MALE. *Spadix* from the mouths of the sheaths or opposite sides of the flagelli compound, jointed; joints approximate, sheathed; ramifications recurved, bearing two rows of sessile flowers on their convex side. *Calyx* 1-leaved, tridentate, sitting on the joints of the rachis in a three-toothed cup, which may be called a lower or exterior calyx. *Corol* 3-parted, with the base fleshy, and partly impervious. *Filaments* six, thick at the base, and inserted on the mouth of the fleshy impervious tube of the corol. *Anthers* linear, incumbent. *Pistillum,* a small, three-toothed, abortive, style-like body is all that is to be found." Roxburgh.

24. (14) C. *Mishmeensis,* (n. sp.) petiolo (pinnifero) spinis solitariis longis uncinatis subtus armato et margine aculeato, pinnis fasciculatis (vel superioribus alternis) lineari-lanceolatis (long. 15 uncialibus lat. $1\frac{1}{4}$ uncialibus) apice obtusis pennicillatis, supra venis 5 setigeris, subtus centrali tantum, spadice aculeato, spatha primaria infima ancipiti secus margines aculeata, spicis simplicibus patentibus, fructibus globosis (albis).

HAB.—At the foot of the Mishmee mountains near Tapan Gam's village: in fruit, November 1837.

DESC.*—*Scandent. Petiole* (in the pinniferous part) trigonal, lower face concave, armed along to middle with long hooked spines, with here and there, particularly about the margins, short aculei, these gradually disappear towards the apex of the leaf. *Pinnæ* fasciculate, with solitary ones interspersed, towards apex distantly alternate, linear lanceolate, fifteen or sixteen inches long, one and a quarter broad, upper face with three keels, which bear bristles of good size; there are also two lateral veins (one on either side) with small bristles; under surface with the midvein unequally bristly above the middle, margins with spreading pungent bristles, apex obtuse, with the bristles so much developed and crowded as to be nearly pencilled.

* Specimens: parts of a leaf, and spadix in fruit, *fruits broken.*

Spadix in the exposed parts plano-convex, with strong short hooked thorns on the convex face. *Spathes* tubular lowest compressed, two-edged, with short teeth along the edges, upper ones not compressed, almost unarmed. *Branches* altogether exserted, being attached considerably above the mouths of the spathes, five inches long. *Spikes* simple, stout, 2-3 inches in length, arising from a knob just above the points of narrow spathes, which cover the internodes of the branches, and which have small acuminate limbs. *Fruit* subsessile, globose, as usual tribracteolate, surrounded at the base by the flattened *calyx* with oblong-ovate segments, and the *corolla* with ovate-lanceolate segments and 6 sterile *stamens;* scales large white, with a brown margin and point. *Seed* one, dry, deeply pitted, with a deep umbilicus on one side.

This species in the spadix is allied to C. tenuis, Roxburgh, but the flowers seem to be dioicous, judging from the remains, neither have the females the same form. The spikes also are rigid, very spreading, without any tendency to be recurved or deflexed. The leaves are widely different, in situation resembling those of C. fasciculatus and gracilis, to which last it appears to be allied.

(25.) 15. C. *floribundus*,* (n. sp.) spinis petioli (pinniferi) aculeatis solitariis longis uncinato-deflexis, pinnis fasciculatis lineari-lanceolatis (long. subpedalibus, lat. 11-12 linealibus)

* C. *pennicillatus*, pinnis æquidistantibus lanceolatis 7-9 veniis margine integris (esetosis) apice setoso-pennicillatis.

C. pennicillatus. *Roxb. Fl. Ind.* 3. *p.* 781. *Mart. Palm.* p. 210.

Hab.—Forests, Pinang. Mr. Wm. Roxburgh.

I subjoin Roxburgh's notice of this plant, which in the shape, venation and tufted points of the pinnæ, and especially their entire smooth margins, appears to present sufficient peculiarities to enable it to be identified.

"Scandent. *Leaflets* thirty-four pair, regularly alternate except the terminal two, which are united, lanceolate, seven to nine-nerved; margins entire and smooth, a pencil of bristles from the apex of each. *Sheaths* flagelliferous.

It is more slender than the common ratan, and less so than C. *gracilis*."

supra carinis 3-5 setigeris, subtus setis paucis secus venam mediam, apice sæpius obtusis vel bifidis, spadice aculeato supra-decomposito, spathis primariis 1-carinatis secus carinam spinis rectis longiusculis armatis cæterum crebre aculeatis secondariis floccoso-ciliatis, corolla calycem duplo excedente, styli ramis lanceolatis.

HAB.—Upper Assam, at the mouth of the Nao-Dihing River, and towards Jorhauth. Both Major Jenkins and Mr. Masters have also sent it to me, so that it appears to be common.

DESCR.*—Sheaths armed with brown deflexed long plano-subulate spines, solitary or in short series, otherwise thickly covered with solitary or seriate brown bristles. The base of the petiole appears similarly armed, the spines being perhaps confined to the edges ; it is in the pinniferous part convex-trigonal, the under face armed with unequal curved deflexed very strong spines (the longest an inch in length or more) also with short scattered prickles. *Pinnæ* fasciculate, with or without solitary ones interspersed, linear-lanceolate, 13-14 inches long, 11-12 lines broad, upper face with three or even five carinæ all bearing bristles, under face with a few bristles on the midvein towards the apex ; margins with ascending stout bristles ; apex obtuse, hispid, often bifid.

Spadix rather long, probably nutant, where exposed plano-convex, armed on convex face with hooked prickles. *Spathes* generally very long, with short limbs, irregularly armed with slender straight spines, and with many aculei. The lowest of the spathes sometimes a foot long, bicarinate, one carina running up the centre of the limb ; those next to it similarly 1-carinate ; carina in the uppermost obsolete. The longer spines are confined to the carinæ. *Branches* distant, supra-decompound, lowermost deflexed, upper ascending, internodes concealed by spathes with truncate margins more or less ci-

* A specimen of the upper part of an axis, with the lower part of the base of the petioles, many specimens of portions of leaves, and male and female inflorescences, the latter before the expansion of the flowers.

liate, and, in the young state especially, grey from whitish filamentous hairs. *Branchlets* which bear the spikes recurved or spreading, with short, acute, often mucronate spathes. *Spikes* attached midway between these, short, scarcely more than half inch long, sub-scorpioid.

Male flowers distichous, ovate: suffulted by a small bracte likewise ciliate and generally pennicillate at the apex, and by two *bracteoles* less combined than usual, indeed sometimes nearly distinct. *Calyx* divided to the middle, segments half-ovate. *Corolla* about twice the length of the calyx, divided almost nearly to the base, segments ovate-lanceolate, spreading. *Stamina* as usual united to base of corolla; *filaments* (free) long, subulate, flexuose in bud; *anthers* obtusely sagittate, attached above the middle, versatile. Rudiment of a *pistillum* of three rather small distinct bodies.

Female flowers on simply spiked more elongated branches. *Spikes* 2-3-inches long, alternate, generally recurved, flexuose, pale ferruginous-tomentose. *Flowers* rather distant, suffulted by an amplectent bracte with a short acuminate limb, and by two *bracteoles,* of which the inner bears an incomplete disc on one side, and between this and the outer bracteole is a space as though there should be an additional flower. *Calyx* (in bud) ovate-conical, a good deal longer than that of the male flower, divided to the middle. *Corolla* (in bud,) length of the calyx, otherwise as in the male, but the segments have thin margins. *Stamina* 6, monadelphous; *filaments* (free) short, flat; *anthers* effete. *Ovarium* cylindrical, 3-celled, shorter than the branches of the *style,* which are lanceolate and papillose. *Ovules* 3.

This species seems to vary a good deal; among the specimens from the Nao Dihing, is a portion of a leaf, in which the spines are short, solitary, and the pinnæ two feet or more in length by thirteen lines broad, with only one keel on the upper face, and this is the only part besides the margins that bears bristles; the apex also is often subulate-acuminate.

There were also specimens found among the dried plants of these Gardens, without name, but which are said to have been prepared from plants growing a long time ago in the Gardens; these, had the petioles been flagelliferous, I should have referred to C. latifolius.

The inflorescence varies a good deal as to smoothness; in some of the more advanced specimens, the margins of the bractes even are nearly smooth.

It approaches especially by its inflorescence to C. latifolius, but that plant has flagelliferous petioles.

26. (16) C. *insignis*, (n. sp.) aculeis vaginarum sparsis conico-subulatis, petiolorum infra pinnas dorsalibus uncinatis intra pinnas supra medium marginalibus superadditis, pinnis distanter et irregulariter alternis (senis cum terminali æquilaterali profunde biloba) cuneato-lanceolatis vel obovatis subtus concavis glaucis apice obtusiusculo tantum setigeris.

Hab.—Malacca, E. Fernandez. Malayan name, *Rotang Bhattoo.*

Descr.*—*Stem* slender, not thicker than a common quill, or including the sheaths about four lines in diameter. *Sheaths* about a span long, with a few scattered conical subulate prickles. *Leaves* 19-20 inches long; *petiole* below the pinnæ about 5 inches long, roundish, above triangular, armed throughout along the centre of under surface with small hooked prickles, and above the middle of the pinniferous part with similar ones along the margins; *pinnæ* irregularly and distantly alternate, five in number, exclusive of the terminal equilateral deeply bilobed one, cuneato-lanceolate, sessile, distinctly concave underneath with inflexed margins, glaucous-carinate above, with many parallel veins and transverse venules, and a short obtuse point, which is the only part bearing bristles. *Flagellus* united to the sheaths high up, very slender (the longest about a foot long) armed with the ordinary prickles.

* Specimens: an entire upper part of a stem, not in flower.

This appears to me a very distinct species, it may be taken perhaps as a passage to Ceratolobus. At first sight it is not altogether unlike C. gracilis of Roxburgh.

*** *Scandentes. Petioli flagelliferi.*

27. (17) C. *latifolius*, spinis vaginarum subverticillatis, petiolis aculeatis, pinnis fasciculatis lanceolatis (long. 16-uncialibus lat. 3-uncialibus) 5-7 veniis supra convexis utrinque esetosis, spadice supra-decomposito spathisque aculeatis, corolla calycem triplo excedente.*

C. latifolius. *Roxb. Fl. Ind. 3. p.* 775. *Icones. Suppt.* 5. *t.* 17. *Mart. Palmæ. p.* 208.

Katu-tsjurel. *Hort. Malab.* xii. t. 65. *fid. Roxb. MSS.*

"Korak Bet of the natives of Chittagong, where it is indigenous, and runs over trees to an immense length. When freed from the sheaths of the leaves it is about as thick as a slender walking cane. Plants introduced by Mr. W. Roxburgh, in 1801, into the Botanic Garden, flowered for the first time in November and December 1809, when they had attained to the height of about forty feet.

Spines numerous on the stems, sub-verticilled, very large, flat and divaricate. On the flagelli fascicled and recurved. *Leaves* alternate, pinnate, from six to twelve feet long including the whip or flagellus, which terminates the common petiole as in many of Rumphius's figures; and the leaf of his *Palmijuncus equestris, vol.* v. *t.* 56. is tolerably like that of my plant, but their size is very different. *Leaves* in seven or eight remote fascicles, of three or four each, broad-lanceolate, very erect, many-nerved, smooth on both sides; with the margins triflingly spinous-dentate, and the upper surface always convex, from ten to eighteen inches long, and from three to six broad. Male. *Spadix* supra-decompound; all the divisions bifarious. *Flowers* small, of a greenish yellow, each sitting in a cup composed of two concave sheathing bractes. *Calyx* 3-toothed. *Corol* 3-parted. *Filaments* six, inserted on the imperforated base of

* Char: ex Icone Roxburghiana citata.

the corol. *Anthers* incumbent. *Pistillum* none, a small 3-lobed gland occupies its place." Roxburgh.

I have no personal knowledge of this species: it appears to be allied to the succeeding, from which it differs by its fasciculate lanceolate pinnæ.

28. (18) C. *palustris*,* (n. sp.) aculeis petioli (pinniferi) faciei inferæ uncinatis, pinnis remote fasciculatis lineari-lanceolatis (long. pedalibus lat. 1¾ uncialibus) supra carinis 5 quarum centrali parce setosa, spadice decomposito parce aculeato, ramis attenuatis filiformibus, spathis primariis aculeis rectis inequalibus secondariis fere inermibus, spicis scorpioideis distantibus, corolla calycem triplo excedente.

Hab.—In watery places, Pular, Province Mergui, Tenasserim coast. Gathered in October 1834.

Descr.†—Dioicous, 6-7 feet high.

Petiole trigonal, under nearly flat face armed with solitary broad claw-shaped aculei which are ternate towards the apex and in the flagellus. *Pinnæ* distantly fasciculate, with or without solitary ones interspersed, linear-lanceolate with a tendency to be spathulate,

* I append to this section the two following species of Roxburgh, which may perhaps hereafter be identified by their vernacular names.

C. *extensus*. *R.*

Scandent. *Leaves* flagelliferous; *leaflets* alternate, remote, equi-distant, narrow-lanceolar. *Spines* in belts, slender. *Berries* spherical.

Deu-gullar the vernacular name in Silhet, where it is indigenous, and is of great extent, say two to three hundred yards; when cleaned toward the base, it is not thicker than a man's fore-finger, but as thick as the wrist towards the apex. The length of the joint is from six to twelve inches. Fl. Ind. 3. p. 777.

C. *quinquenervius*. *R.*

Scandent. *Leaves* flagelliferous; *leaflets* few, remote, equi-distant, lanceolar, five-nerved. *Spines* distinct, few, short and strong; *spadix* decompound.

Hurnur-gullar the vernacular name in Silhet, where this species is found, running over trees, to a great extent; the ratan when cleaned is about as thick as a man's finger throughout, and the joints from six to eight inches long. Fl. Ind. loc. cit.

† Specimens; apex of a leaf, and also of a male spadix.

twelve inches long, one and three-quarters broad, five-keeled above, with two lateral veins also slightly prominent; a few bristles occasionally on mid-keel; margins rough with appressed bristle-shaped teeth; apex mucronate-cuspidate, smooth or somewhat hispid.

Spadix two and a half feet long, nodding or curved, slender, and thinly branched, where exposed plano-convex, convex face armed with short aculei. *Spathes* 3-4 inches long with short half-ovate limbs, armed with scattered, irregular, straight or hooked aculei. *Branches* attached just opposite the ends of the spathes, about a span long, slender, slightly flexuose, their lowermost spathes empty. *Spikes* also inserted opposite the ends of their spathes, (which are lax, clavate, generally armed with a few minute prickles,) about an inch long, scorpioid.

Flowers suffulted by an amplectent scale-shaped bracte, with a short acute spreading limb, and by a short, obscurely three-toothed, rather large, oblong cup. *Calyx* short, stout, divided below the middle into three oblong, broad segments. *Corolla* three times

In evidence of the numbers of species of this genus, I may mention that I have just received from Malacca a very distinct species of this section with the name *Rotang Jarnang*, which is the true name of C. Draco.

This species is distinguishable at once by the very small numerous deciduous prickles of the sheaths, (the old sheaths are merely rough from their scars,) the margins of the mouths of which are lacerate-fibrous. The *petiole* below the pinnæ is about a span long, armed with rather distant, stout, somewhat curved prickles, marginal ones being also found here and there: at its junction with the sheath very gibbous and transversely puckered; also among the pinnæ short hooked prickles occur along the dorsum, being continued into the slender flagellus. *Pinnæ* alternate or distantly sub-opposite, linear-lanceolate, caudato-acuminate, 10-11 inches long, $6\frac{1}{2}$-7 lines broad, above 1-carinate, carina and a lateral vein on both sides bristly.

For this the name C. micracantha may be proposed.

Another species of the same section sent from Malacca, without any name, presents green sheaths, with very few slightly curved white prickles. Total length including flagellus four feet, of the pinniferous part twenty-one inches. *Petioles* pinniferous to the base, armed with a dorsal row of stout clawed prickles, which towards the apex become binate or ternate with scattered ones intermixed. *Pinnæ* alternating or fasciculate, lowermost with cartilaginous swollen insertions, and apparently deflexed, linear-lanceolate, 5-7 inches long, 5-7 lines broad, without bristles on either side or with a very few on the carina above, acuminate with bristly points, apparently glaucous underneath.

This appears quite distinct.

longer, divided nearly to the attenuate fleshy base into three oblong, ovate, erect, ascending segments. *Stamina* as usual united to corolla, above this very shortly monadelphous ; *filaments* (free) long, subulate, introflexed in æstivation ; *anthers* large, linear-oblong, attached above the middle. *Pollen* yellow. *Pistillum* rudimentary.

In the diffuse, slender, spadix, this species approaches somewhat to C. leptospadix, but otherwise is abundantly distinct. In its leaves, excepting the flagellus, it approaches nearest to C. floribundus, Mishmeensis, and latifolius.

Sect. II.—(PIPTOSPATHÆ).

29. (19) C. *verticillaris,* (n. sp.) aculeis vaginarum verticillatis, verticillis zonis vel ternatis, superioris spinis validis planis deflexis, inferiorum duarum setiformibus in annulum alte coalitis, petioli (flagelliferi) pinniferi aculeis subtus fasciculatis uncinatis, supra lineatis dentiformibus irregularibus, pinnis æquidistantibus linearibus (long. 12-13 uncialibus lat. uncialibus) supra carina setigera subtus venulis tribus setigeris, spadicis supra-decompositi erecti pedunculo inermi, spathis persistentioribus binis aculeis subulato-setiformibus armatis, floribus minutis numerosissimis.

Hab.—The interior of Malacca, it was brought to me with the name *Rotang Simote.*

Descr.*—Scandent. *Stem* with the sheaths about one inch and a half in diameter. *Sheaths* green, armed, generally at short intervals, with complete whorls of flat very sharp deflexed brown-pointed spines ; the spaces between the strong spines filled with minute bristles. Under each of the above whorls are two others of very

* Specimens ; an entire upper part of a male plant in flower : but with very few flowers remaining.

slender bristles united to each other high up so as to form a ring, these bristles, are firm and thorny, white below where united, above black. These two whorls have an ascending direction, and cross the whorl of deflexed stout spines. The spaces between the whorls generally choked with foreign bodies or occupied by ants. *Petioles* flagelliferous, part below the pinnæ $1\frac{1}{2}$-2 feet long, flattened, somewhat triangular, armed below with bands or lines (generally complete) of stout thorns, above of small bristles. In the pinniferous part, which is about six feet long, the under flattish face presents the usual clawed thorns, the upper angular face unequal incomplete bands of short tooth-shaped bristles confluent at the base. *Pinnæ* equidistant, generally regularly alternating, linear, about twelve or thirteen inches long, an inch broad, subulate-acuminate: above with a central bristle-bearing carina, below with three veins bearing bristles; margins rough with bristly teeth.

Spadix about two feet long, or more, erect, axillary, adhering as usual to the next sheath; about three inches from the axilla presenting two *spathes*, which are somewhat two-keeled, and not very concave, armed on the back by lines of stout bristly prickles: the uppermost spathe is rather the largest, about a span long; the sheaths are of considerable length, similarly armed. The peduncle itself is unarmed. *Branches* ascending, naked at the base, 4-6 inches long, much divided, divisions rather spreading suffulted by an inconspicuous short brownish spathe with a rather long lanceolate acute limb. *Spikes* very numerous, each scarcely more than an inch long, chesnut-red, each suffulted by a similar but smaller spathe.

Flowers very numerous, about thirty-five to each spike, (of which there are about twelve to the lower divisions of the lower branches,) very minute, exactly distichous. *Bractea* amplectent, with a short rather deflexed limb; cup nearly entire, shorter than the bractea. *Calyx* cup-shaped of the same texture as the cup, three times longer than it, obscurely three-toothed. *Corolla* (in bud) twice as long as the calyx, depressed at the summit, divided to the base into three oblong segments. *Stamina* 6. A large oblong rudiment of a *Pistillum*.*

* These parts in the specimen are generally destroyed by insects, and the calyx generally is also more persistent than the corolla.

This very remarkable species is evidently allied to C. mirabilis, Reinwdt.* to which indeed I should have referred it, had not Reinwardt described his plant as having the long peduncle of the pendulous spathe armed with distichous thorns.

The armature of the sheaths is very curious, and is well characterised by Martius.† It is almost equally distinct by its exceedingly numerous minute flowers, and the great degree of branching of the spadix.

30. (20) C. *Draco,*‡ aculeis vaginarum rectis seriatis petiolorum sparsis, pinnis æquidistantibus lineari-lanceolatis (long. 1½ pedalibus lat. 7-8 linealibus), spadicis decompositi erecti pedunculo aculeis seriatis armato, spathis coriaceis infima dorso seriebus crebris aculeorum intermediis secus centrum parce aculeatis summis inermibus, fructibus ovato-rotundis materie resinosa incrustatis.

C. Draco. *Willd. 2. p. 203. Syst. Veget. ed. Schultes. 7. pt. 2. p. 1323. Roxb. Fl. Ind. 3. p. 774. Martius. Palm. p.* 211. Palmijuncus Draco. *Rumph. Hb. Amb.* 5. *p.* 114. *t.* 58. *f.* 1.

Hab.—A native of Sumatra and the Malay Islands. Flowering time March and April. Roxburgh. Penang, Mr. Lewes. *Jarnang* of the Malays of Penang.

Descr.§—Young *spadices* imbricated with large coriaceous spathes whose margins towards the apex are recurved, almost woody in texture, outside they are ferruginous red, inside chesnut-red. The lowermost much armed with seriate very strong deflexed spines; those next to this are slightly armed along the middle of their backs, the upper ones almost unarmed. Peduncle much armed with stout seriate or fasciculate thorns.

* Mart. Palm. p. 213. † Loc. cit.

‡ Char. part. e Roxburghio.

§ Specimens of young, and of fruit bearing mature spadices.

Fruit bearing *spadix* nodding? nearly two feet long, without spathes, with two or three annular scars beneath that of the lowest branch; peduncle short, armed: branches several, spreading, upper ones simple, lowermost branched, naked at the base. *Spikes* short, stout, flexuose, a squamiform bracte and two annular bracteoles under each *fruit*.

These are ovate-round, on short, stout, stalks, surrounded at the base by the calyx, and the spreading or revolute linear-lanceolate petals, tipped at the point by the remains of the style. Scales with a narrow deep longitudinal furrow, naturally whitish, but incrusted with a rich blackish-red secretion, the best Dragon's Blood of commerce. *Seed* generally one, sometimes two, in which case they are nearly hemispherical. *Albumen* much ruminate. *Embryo* basilar.

I subjoin Roxburgh's description of this plant.

" *Trunk* while the plants are young, erect, and then resembling an elegant, slender palm tree, armed with innumerable dark coloured, flattened, elastic spines, often disposed in oblique rows, with their bases united. By age they become scandent, and overrun trees to a great extent. *Leaves* pinnate, their sheaths and petioles armed as above described. *Leaflets* single, alternate, ensiform, margins remotely armed with stiff, slender bristles, as are also the nerves; from twelve to eighteen inches long and about three quarters of an inch broad. *Spadix* of the *female hermaphrodite* inserted by means of a short armed petiole on the mouth of the sheath opposite to the leaf, oblong, decompound, resembling a common oblong panicle. *Spathes* several, one to each of the four or five primary ramifications of the spadix, lanceolate, leathery; all smooth except the exterior or lower one which is armed on the outside. *Calyx* of the female or rather *female hermaprodite*. *Perianth* turbinate, ribbed; *mouth* three-toothed, by the swelling of the germ it splits into three portions, and in this manner may be seen adhering with the corol to the ripe berries. *Corol* three-cleft; *divisions* ovate-lanceolate, twice as long as the calyx, permanent. *Filaments* six, very broad, and inserted into the base of the corol. *Anthers* filiform, and seemingly abortive. *Germ* above, oval. *Styles* short. *Stigma* three-cleft; *divisions* revolute, glandular on the inside. *Berry* round, pointed, of the size of a cherry."

The natural secretion of the fruit constitutes the best D'jurnang, or Dragon's Blood; a second and rather inferior kind is produced from the fruits, from which the natural secretion has been removed by heat and bruising. The third and most inferior appears to be the refuse of this last process. It is perhaps doubtful, whether this article is procured from this plant by incisions.

The above is taken from Rumph. who has a copious article on the subject.* Mr. Lewes informs me, that he long ago forwarded a full account of the preparation of this Dragon's Blood to Dr. Wallich; its true source not appearing to him to be generally known.

31. (21) C. *geniculatus,* (n. sp.) aculeis petioli (flagelliferi) pinniferi subtus uncinatis semi-verticillatis supra sparsis dentiformibus, pinnis æquidistantibus lineari-lanceolatis (long. 14-uncialibus lat. uncialibus) supra 1-carinatis (carina parce setosa) subtus venis 3 setigeris margine integerrimis, spadicis geniculati pedunculo bipedali compresso secus margines valide aculeato, spathis omnibus demum deciduis, fructibus rotundis rostratis (albis).

Hab.—Penang, Mr. Lewes. *Rotang Dodoor* of the Malays of that Island.

Descr.†—*Petiole* (of pinniferous portion) obtusely trigonal, underneath armed with hooked claws, upper angle here and there with small tooth shaped prickles. *Pinnæ* approximate, often sub-opposite, linear-lanceolate, 15-16 inches long, one broad, subulato-acuminate,

* Hb. Amb. V. p. 114.

† Specimens; the S. portions of a leaf and 3 spadices with immature fruits.

with 3 veins prominent on the upper surface; of these the central bears a few bristles towards the apex, under surface with two lateral veins bristly, and also the central towards the apex; margins except the point without bristles or teeth.

Spadix three feet long. *Peduncle* below the branches one foot and a half long, flattened, not two-edged, with scars of a row of stout marginal spines; above the branches unarmed, at the insertion of each branch swollen into knots. First scar of the spathes immediately under the lowest branch. *Branches* all naked at the base, lowermost a span long, angular, stout. *Spikes* spreading, suffulted by lanceolate acute scarious bractes, stout, flexuose, 2-3 inches long: some of them present subulate abortive branches.

Flowers subsessile at the flexures, suffulted by a scale-shaped annular bracte, and at the base surrounded by two annular alternating bracteoles, the inner of which is almost cup-shaped.

Fruit subglobose, cuspidate by base of the style, surrounded by the calyx, more or less split, and by the corolla much more split and tending to be lacerate; its segments oblong, twice as long as those of the calyx; scales large, pale, yellowish white with a narrow central furrow and dark brown margins with whitish edges. *Seed* one, (immature.)

This species comes very close to the succeeding, and there is a similarity in the Malayan name which is suspicious. Nevertheless I have little doubt of its being quite distinct, especially from the smooth margins of the leaves, a very unusual character, the flat, not two-edged peduncle armed strongly along the edges, the swollen nodes, the stout, rigid, very flexuose spikes, and the round fruit.

The spikes call to mind by their flexures the spikes of some Rottbotliaceous grasses.

32. (22) C. *longipes*, (n. sp.) aculeis vaginarum planis seriatis vel solitariis setis presertim versus margines interspersis, petioli (flagelliferi) infra pinnas paucis subulatis inequalibus, inter pinnas uncinatis solitariis, pinnis æquidistantibus lineari-lanceolatis (long. 14. uncialibus lat. uncialibus) supra venis tribus setigeris, spadicis decompositi elongati nutantis pedunculo bipedali ancipiti subinermi, spathis omnibus demum deciduis, fructibus oblongis styli basi cuspidatis basi calyce tantum circumcinctis.

Palmijuncus verus angustifolius. *Rumph. Hb. Amb.* 5. *p.* 105. *t.* 54. *fig.* 2. ?

Hab.—Malacca, C. Fernandez, sent with the name *Rotang* Dodow.

Descr.*—*Sheaths* very much armed with stout flat spines, broader than usual, with bristles often intermixed, those along the margins, which are very bristly, slenderer but not longer. The marginal ones of the base of petiole subulate-triangular, and rather longer than any of the others. *Petiole* at the base convex below, channelled broadly above, armed with long irregular spines, (which about a foot from the axil appear reduced to a marginal row of distant short straight teeth and another similar one along the centre of the lower face,) inclusive of flagellus about twelve feet long; pinniferous portion about seven feet; lower two feet naked, above the channelled part rather flat above, convex below. Between the pinnæ it is obtusely triangular, above unarmed, below armed with solitary distant short aculei. *Pinnæ* about fourteen inches long, about an inch broad, linear-lanceolate, subulato-acuminate, upper face with the central and two lateral veins sparingly bristly; under smooth; margins and apex bristly.

Spadix adhering to the next sheath as usual, throughout the lower two or two and half feet of its length naked, unarmed, or with a very few not very strong spines along the edges, compressed, distinctly two-edged, marked with the annulus of the first spathe, which suffults the lowest branch of the spadix; surface irregularly sprinkled with brown chaffy matter. Fruit bearing part a little more than eighteen inches long, rather compressed, but not two-edged. *Branches* several, angular, themselves much divided, the lowermost 4-5 inches apart: without suffulting spathes. *Spikes* varying in

* Specimen; apex of a fruit bearing plant, fully expanded leaf wanting.

length, lowermost of the lowest branches 4-5 inches long, spreading, angular.

Fruits on shortish stalks, uppermost of each spike nearly sessile, spreading, oblong-ovate, length six lines, breadth three and a half, attenuated into a short mammilla terminated by the base of the style, surrounded at the base by one envelope! divided below the middle into three oblong segments, between this and the fruit itself is a short cup variously lacerated, and outside at the apex of the stalk, two bractes, the outer one subannuliform. Scales whitish, cartilaginous, with pale margins, the central furrows deep, and consecutive.

Seed (immature,) oblong. *Albumen* ruminate.

This is probably the plant of Rumphius, quoted by most authors as C. verus; it resembles it in the length of the spadices, the want of a spathe when in fruit, the distance of the *annulus* or cicatrix of this from the axilla, and its suffulting the lowest branch of the inflorescence.

It is, as may be supposed, very closely allied to the C. platyacanthus of Martius,* from which however it differs in the very long two-edged peduncles of the spadix, the want of spathes when in fruit, in which points Martius's plant differs from that of Rumph.

It is the only one I have yet seen of this section in which all the spathes appear to be deciduous or in which the fruit is only surrounded by one envelope, the corolla being apparently for the most part deciduous. In this again it differs from Martius's plant.

From the preceding to which it is closely allied, it is known at once by the absence of the remarkable very long spines to the margins of the mouths of the sheaths, and by the spadix and fruits.

33. (23) C. *Hystrix*, (n. sp.) aculeis vaginarum seriatis vel sparsis marginum longissimis spithamæis vel pedalibus, petioli

* Palm. p. 206. t. 160 f. i. ii. iii.

(flagelliferi) infra pinnas valde inæqualibus sparsis patentissimis, inter pinnas subtus uncinatis supra minutis dentiformibus, pinnis æquidistantibus confertis linearibus (long. 16-uncialibus lat. 5-6 linealibus) supra carina et carinulis duabus setigeris, subtus venis 5 setosis, spadice decomposito erecto, spatha crebre armata spinis marginum apicem versus longissimis, spicis florum fæmineorum ascendenti-convergentibus fructuum patentibus, dentibus calycis villosis vel pennicillatis, fructibus oblongis albis.

HAB.—In forests. Ayer Punnus, Rhim; Province of Malacca. Malayan name *Rotang Sabote.*

DESCR.*—Climbing to a great extent, flagelliferous, diameter of stem towards the flowering part $1\frac{1}{4}$ inch. *Sheaths* swollen at the insertion of the petiole, armed with strong large flat spines, distinct, or in the usual incomplete verticils, those of the margins of the mouth of the sheath exceedingly long, a span or a foot in length, and proportionally broader at the base. *Petiole* $1\frac{1}{2}$ to $1\frac{3}{4}$ foot long in its lower naked part; where it is rather angular, and variously armed. The spines of the margin one inch long, subulate, the others aculeiform, while the upper flatter face has small thorny teeth. Pinniferous part 5-6 feet long, rather angular, armed above along the centre with short straight teeth, below with solitary hooked thorns. These are as usual continued into the *flagellus,* which is very long. *Pinnæ* very numerous, generally approximate in pairs, linear, subulato-acuminate, 16 inches long, 6 lines wide, under face with 5 bristle-bearing veins, the upper has the midvein carinate, one lateral one on either side sub-carinate, bearing bristles chiefly above the middle; margins bristly, ciliate; apex as usual hispid.

Spadix $2\frac{1}{2}$ feet long, (exserted 2 feet,) peduncle adhering to the next sheath, in the young state so imbricated with spathes as to be subulate; of these spathes the lowermost 4 are armed, the armature gradually diminishing from the base upwards. In flower it has one *spathe* near the axilla, boat-shaped, 4-5 inches long, flattish or nearly

* Specimens; entire specimens of plant with female flowers and fruit.

revolute at the apex, coriaceous, armed on the back with very strong broad spines, of which the uppermost along the margins are a good deal the longest, and awl-shaped from a flat base. *Branches* several, with the same ascending direction as the peduncle, naked at the base. *Spikes* 2-3 inches long, also ascending, slender, flexuose, ferrugineo-furfuraceous, suffulted at the base by an obscure squamiform bracte.

Flowers solitary on short stalks, occupying the flexures, stalk furnished with one minute bracteole! *Calyx* short, cupshaped, obsoletely three-toothed, teeth short, villous at the points. *Corolla* with a sub-globose base, twice as long as the calyx, divided to the middle; segments half-lanceolate, spreading. *Stamina* adhering to corolla to the base of its segments; *anthers* linear-sagittate, effete, on very short *filaments*. *Ovarium* ovate-roundish, covered with shortly ciliate scales, 3-celled at the base. *Style* divided to the base into three oblong-clavate segments, very lamellar, and papillose on the inner surface and sides.

Fruit bearing spadix with or without the spathe. *Spikes* spreading, very flexuose. Stalks of the fruit spreading. *Fruit* surrounded at the base by the persistent envelopes, elliptic, shortly mammillate at the apex. Scales large, cartilaginous, appearing to the naked eye to have two lines down the centre, margins cartilaginous. *Seed* 1, oblong, erect. *Tegument* dark-brown, with the usual resiniferous pits, rather thick in some parts. *Albumen* horny, deeply ruminate. *Embryo* basilar.

This species is closely allied to C. platyacanthos, Mart. from which, however, it is at once distinguishable by the enormously long spines of the margins of the mouths of the sheaths. The armature of the lowermost and most persistent spathe also differs in the analogous elongation of the spine of its apex. The teeth of the calyx are moreover tufted with hairs, and the fruit of the same period of development is oblong, not obovate as in the species alluded to. Martius also gives the spadices in his species as "pedes nonnullos longi."*

* Palm. loc. cit.

It appears to vary a good deal. I have specimens sent by E. Fernandez from Malacca, under the name *Rotang Pusaisur*, which is of smaller size, the spadix (with young fruit) not a foot in length, and the flowers with two bracteoles. But otherwise the plants are so much alike, and there appears to be so great a tendency to vary in the length of the spadices, that I have thought it better to unite the two, particularly as so little is yet known of the real value of the characters employed in the distinction of the species.

The female spikes in flower resemble a good deal the same parts of C. leptopus; and it is to be remarked that the lowermost spathe, though persistent for a long time, presents scarcely any sheath.

In the armature of the petioles it may be considered to approach in some degree to C. castaneus, the thorns in both being often or generally solitary, and very unequal in size.

Rumph's figure of Palmijuncus verus angustifolius* gives, with the exception of the want of the long spines, a good idea of this species in fruit.

Sect. III.—(PLATYSPATHÆ.)

Huic sectioni pertinet Katu-tsjurel, Rheede. Hort. Mal. 12. t. 65.† Roxburghio ad Calamum suum latifolium refertus.

34. (24) C. *leptopus*, (n. sp.) spinis vaginarum seriatis, petiolorum (flagellifer:) partis inferioris nudæ seriatis, aculeis partis pinniferæ uncinatis, pinnis æquidistantibus lineari-lanceolatis (long. 15-16-uncialibus lat. 12-13-linealibus) cirrhoso-acuminatis supra 1-carinatis sub-glabris subtus sæpius

* Herb. Amb. v. t. 54. f. 2. C. verus of most authors. C. platyacanthos. Mart. loc. cit.

† This species may be distinguished as C. (Platyspatha) *Rheedei*, petiolis spadicibusque aculeatis, pinnis distanter fasciculatis lineari-lanceolatis.

venis 3 setigeris, spadice nutante vel pendulo decomposito infra spathas spinis subulatis armato, spathis coriaceis infima spathiformi secus carinas duas armata reliquis planis inermibus, spicis ascendenti-convergentibus, floribus oblongis.

HAB.—Malacca. *Rotang Chinchin* of the Malays.

DESCR.*—Scandent ; diameter of the stem and sheaths about one inch. *Sheaths* about a span long, armed with fascicles of flat rather deflexed spines, shorter and stouter than usual; at the base of the petiole swollen transversely. *Petiole* in its lower naked part about two feet long, triangular, armed with similar and generally solitary but smaller spines, those of the margin subulate and slender : pinniferous part convex-trigonal, under convex-face armed with clawed prickles three or four together, upper unarmed or with smaller prickles. *Pinnæ* many, alternating, sometimes almost opposite, linear-lanceolate, 15-16 inches long, 12-13 lines broad, acuminated into a long cirrhose bristle, midvein prominent above and generally smooth, underneath with a few bristles, as have also two lateral veins : margins bristly especially towards the point.

Spadix (young) club-shaped, mature pendulous (?) ; peduncle about a foot long ; exserted part flattened, slender, about a span long, much armed chiefly along the edges with short stout spines in twos or threes ; alternately and distantly branched, each branch suffulted by a large leathery ascending *spathe ;* of these the outermost is spathiform, the margins revolute towards the apex, indistinctly bi-carinate, with stoutish solitary spines along the keels ; the rest flat, unarmed, about a span in length. *Branches* 2 or 3 times shorter than their spathes, nearly of the same direction with the spadix, with distichous slightly spreading ramifications. These (the *spikes*) are 1½-3 inches long, distinctly flexuose : bearing at each flexure a scale-like amplectent bracte, and one flower.

Flowers all pushed to the posticous side, on short stalks or nearly sessile, surrounded at the base by a short, somewhat 3-toothed cup,

* Specimens: apex of a flower bearing stem of a female plant.

outside which is on the posticous side a larger bracte, and on the anticous side a smaller one.

Calyx oblong-ovate, rather large, with three short stout acute teeth. *Corolla* in the part corresponding to the calyx ovate-ventricose, 3-partite a little below the middle (or to the calyx,) segments linear, acute, rather spreading. *Stamina* 6 ; *filaments* united to the corolla as far as the base of its segments : thence free, short, broad, subulate ending in bristles ; *anthers* deficient. *Ovarium* ovate-oblong, densely covered with shortly ciliate-scales, 3-celled. *Ovules* solitary. *Style* very short, stout, divided nearly to its base into 3 branches which are subulate, spreading or almost recurved, rather longer than the petals, with an elevated line along the centre of their backs ; inner face stigmatic.

This species differs from C. platyspathus* abundantly. The petioles (not the spadices) are prolonged into flagelli,

* C. *platyspathus :* scandens, aculeis vaginarum crebris subulatis rectis petioli rectis et reduncis, pinnis sparsis lineari-lanceolatis long. sub-pedalibus lat ; pollicaribus pluriveniis plicatis subtus ferrugineo-tomentosulis, spadicis aculeis rectis abortivis loriformibus, spathis subinermibus, spicis abbreviatis confertis.*

C. platyspathus, Mart. Palm. p. 210.

Hab.—Tavoy, Tennasserim Provinces. W. Gomez.

I subjoin Martius's character and description of this species :—

"*Calamus platyspathus : caudice scandente tenui ; frondibus ecirrosis ; pinnis sparsis, terminalibus distinctis lineari-lanceolatis plurinerviis plicatis, subtus ferrugineo-tomentosulis, aculeis vaginarum crebris subulatis rectis, petioli rhacheosque rectis et aduncis ; spadicis masculi decompositi julis abbreviatis confertis, aculeis rectis ; spathis (primum clausis, dein expansis ?) planis, subinermibus ; loris aculeatis.*

Species distinctissima. Pinnae spithamam ad pedem longae, medio ultra pollicem latae. Spadix sesquipedalis, laxus, rhachi inferne ancipiti superne teretiuscula. Rami florigeri masculi quadripollicares et sursum breviores, primum, uti videtur, spathis membranaceis omnino involuti, quae tandem explanatae, dorso nervis binis nunc passim aculeatis nunc inermibus sunt percursae. Juli cujusvis rhacheos partialis secundo-convergentes, continent flores 7-11 parvulos, pariter in unum idemque latus conversos, quasi uti in racemo scorpioideo. Calyx campanulatus, sinubus rotundatis in denticulos tres breves excisus pallidus. Corolla viridiflava, petalis lanceolatis."

* Char. e Martio.

the spines of the sheaths are distinctly seriate, the pinnæ neither plicate, nor tomentose underneath.

It comes close to the preceding section, its young spadices having a strong resemblance to those of C. Draco. The mature spadices again resemble to some extent those of C. Hystrix, and there is moreover a tendency in the spathes to be deciduous.

35. (25.) C. *Mastersianus*, (n. sp.) vaginarum spinis plano-subulatis sub-deflexis aculeis irregularibus interspersis, petioli partis nudæ dorsalibus et marginalibus aculeis interspersis, aculeis partis pinniferæ dorsalibus cum vel absque marginalibus, pinnis æquidistantibus linearibus (long. 13-uncialibus lat. 7-linealibus) cirrhoso-acuminatis, supra carina centrali et venula laterali utrinque setigera subtus vena centrali setulosa, spadice (flagellifero) aculeato masculo supra-decomposito, spathis planis coriaceis extus glaucis infima bicarinata secus carinas aculeata, spicis fæmineis distantibus patentibus, floribus conicis, corolla calyce paullo-longiore, fructibus pisiformibus cuspidato-rostratis (albidis), albumine subæquabili.

HAB.—Assam, No. 1201, of my Assam collections. *Soondee-bet* of the Assamese. The smallest *bet* of Assam; Major Jenkins.

DESCR.*—*Stem* with the sheaths about half an inch in diameter. *Sheaths* armed with stout flat spines, somewhat deflexed, concave underneath, arising from a large sub-conical base, among these, except perhaps towards the apex of the sheaths, occur smaller prickles very irregular in size. *Ligula* very large, coriaceous. *Petiole* a good deal swollen at its insertion; lower naked part $3\frac{1}{2}$-4 inches long, plano-convex, armed on the centre of the under face with a row of distant spines like those of the sheaths but smaller, along the margins with

* Complete specimens of the female plant in flower and fruit, and portion of a male spadix.

still smaller ones interspersed with small prickles. Pinniferous part (which is 3-4 feet long) armed with stout clawed prickles along the centre of the under face, a few others being added about the margins. *Pinnæ* equidistant, linear, about thirteen inches long, seven lines broad, cirhoso-acuminate, 1-carinate above; carina and a lateral vein on either side bristly towards the apex, midvein of the under surface with a few smaller bristles : margins rough with minute bristle teeth.

Male Spadix supra-decompound, more slender than the female; Branches a span long. *Spathes* more membranous, especially about the limbs. *Spikes* scarcely more than an inch long, slender, very flexuose, spreading or recurved, sometimes scorpioid, arising from a cartilaginous base opposite the ends of their spathes. *Bractea* with an acute spreading limb. *Cup* very shallow, almost wanting anticously, posticously broadly emarginate and sub-bicarinate.

Flowers oblong-ovate, exactly distichous. *Calyx* with a broad cartilaginous base, divided to the middle into three broad rather acute segments. *Corolla* about twice as long, in bud ovate-conical, divided almost to the attenuate base into three lanceolate-ovate segments. *Stamina* shortly monadelphous; *filaments* (free) subulate, about half the length of the petals; *anthers* ovate-sagittate, yellow. Rudiment of the *Pistillum* large, of three oblong bodies like abortive carpel leaves.

Female spadix 5-6 feet long, decompound, nodding. *Peduncle* adnate to the next sheath, plano-convex, armed on the convex face, chiefly along centre, with broad hooked prickles, along the edges with spreading subulate middling sized spines, the armature is continued above this in the shape of hooked prickles which gradually encroach on the surface of the peduncle, so that the apex has the whole surface armed. A linear, coriaceous, entire or split *spathe*, brown inside, whitish outside, at the base of each branch; the lowest about a foot long, bicarinate, carina armed except towards the apex with stoutish prickles, subulate from an oblique bulbous base. Remaining spathes diminishing in size gradually, all unarmed, sometimes split and lacerated, subsequently the tubular parts alone remain. *Branches* of the spadix longer a good deal than the internodes, bearing many filiform spreading, flexuose spikes, 2-4 inches in length, surrounded at the cartilaginous base by a whitish scale-shaped annular bracte.

Flowers distichous, rather distant, one at each flexure, of the shape of a sugar loaf, small, suffulted by a small annular scale-shaped bracte, and two minute bracteoles. *Calyx* oblong, conical, of a thick substance at the base, with three short sub-cordate mucronate teeth with whitish membranous margins. *Corolla* oblong-ovate, a little longer than the calyx, divided nearly to the middle; segments erect rather obtuse. *Stamina* 6; *filaments* not adnate to the corolla, united into a cup surrounding the lower part of the ovarium, (free) very short; *anthers* ovate-sagittate, effete. *Ovarium* oblong-obovate, smooth at the base, where it is 3-celled, otherwise covered with scales. *Style* (common) scarcely any, the branches revolute from the base, subulate, stigmatose inside. *Ovula* solitary.

Fruits very numerous, of the size of a pea, surrounded at the base by the perianth, beaked by the hard persistent base of the style. *Scales* very numerous, minute, whitish with fuscous margins and points, which are incised. *Seed* baccate, erect, roundish-placentiform. *Tegument* thin; pulp gelatinous, thick opposite the *chalaza*, and in a less degree on the opposite face. *Raphe* of two divergent whitish branches, terminating about the middle of the ventral face of the seed. *Albumen* cartilaginous, solid, surface slightly unequal; opposite the chalaza is a shallow foveola, and a smaller and shallower one on the opposite face: on a long section it appears pulley-shaped. *Embyo* basilar, conical.

This appears to be a very distinct species, especially in its inflorescence. It has considerable affinities with Calamus tenuis, especially in the female spikes and flowers. I have dedicated it to my friend Mr. Masters, who is now investigating the Flora of Assam with great success.

36. (26) C. *ramosissimus*, (n. sp.) spinis —— pinnis —— spadicis supra-decompositi inermis pedunculo infra spathas ancipiti sursum teretiusculo areolato, spathis (terminalibus) membranaceis scaphiformibus, spicis gracillimis, floribus (masculis) numerosissimis, corolla calyce oblongo breviter tridentato duplo fere longiore.

HAB.—Uncertain.

Descr.*—*Spadix* unarmed, about two feet in length; peduncle flat and two-edged; internodes long, compressed, not two-edged, pitted from pressure of the flowers in bud. *Branches* the length of the internodes of the spadix, lowest about nine inches long, spreading, extremely divided; largest *branchlets* of lowest panicle about four inches long. The uppermost *spathe* two inches long, membranous, acute, smooth, boat-shaped. *Spikes* about an inch long, very slender, very flexuose with a scale-shaped bracte at each flexure: rachis triangular. *Flowers* extremely numerous, suffulted by the above bracte, and surrounded by a very shallow, oblique, oblong-ovate, cup, emarginate behind. *Calyx* oblong, with three very short rounded teeth. *Corolla* not quite twice the length of the calyx, divided nearly to the base; segments oblong, rather obtuse. *Stamina* 6, united to the corolla as far as the base of its segments; *filaments* (free) long, subulate, flat; *anthers* (included) obtusely sagittate. Rudiments of the *Pistillum* very long, nearly equalling the stamina, composed of 3 subulate distinct bodies.

This species approaches closely to C. Jenkinsianus from which it appears to be distinguished by the comparatively long internodes of the spadix, the lowest being distinctly 2-edged, by the very slender spikes, the obsolete cup, and rather longer calyx. It is one of those which establishes some degree of affinity, at least in inflorescence, with certain Gramineæ. The male flowers, moreover, of this and many others are not altogether unlike the flowers of such grasses as *Oryza* and *Blepharochloa*.

Sect. IV.—(CYMBOSPATHÆ.)

Dæmonorops auctorum.

* *Gymnospathæ; spathis inermibus (semi-apertis et secundis.)*

37. (27) C. *nutantiflorus*, (n. sp.) spinis —, pinnis linearibus equidistantibus supra carina centrali et venis lateralibus

* Specimen: a male spadix (entire?) with very few flowers, and one terminal spathe.

duabus setigeris, spathis inermibus acuminatissimis secundis, pedunculo spadicis (masculi) supra-decompositi inermi, ramis nutantibus dense ferrugineo-furfuraceis, spatharum (secundariarum) laminis majusculis, calycis dentibus obtusis villoso-penicillatis quam corolla sub-duplo brevioribus.

Hab.—Assam, Major Jenkins.

Descr.*—*Petiole* in the pinniferous part armed with ternate prickles. *Pinnæ* equidistant, linear, about a foot long, five lines broad, upper surface with one central carina bearing small bristles, and a lateral vein on each side with long bristles; under surface smooth; margins with many appressed bristles.

Spadices about two feet long. *Peduncle* unarmed, apparently united to the neighbouring sheath, compressed, about three inches long to the first flower-bearing branch, below which it presents one annulate scar. *Spathes* all pushed as it were to one side, the lowest about eighteen inches long, one-keeled along the centre, all very much acuminated, and considerably longer than the spadix, (the tips about level-topped) coriaceous, striate, chesnut coloured internally, externally glaucescent, much flatter than in almost any other species of the section. Flower-bearing branches each suffulted by one of the above spathes, very much branched, 4-6 inches long, towards the time of expansion nodding and secund.

Spikes like the branches sprinkled with dark coloured tomentum, about an inch long, very flexuose with a single flower at each flexure.

Flowers distichous, sprinkled with tomentum. *Bracte* amplectent, with a short membranous limb, the margins more or less ciliate, and the apex often tufted. *Cup* bidentate, membranous, about three times shorter than the calyx: margins ciliate, and teeth tufted. *Calyx* oblong, very coriaceous and much striate, three-toothed; teeth obtuse, with tufts of brown wool. *Corolla* oblong, one-third longer than the calyx, divided almost to the base into three oblong obtuse segments. *Stamina* 6; *filaments* subulate, distinct, reddish; *anthers*

* Specimens: three male spadices, and a portion of a young leaf.

obtusely sagittate, about as long as the filament. A small 3-lobed rudiment of a *pistillum*.

This remarkable species, for which I am indebted to Major Jenkins, appears to be an intermediate form between the true Cymbospathæ and Platyspathæ; the majority of the characters being those of the former section.

It is closely allied to the succeeding, from which it is to be distinguished by the unarmed peduncle of the spadix, the unarmed spathes (the second one at least presents no spines,) the comparatively large limbs of the secondary spathes, and the nodding very scurfy branches. I take it to be one of the forms exhibiting a representation of Gramineæ, to some Andropogoneous forms of which it is at first sight not altogether unlike.

** *Acanthospathæ; spathis externis aculeis armatis.*

* *Scandentes. Petioli flagelliferi.*

38. (28) C. *Jenkinsianus,* (n. sp.) vaginarum spinis longis planis deflexis setis multis interspersis, petioli partis nudæ dorsalibus et marginalibus crebris mediocribus, partis pinniferæ inferioris marginalibus ventralibusque cum aculeis dorsalibus uncinatis, aculeis partis superioris ventralibus solitariis et dorsalibus palmatis, pinnis equidistantibus linearibus (long. bipedalibus lat. 6-7 linealibus) supra carina centrali et venis lateralibus 2 setigeris, vena media subtus parce setulosa, spadicis elongati decompositi pedunculo crebre armato, spathis sub-apertis extima subplana bicarinata dorso spinas graciles deflexas interdum fere setiformes gerente, rostro sub-triplo breviore.

Hab.—Assam. Major Jenkins.

Descr.*—*Stem* with the sheaths one inch and three quarters in diameter. *Sheaths* highly armed with long seriate flat brown

* Specimens; an entire upper part of a male plant in flower, and two or three female spadices in flower, (after fecundation.)

spines, broader, but less hard than usual, deflexed, except those of the margins which are ascending; rather long thorny bristles occur mixed with these or in distinct series. The edges of the larger spines irregular from adhering brownish tissue. *Petiole* transversely puckered at the base: naked part 5-6 inches long, armed on the back with stout deflexed brownish spines, solitary, or, as in the lowest, in short series; numerous shorter and rather stronger ascending ones along the margins, solitary or a few together.

These are continued into the pinniferous part, which is angular above, convex below, while the back of the same is armed with short strong conical claw-shaped prickles, which upwards appear reduced into a central series. *Flagellus* long, armed with the usual claw-shaped aculei. *Pinnæ* alternate, linear, the largest in the specimens nearly two feet long, 8-9 lines broad,* cirrhoso-acuminate, above with a central carina bearing bristles, and with a lateral one on either side with very long and often stout bristles; under surface with a bristle here and there on the midvein; margins rough with numerous appressed bristles. Young petiole covered with a brownish tomentum.

Male spadix 2-feet long, adnate to the contiguous sheath. *Peduncle* between the lowest spathe and the axilla about 2 inches long, very much armed with black spines; above the lowest spathe quite unarmed. *Spathes* open, level-topped ? not over-lapping, probably spreading, except perhaps the lowest, which is attached about 2 inches below the lowest branch. It is two feet long, linear-lanceolate, acuminate into a long beak, concave, scarcely boat-shaped, bicarinate on the back and armed with deflexed irregular rather slender blackish spines. The other spathes (one to each branch of the spadix) gradually diminish in size upwards, they are leathery or chartaceous, chesnut brown inside, glaucescent outside, unarmed except the second, which presents a few weak thorns along two obscure carinæ. Flower-bearing *branches* several, ascending, longer than the internodes, decompound, much shorter than their spathes, except perhaps the uppermost. *Spikes* flexuose, more or less covered with rust coloured scurf; the lowest of each branch 3-4 flowered, the upper about 2-flowered.

* The average size 14-16 inches long, 6-7 lines broad.

Flowers oblong, oblique, situated at the flexures, each suffulted by an amplectent ovate-acute generally ciliate bracte, and a cup with two pennicillate teeth next the axis. *Calyx* oblong, very striate, shortly 3-toothed; teeth with short tufts of ferruginous hairs. *Corolla* rather more than twice the length of the calyx, divided nearly to the base; segments oblong, concave. *Stamina* 6; *filaments* subulate, fleshy, red, united by their bases to each other and to the petals. *Anthers* not seen, nor the rudiment of the *Pistillum*.

Female spadix about the same length: the lower part of the peduncle, however, is longer, and the armature as well as that of the outer spathe more slender, bristly and white; the beak is also similarly armed. Flower-bearing *branches* flattened, so that the spikes are nearly bifarious. *Spikes* or more properly speaking racemes, 2-3 inches long, flexuose, also scurfy.

Flowers solitary at the flexures, the lowest on short stout stalks, the upper ones sessile. An amplectent acuminate blackish *bracte* (at the base of the stalk,) and two *bracteoles* to each flower: between the upper and larger, sometimes cup-shaped bracteole and that next it a gibbosity as though there should be another flower. Apex of the upper bracteole pennicillate. *Calyx* barrel-shaped with three obsolete teeth. *Corolla* rather more than twice as long, divided nearly to the base into three linear-lanceolate erect segments. *Stamina* 6; *filaments* united to the base of the corolla and each other into a cup, (free) short, very broad, without anthers. *Ovarium* roundish-oblong, covered with scales, 3-celled. *Ovules* solitary. *Style* stout, with three rather long stout sub-recurved branches, lamellar, and pappillose inside.

The young fruit bearing spadix unaltered; *fruits* (very immature) roundish, about the size of a large pea, surrounded at the base by the persistent perianth, beaked by the base of the style; scales numerous, fuscescent with pale irregular edges. *Seed* one.

This species is closely allied to the preceding, and to C. ramosissimus; it is also one of the forms shewing Dæmonorops not to be generically distinct from Calamus. Indeed this and the preceding species weaken greatly the distinctions between the two last sections, herein proposed, particularly if, as I suspect, the spathes of this species are spreading. The upper part of the spadix might almost be mistaken for the same part of C. ramosissimus, and only differs from the same part of the section Platyspathæ in the greater degree of contraction.

39. (29) C. *grandis*, (n. sp.) aculeis petiolorum dorsalibus uncinatis cum marginalibus (infra pinnas) inæqualibus interdum spiniformibus, pinnis glaucescentibus lineari-lanceolatis (long. 18-20 uncialibus lat. 1¼ uncialibus) supra 1-carinatis, vena media utrinque et margine cum vel absque setis, spathæ extimæ spinis planis latis deflexis, rostro æquante, calyce subintegro margine ciliato, fructibus globosis.

Hab.—Malacca. Sent by E. Fernandez under the names *Rotang Sumamboo*, and *Rotang Chry ?*

Descr.*—A stout Palm, diameter of the stem (including the sheaths) about two inches. *Sheaths* armed with broad, flat, generally very obliquely seriate, dark brown or black, spreading, unequal spines. *Leaves* 15-16 feet in length. *Petiole* swollen at its insertion, stout; in the lower two feet without pinnæ, plano-convex, armed along the centre of the convex face towards the base with a good many scattered rather deflexed small prickles; these upwards become hooked; along the margins they present a few broad flat short thorns pointing downwards, and within the margins a number of still shorter, generally solitary, ascending thorns; the pinniferous part, which is 6-9 feet long, armed below with strong hooked prickles generally in threes, these are continued into the *flagellus*. *Pinnæ* alternate, equidistant, of a whitish glaucous aspect, linear-lanceolate, 18-20 inches in length, one inch and a quarter in breadth, acuminate at the apex into a long awl-shaped point, 1-carinate above, without setæ on either face or along the margins, or with the midvein setigerous on both sides, as well as the margins.

* Specimen: an entire upper part of a male and female plant in flower, and several spadices in fruit.

Spadices axillary, erect, 14-15 inches long, including spathes; peduncles adhering to the next sheath, free scarcely an inch long, much armed towards the summit with short prickles. *Spathes* several, coriaceous, more or less boat-shaped, one to each branch of the spadix. The outermost largest, bicarinate, and with the second and third entirely enclosing the others, armed on the back, especially the outermost, with flat ascending brown spines, tapered at the point (especially the outer) into a long flat beak, which is armed towards the base with a few thorns. The inner ones generally unarmed, all more or less covered with rust-coloured scurf.

Male spadices 15-18 inches long, of which the beak forms one-half; branches decompound. *Spikes* short, scarcely exceeding half an inch in length, flexuose. *Cup* with the margins nearly entire, about three times shorter than the calyx. *Calyx* oblong, shortly 3-toothed, margins villous-ciliate. *Corolla* cylindric-oblong; *petals* three,* oblong, erect. *Stamina* 6; *filaments* blood coloured, lower halves united into a fleshy mass, (free) subulate; *anthers* oblong-sagittate. *Pollen* 1-3 plicate. Rudiment of the *Pistillum* deeply 3-lobed.

Female spadix very stout with the internodes swollen at the centre, and having a corky appearance, all sprinkled with rust-coloured scurf. Branches of the female spadix stout, ascending. *Spikes* short, stout, similarly scurfy, flexuose. *Flowers* on short stalks, the uppermost about sessile, with one bractea at the base, and two bracteoles, that close to the base of the flower almost cup-shaped, entire.†

Calyx barrel-shaped, almost entire, striate-veined; margin fringed with reddish cellular processes. *Corolla* about $\frac{1}{3}$ longer than the calyx, ventricose from the middle downwards, divided nearly to the base into 3 erect segments. Six rudimentary *stamina* line the lower half of the corolla. *Ovarium* oblong, three-celled, covered with scales, continued into a stout short cylindrical style, with three long, revolute, horn-shaped branches, stigmatose on the inner face, which is also longitudinally furrowed. *Ovula* solitary.

* The internode is long; the petals being distinct as far as the base of the rudimentary Pistillum.

† A niche exists between this and the back of the second, (which is sub-bicarinate) as though there should be another flower.

Fruits more exposed than the flowers, the spathes being gaping, and at length these falling off, quite exposed, surrounded at the base by the calyx and corolla, (the latter being generally split) terminated by the persistent base of style about the size and shape of a large marble; scales light tawny colour with white edges, central furrow narrow, on either side of which the scale is more than usually gibbous. *Seed* (immature) erect, the covering abounding with resin of a rich blood colour. *Albumen* horny-cartilaginous, very much ruminate. *Embryo* basilar.

This seems to me distinct from Dæmonorops melanochætes, Bl.* by the large leaves, the broad glaucous pinnæ the large spines of the outer spathes, and their beaks equalling or exceeding them in length.

40. (30) C. *intermedius*, (n. sp.) aculeis petiolorum dorsalibus uncinatis, spinis et aculeis marginalibus inæqualibus infra pinnas superadditis, pinnis lineari-lanceolatis (long. 15-uncialibus, lat. uncialibus) supra carina una cum vel absque setis et venis 2 lateralibus setigeris, subtus vena media setigera, spadicis pedunculo inermi, spathis externis spinis longis gracilibus deflexis armata, rostro longissimo.

Hab.—Malacca. Sent by E. Fernandez, with the name *Rotang Chrysa.* ?

* C. *Melanochætes*, spinis petioli dorsalibus lanceolato-subulatis aliis setiformibus marginalibus supra additis, pinnis æquidistantibus linearibus (long: subpedalibus lat. 3-4-linealibus) secus venam mediam et margines setoso-aculeolatis, spadicis pedunculo (infra spathas) spinis armato, spathis breviter rostratis extimis spinis parvis armatis.*

"Palmijuncus niger. *Rumph. Hb. Amb.* 5. *p.* 101. *t.* 52. Calamus niger, *Willd. Sp. Pl.* 2. *p.* 203. *Lam. Enc.* 6. *p.* 306." Dæmonorops melanochætes. *Bl. in Syst. Veg. ed. Schultes.* 7. *pt.* 2. *p.* 1333. *Mart. Palm. p.* 198. *t.* 117, 125. *f.* 1.

Hab.—Penang. Wallich.

The spathes in plate 125, the only one I have seen, are represented as partially open, in which respect it approaches C. nutantiflorus and Jenkinsianus. The pinnæ are said to be 3-4 feet long.

* Char. e Martio.

Descr.*—Stature much the same as that of the preceding. *Sheaths* armed with black seriate flat spines. *Petioles* transversely puckered at the base; naked portion (below the pinnæ) about a foot long, plano-convex, armed on the back towards the base with scattered prickles; about a span from this, it has on the back solitary, rather long deflexed spines, and along the margins some stout deflexed spines, and more numerous, slender, ascending ones inside these. Pinniferous part three and a half to four feet in length, angular with claw-shaped aculei along the lower convex surface. These are continued into the *flagellus*. *Pinnæ* rather distant, scattered, often opposite, linear-lanceolar, fifteen inches long, not exceeding one in breadth, subulato-acuminate, glaucescent ?, above with a central carina with or without bristles and two lateral veins bearing a few long bristles; midvein underneath bristle-bearing as also are the margins.

Spadix with an ovate body and a very long beak, twice as long as the body, the whole length being about eighteen inches. The peduncle unarmed; about an inch long in its free exserted part. Outer *spathe* bicarinate, covered with very long deflexed, slender, subulate brownish thorns, as is also the very long and stout beak. The second is thickly armed in a similar manner. The branches of the spadix flowers and fruit scarcely, if at all, distinguishable from the same parts of C. grandis.

This species is distinguishable with difficulty from the preceding. The stature appears to be smaller, and it presents lateral veins with bristles. The chief distinction however is in the armature of the spathes, the thorns of which are very slender, more deflexed, and much more numerous.

41. (31) C. *Lewisianus,* (n. sp.) aculeis petiolorum dorsalibus uncinatis, marginalibus (infra pinnas) inæqualibus conico-subulatis sæpius binatis vel ternatis superadditis, pinnis con-

* Specimens : an entire upper part of a female plant with young fruit.

fertis linearibus (long. 13-15 uncialibus lat. 5-6 linealibus) supra carina una et venis 2 setigeris subtus setis nullis, spathæ extimæ spinis planis subulatis gracilibus.

Hab.—Penang. Sent by Mr. Lewes, with the name *Kichum.*

Descr.*—Less stout than the preceding, the diameter of the stem, including the sheaths, being scarcely more than an inch. *Sheaths* armed with solitary or seriate, long, flat, black spines; margins revolute. *Petiole* much swollen at the base, there armed with scattered, deflexed shortish thorns; below the pinnæ about a foot long, plano-convex, armed along the back with a few solitary hooked prickles, along the margins with short, conical-subulate, solitary, binate or ternate thorns. In the pinniferous parts obtusely triangular, armed along the convex lower face with hooked and solitary prickles upwards, gradually becoming palmate. *Pinnæ* æquidistant, approximated, linear, 13-15 inches long, 5-6 lines broad, bristle-pointed, upper surface with one carina and a lateral vein on either side setigerous; under, smooth; margins rough, with appressed bristles.

Spadices oblong, including the beak of the outer spathe 6-9 inches long; peduncle below the spathes armed with flat spines. Outer *spathe* bicarinate, armed with rather weak, deflexed, long black spines, often so slender as to become bristly. Second spathe with about two rows of slender thorns; the rest unarmed.

The spadix is scarcely distinguishable from that of the preceding, but in the specimen the branches are more slender, and less scurfy.

This is extremely akin to the preceding species, the thorns however of the lower naked part of the petioles are different, those of the margins much shorter and fewer. The pinnæ also differ.

* Specimens: an entire upper part of a female plant.

42. (32) C. *angustifolius,** (n. sp.) spinis vaginarum paucis aculeis plurimis interspersis, aculeis petiolorum solitariis crebris sparsis, inter pinnas inferiores dorsalibus uncinatis ventralibus dentiformibus, pinnis confertis linearibus (long. 8-10 uncialibus lat. 3-4 linealibus) carina et venis 2 lateralibus utrinque setigeris, spathæ extimæ aculeis istis vaginarum similibus, rostro inermi dimidio breviore.

Hab.—Malacca Province. Malayan name, *Rotang Ghittah.*

Descr.†—A rather more slender species than the preceding. *Sheaths* thickly armed with unequal, short, flat, scattered, solitary thorns. *Leaves* 5-5½ feet in length. *Petiole* puckered transversely at the base; below the pinnæ 3-4 inches long, plano or concavo-convex, armed on both faces, especially the under, with scattered, unequal, short, straight or curved thorns; in the pinniferous part angular-convex, lower face with hooked palmate prickles, upper with scattered small straight prickles. *Pinnæ* equidistant, very numerous, very narrow, 8-10 inches long, 3-4 lines broad, tapered into a long bristle, upper face with one central carina, and two lateral carinulæ

* I am inclined to place near this a very distinct species of Calamus, lately received from my collector E. Fernandez, with the name *Rotang Pajare,* and which by it excessive armature and degree of fasciculation of the pinnæ, differs from all the others I have yet met with. The following is a description of it:—

Stem with the sheaths about an inch in diameter. *Sheaths* with very oblique mouths, excessively armed with the usual seriate thorns, of which some series are very large, others much smaller, some almost bristle-shaped. The larger ones deflexed; general colour of the older ones blackish from a whitish base. *Petiole* below the pinnæ about 2 feet long, much channelled towards the base, much armed with stout, straight, unequal thorns, of these the lowermost are like those of the sheaths, and exist on the ventral surface; above they are stout, subulate, but much shorter, and are confined to the dorsum and margins. In the pinniferous part they are hooked, and confined to the same part, towards the *flagellus* they become palmate. *Pinnæ* very numerous in large sub-opposite distant fascicles, linear-lanceolate, 1 foot long, 8-9 lines broad, acuminate, with 5 bristle-bearing carinæ above, underneath smooth, apex generally bristle-tufted. Length of leaf exclusive of the *flagellus* about 10-11 feet.

† Specimens: a complete upper part of a male plant in flower.

setigerous, under face with the same, or with the central only bearing a few bristles; margins bristly. *Spadix* (with the spathes) narrow oblong; peduncle rather slender, somewhat armed. Outer spathe with its beak, which is about half the length, about fourteen inches long, bicarinate, armed (except the beak) with thorns like those of the sheaths, the upper ones rather the longest. Beak quite flat with a tendency to become a cirrhus. Second spathe obsoletely bicarinate, with a very few small thorns about the middle of its back. Branches of the spadix pressed into a thick oblong mass; lower divisions decompound.

Spikes slender, an inch long, very flexuose, with a single flower at each flexure, sprinkled with rust-coloured scurf. A small amplectent *bracte*, and a *cup* to each flower. *Flowers* 8-10 to each spike, small, oblique. *Calyx* oblong-cylindric, three times longer than the cup, with three small teeth. Corolla 3-times as long as the calyx, divided nearly to the base into three erect segments. *Stamina* six; *filaments* united into a cup; *anthers* linear-sagittate. *Pollen* yellow. A rudiment of a *Pistillum* hidden in the cup of the filaments.

This is a very distinct species in all respects, as well by the armature of the sheaths and petioles and outer spathe, as by the narrow short pinnæ.

** *Erectæ. Petioli foliorum superiorum tantum flagelliferi.*

43. (33) C. *monticola*, (n. sp.) spinis vaginarum longis subulatis deflexis, petiolorum (superiorum) marginalibus inæqualibus et aculeis dorsalibus uncinatis, pinnis æquidistantibus linearibus (long. 10-18 uncialibus lat. 6-8 linealibus) supra carina et venis 2 lateralibus setigeris subtus glabris, spatha extima secus carinas duas spinis gracilibus deflexis armata.

Hab.—Subgregarious in thick Forests on Gonoong Miring, an off-set of Mt. Ophir, at an altitude of 1500—2000 feet.

DESCR.*—Erect, about eight feet in height. *Sheaths* armed with long deflexed flat subulate black thorns, disposed in lines but individually distinct; surface dark brown from adhering scurf. *Petioles* of the *upper leaves* gibbous at the base, lower naked part about ten inches long, concavo-convex, armed with a dorsal row of stout hooked prickles, and along the margins with long generally deflexed spines, and within these towards the base short ascending ones; these are extended into the flagellus; pinniferous part convex below and armed with hooked palmate prickles, which are continued into the flagellus, (which is about 1½ foot long;) above rounded-angular unarmed. *Pinnæ* alternate, equidistant, linear, 10-11 inches long, 6-lines broad, subulato-acuminate, above with the central carina and 2 lateral veins bristle bearing, underneath smooth, margins bristly. *Lower leaves* without flagelli. *Petiole* (of the pinniferous part) convex-trigonal, unarmed. *Pinnæ* alternate or often sub-opposite, linear, eighteen inches long, eight lines broad, otherwise like the others, except that the midvein below bears towards the apex numerous small bristles.

Spadix with its peduncle adhering to the next sheath, unarmed, covered with dark brown scurf. *Spathes* more open than in the others; outer one 16-17 inches long, bicarinate, armed between and along the carinæ with weak, long, subulate, deflexed, flat, black spines; the beak 9-10 inches long, erect, flat, sparingly armed except towards the apex, with long deflexed subulate bristles: its surface when young also covered with black scurf. Branches of the spadix 2-3 inches long, included, ascending, ferruginously scurfy. *Spikes* few flowered, stout, flexuose.

Flowers on short stalks or sessile, bracteate, inner bracteole cup-shaped, and between it and the outer bracteole a niche. *Calyx* sub-cylindrical, minutely 3-toothed. *Corolla* scarcely twice as long as the calyx, divided nearly to the base into three erect segments. Sterile *stamina* 6. *Ovarium* oblong, covered with denticulate scales: 3-celled. *Ovules* erect, solitary. *Style* three-partite nearly to the base; branches revolute, stigmatose internally.

Spathes of the fruit-bearing spadix opened out, or none. *Fruit* surrounded at the base by the flattened out, more or less split, pe-

* Specimens: complete upper part of a female plant in flower and fruit.

rianth globose, shortly cuspidate by the style, of the size of an ordinary marble; scales tawny with a dark brown intro-marginal line: longitudinal furrows as it were continuous. *Seed* (immature,) erect; tegument fleshy.

*** *Chætospathæ; spathis externis setis barbatis. Folia suprema (floralia ?) tantum flagellifera.*

44. (34) C. *calicarpus,* (n. sp.) scandens? petiolis infra pinnas pedalibus spinis marginalibus longis et aculeis dorsalibus armatis, intra pinnas aculeis dorsalibus palmatis, pinnis æquidistantibus linearibus (long. 12-13 uncialibus lat. 4-5 linearibus) supra carina 1 et venis 2 setigeris subtus vena centrali tantum setigera, calyce (fl: fæm:) oblongo-ovato breviter tridentato.

Hab.—Malacca, where the male appears to be known under the name *Rotang Chochoor Minia,* the female under that of *Rotang Chochoor.*

Descr.*—Scandent? Diameter of the *stem* (with the sheaths) about one inch. *Sheaths* covered with rust-coloured scurf, and highly armed with very numerous, long, ascending, rather slender, very unequal spines, generally disposed in series. *Petiole* below the pinnæ about a foot long, channelled convex, armed towards the base, where it is not gibbous or puckered, with spines like those of the sheaths; towards the pinnæ they become much fewer and are chiefly confined to the margin, those of the dorsum more or less aculeiform. In the pinniferous part which is 5½-6 feet long, the prickles are confined to the lower convex surface, are hooked and generally ternate or palmate; these are continued into the *flagellus. Pinnæ* equidistant, approximate, very numerous, linear, 12-13 inches long, 4-5 lines broad, distinctly acuminated into a long bristle: upper surface with the central carina and 2 lateral veins setigerous; under surface with more numerous smaller bristles along the mid-

* Specimens: entire upper parts of male and female plants in flower and fruit.

vein, the lateral veins with or without bristles ; margins with bristles. The leaves towards the apex of the stem small, with comparatively very long flagelli.

Spadices with compressed shortly exserted peduncles bearded along the edges. Male spadices much branched, varying in length, in some 15-16 inches long, in others also including the spathes scarcely 6, and then much more ovate. Outer *spathe* in the exposed part densely covered with grey-brown, bristly hairs an inch or 1½ inch long, these are continued up above the middle of the beak, the moderate apex of which is smooth. Second spathe bearded chiefly along the middle, as is also the third. *Spikes* flexuose, with some rust-coloured scurf, a single flower at each flexure, suffulted by a bracte and a cup.

Flowers as usual oblique. *Calyx* nearly cylindrical, 3 times longer than the cup, with three short teeth. *Corolla* divided almost to the base, not quite twice as long as the calyx. *Stamina* 6, united among each other and to the base of the corolla ; *filaments* subulate from a stout base ; *anthers* linear-sagittate. Rudiment of a *Pistillum* minute, tripartite.

Female spadices shorter, the upper ones not more than 4-6 inches long, branches generally simple. *Flowers* with 1 bractea and 2 bracteolæ, a callous looking space on one side between the lower and the uppermost almost cup-shaped bracteole. *Calyx* ovate, the teeth somewhat tufted at the points. *Corolla* 3-partite below the middle : ovate from the middle downwards, segments erect. Sterile *stamens* 6. *Ovarium* oblong-ovate, covered with scales, three-celled ; *ovula* solitary ; *style* stout, short with three long revolute inwardly stigmatic branches. *Fruit* exposed, globular, about the size of a large marble, mammillato-cuspidate, surrounded at the base by the persistent perianth ; scales tawny with a rather broad dark brown intromarginal line. *Seed* erect. *Albumen* deeply ruminate. *Embryo* basilar.

45. (35) C. *petiolaris,* (n. sp.) erectus, petiolorum parte nuda sub-7-pedali teretiuscula inferne spinis oblique seriatis armata superne aculeis dorsalibus uncinatis et marginalibus (paucis) dentiformibus vel omnino inermi, inter pinnas cum vel absque aculeis dorsalibus, pinnis confertis æquidistantibus linearibus (long. 15-17 uncialibus lat. 6-7 linealibus) supra

carina et venis 2 setigeris subtus vena centrali setulosa, cupula et calyce ovato-oblongo obsolete tridentato.

HAB.—Malacca.

I have two forms of this, which may hereafter be found to be distinct, particularly as the characters of this section of Calamus would seem to depend in a considerable degree on the armature of the petioles. I subjoin descriptions of both.

VAR. A. DESCR.*—Erect, armature of the *sheaths* the same as that of the preceding species. *Petioles* below the pinnæ very long, those of the apex of the stem alone produced into flagelli, of the pinniferous part about seven feet long, armed below the middle on the convex under face with rather small palmate hooked prickles. *Pinnæ* very numerous, approximate, linear, 15-17 inches long, 6-7 lines broad, acuminated into long bristles, upper surface with one carina bearing bristles towards the apex, and two lateral veins more bristly, under surface with many smaller bristles along the mid-vein; margins bristly.

Upper flagelliferous leaves and inflorescence exactly like that of small specimens of the preceding. *Spikes* very flexuose, ferruginously pubescent, one bractea and a cup to each flower. *Calyx* oblong with three minute teeth, sometimes ciliate. *Corolla* rather more than twice the length of the calyx, divided below the middle into three oblong segments. *Stamina* 6; *filaments* united to each other half way up, during flowering reflexed; *anthers* linear-oblong. A three-lobed rudiment of a *Pistillum.*

VAR. B. DESCR.†—Armature of the *sheaths* like that of C. calicarpus. *Petiole* 7 feet in length to the *lamina,* which is about 4½ feet long:

* Specimens: a leaf and male inflorescence.

† Specimens: an entire leaf and upper part of a male plant in flower.

Under the name Rotang Kertong, I have two specimens of a male spadix of what appears an additional species of this section of Calamus. In this the spadix with the spathes is oblong, 19-20 inches long, the outer spathe obscurely bi-carinate with two rows of ascending flat spines about the carinæ, tapering into a long straight stout beak, armed along the margins with very slender spines. The flowers resemble those of C. petiolaris.

the upper ones only extended into flagelli; below the pinnæ sub-cylindrical, armed in the lower 2 feet here and there with oblique nearly complete series of ascending short flat subulate thorns becoming gradually fewer upwards; 4 feet from the base quite unarmed; as it is also among the pinnæ, where it is convex below, angular or bifacial above. *Pinnæ* as in the preceding.

Inflorescence the same as in the preceding, but the *spadices* and the *spikes* are more tomentose, much longer, and the lowest spathe reaches to the axilla. *Flowers* much the same, but the *calyx* is cylindric-oblong with three acute teeth, the *cup* also has three acute teeth. *Corolla* divided nearly to the base, twice the length of the calyx.

PLECTOCOMIA.

Mart. et Blume in Syst. Veg. ed. Schultes. 7. *pt.* 2. *p.* 1333. *Mart. Palmæ. p.* 199. *t.* 114. 116, *f.* 1 *Endl. Gen. Pl. p.* 249. *No.* 1738.

Char. Gen.—*Spicæ* (vel racemi) filiformes (paniculatæ). *Flores* dioici, masculi bractea et bracteolis duabus (interdum obsoletis setiformibus) suffulti. *Stamina* 6. *Ovarium* squamis obtectum. *Fructus* exsuccus, 1-3-spermus, squamis retrorsis loricatum. *Albumen* æquabile. *Embryo* basilaris.

Habitus—Palmae *perennes, scandentes, habitu omnino Calami.* Petioli *in flagellos extensi.* Pedunculus spadicis *spathis imbricantibus omnino vestitus;* rami florigeri *caudiformes subfastigiati, secundi, penduli, spathis subdistichis persistentibus arcte imbricati.* Spicæ *in sinubus spatharum absconditæ.* Ovarium *squamis (ciliatis fimbriatisve apice laciniatis) tectum. Stylus* tripartitus, ramis subulatis. Fructus *globosi.*

Genus a Calamo inflorescentia praesertim distinguendum. Discrepat etiam bracteis bracteolisque setaceis, fructus squamis fimbriatis apice productis, (qua nota ad Zalaccas quasdam accedit,) et albumine omnino æquabili.

46. (1) P. *elongata*, pinnis lineari-lanceolatis (long. 2-3 pedalibus lat. 2-3 uncialibus), spathis (ramorum florig:) ambitu rotundatis, calycis cupuliformis dentibus brevibus mucronatis villoso-ciliatis, petalis oblongo-lanceolatis acutis, squamis (fructus) margine fimbriato-denticulatis.

P. elongata, *Mart. et Blume in Römer et Schultes Syst. Veget.* 7. *pt.* 2. *p.* 1333, *obs.* 2. *Martius. Palm. p.* 199. *t.* 114. 116. Calamus maximus. *Reinw. auct. Martii.*

Hab.—In forests near the sea-shore at Koondoor, Malacca, and generally perhaps in the interior. Malayan name *Rotang Oonar,* Rotang Dahown.*

Descr.—A gigantic climbing species, very striking when in fruit from the massive pendulous rich brown spadices. *Stem* in the lower part almost as thick as a man's leg. *Sheaths* of the leaves much armed, (especially along the margins of the mouth,) with stout spines of the usual characters. *Leaves* with the *flagelli* about 20 feet long. *Petiole* armed on the under face with fascicled subulate deflexed spines varying in number from two to four, these in the flagellus become more numerous, stronger and hooked prickles. *Pinnæ* distant, arched downwards, linear-lanceolate, tapering to both ends, very acuminate, the longest three feet in length, in breadth 2-3 inches coriaceous, pale-green above, glaucous below.

Spadix axillary. *Peduncle* covered with imbricate sheathing spathes, the limbs short, slightly spreading. From the axilla of each of these rises a long ($2\frac{1}{2}$ feet) pendulous tail-like branch imbricated with similar but smaller spathes. The branches are all secund. *Spathes* distichous, amplexicaul, nearly round, $1\frac{3}{4}$ inches broad, acute, coriaceous, brown, very concave: from the middle to the apex the outline is more angular.†

* *Oonar*, Mr. Westerhout informs me, is the Malay appellation for the flagelli of these Palms.

† Martius's figures represent the spathes of the male and female alike; in the female specimens before me though the flowers are open, the spathes are so closely imbricated and so concave that the branches are strictly subulate in form.

Spikes (or panicles) rather shorter than the spathes, slender, slightly furfuraceous, many flowered. Lower divisions 2-3 flowered, upper 1-flowered. *Flowers* of middling size, oblique, all pressed to one side if viewed anticously, if posticously distichous, suffulted by a short stout subulate bracteole. *Male; Calyx* striate, angular, cup-shaped, divided to the middle into three short oblong teeth, each ending in a stout mucro. *Corolla* three times longer than the calyx, 3-partite to the base; petals narrow-lanceolate, rather obtuse. *Stamina* six, almost entirely distinct from the corolla, the longest $\frac{1}{3}$ shorter than the corolla. *Filaments* long, towards the base triangular and red, above filiform, white. *Anthers* twice the length of the filaments, linear, attached a little below the middle. A rudiment of the *Pistillum.*

Female Spikes stouter, more ferruginous. *Flowers* fewer, larger, distichous, lower on short stalks, the upper sessile.

Calyx nearly round, with three teeth triangular in outline, mucronate as in the male, coriaceous, scarcely striate, margins of teeth villous. *Corolla* ventricose at the base, tripartite below the middle; segments oblong-lanceolate, acute. *Stamina* 6, united to corolla as far as the base of its segments; *filaments* subulate, flattened; *anthers* effete, much smaller than in the male flowers. *Ovary* roundish-ovate, covered with exceedingly numerous reflexed scales ciliate fimbriate, with long multifid points. *Ovula* three, erect, anatropous, so close as to leave some doubt whether septa exist. *Style* short, stout, divided nearly to the base, branches rather longer than the corolla, subulate, inner faces stigmatose and canaliculate.

Fruits crowded in the axillæ of the spathes, which are now more spread out and more indurated, generally 3-5 together, globular, about the size of a carbine bullet, surrounded at the base by the perianth; terminated by the remains of the very short style; very hispid, or ramentaceous (each scale terminating in a fimbriate ramentum;) incompletely 3-celled. *Seeds* (immature) 1-3, when three, convex-trigonal. *Albumen* solid.

This species is of inferior value to most others, and is chiefly used for making baskets.

47. (2) P. *Assamica,* (n. sp.) pinnis ——— spathis ——— calyce (fl. fæm.) ad medium tripartito laciniis cuneato-rotun-

datis, petalis e basi lineari acuminatissimis, fructibus globosis, squamarum apicibus longis persistentibus fimbriatissimis.

HAB.—Upper Assam.

DESCR.*—The specimens of the *spadix* are larger, the branches very ferruginous, 2-3½ feet long. *Spathes* 2½-3 inches long, shape not ascertained from their being much lacerated and split, and partly deficient.

Fruit (when dry,) of a rich ferruginous brown colour, 11-12 lines in diameter, surrounded at the base by a calyx of three ovate-oblong sepals and as many petals, which are very long and acuminate from a linear base, terminated by a style tripartite almost to the base with subulate connivent branches; one-celled, very villous from the highly ciliate, fimbriate, split, recurved points of the scales. *Seed* similar to that of the succeeding, but a little larger. *Albumen* cartilaginous, solid, its tissue radiating from the centre. *Embryo* basilar.

I have under the succeeding species noted the differences by which this appears to be distinguishable. The fruit is a good deal like that of P. elongata, judging from Martius' figure,† but the scales are so fimbriate, that it has quite a woolly appearance.

48. (3) P. *Khasiyana,* (n. sp.) pinnis ———— spathis obovatis apicem versus obcuneatis, sepalis (fl. fæm.) sub-distinctis planis glabris, petalis e basi lanceolata acuminatis, fructibus rostrato-cuspidatis, squamarum fimbriatarum apicibus deciduis.

HAB.—Khasiya Hills.

* Specimens of a spadix in fruit marked by Dr. Wallich as "Zalacca, specimens received from Major Jenkins, March 1840, from Upper Assam."

† Palmæ. loc. cit.

Descr.*—*Spathes* of the peduncle with erect oblong-lanceolate limbs. Flower-bearing branches 1-2 feet long, secund, pendulous. *Spathes* at base half amplectent, rather distant, distichous, laxly imbricated; outline obovate, towards the apex broadly obcuneate, margins below this part incurved, (so that they are very concave,) two or three times longer than the spaces between them. *Spikes* concealed by the spathes, two or three times shorter than them, as usual furfuraceous, 3-7 flowered.

Flowers distichous, large. *Calyx* flat, small, divided almost to the base into three triangular mucronate smooth teeth. *Corolla* divided almost to the base into three ascending, lanceolate, acuminate segments, four to four and a half lines long. *Stamina* six, with very broad, flattened, short filaments, and small effete anthers. *Ovarium* broadly globose, covered with exceedingly numerous, shortish, very fimbriate scales with multifid points, 3-celled. *Style* very short, stout, with three stout, subulate, spreading branches as long as the petals, channelled and stigmatic on their inner faces.

Spathes of the fruit-bearing spadices spreading, rarely perfect, generally much lacerated or deficient. *Fruit* surrounded at the base by the calyx, and corolla now flattened out, apex attenuated into the style; rostrato-apiculate, otherwise round, about one inch in diameter, dark brown; scales very numerous, rather small, either nearly smooth, or with ciliate margins and recurved split fimbriate points; when not much rubbed it has a woolly appearance. *Seed* covered with a rather thick, brown, cellular spongy substance. *Albumen* solid, horny, of cells radiating from the centre. *Embryo* of the ordinary shape, basilar.

This would appear nearly allied to the preceding from which it differs in the smaller spathes, the very small calyx with minute triangular teeth, the broader petals, the brown, not rust-coloured fruit, which is smaller, and not by any means so villous, the points of the scales being less fimbriate and often deciduous.

* Specimens of a female spadix in flower, and part of a spadix in fruit; the latter found among the collections here, without any note of its locality.

49. (4) P. *Himalayana*, (n. sp.) pinnis lineari-lanceolatis (long. $1\frac{1}{2}$ pedalibus lat. $1\frac{3}{4}$ uncialibus) 5-veniis, spathis cuneato-oblongis apicem versus late obcuneatis, floribus masculis setis tribus suffultis, calycis ultra medium tripartiti cupuliformis laciniis glabris in setam desinentibus.

Hab.—Sub-Himalayan ranges about Darjeling; Collectors sent from the Saharunpore Garden.

Descr.*—Pinniferous part of the *petiole* armed below with stout hooked prickles, confluent at the base, these are continued increased in number into the flagellus. *Pinnæ* alternate, linear-lanceolate, very acuminate, 18 inches long, $1\frac{3}{4}$ broad, with 5 veins prominent on the upper surface, margins with short sub-appressed spinescent teeth; from the great degree of conduplication of the base the pinnæ may almost be said to be petioled.

Branches of the *spadix* about two feet long, covered with rust-coloured tomentum. *Spathes* almost stem-clasping, conduplicate, coriaceo-scarious, apex decidedly obcuneate in outline; they exceed in length by $\frac{1}{4}$ the inter-spathal spaces. *Spikes* solitary, about $\frac{1}{2}$ as long as the spathes, angular, flexuose, densely rusty-tomentose.

Flowers suffulted by three narrow bristle-pointed scarious bractes, sub-distichous. *Calyx* cup-shaped with three short rounded teeth ending in bristles. *Corolla* oblong and oblique, 4-5 times longer than the calyx; petals hard. *Stamina* 6, united at the base into a short cup; *filaments* stoutish, subulate; *anthers* large, linear-oblong, obtusely sagittate. No rudiment of a female?

This may be the male of the preceding, but the appearance of the spathes, which are generally much the same in both sexes, and their shape, which is cuneate-oblong with straight edges in the oblong parts, and concave edges in the obcuneate part has induced me to attempt to characterise it as distinct. I may also remark that the plants of

* Specimens consist of a portion of a leaf and male spadix.

the Khasiya Hills are generally distinct from those of the Himalayas.

From P. elongata it differs essentially in the shape of the spathes, in that of the calyx as well as in the smoothness of its margins, and perhaps in the flowers being tribracteolate.

EUGEISSONA.

CHAR. GEN.—*Inflorescentia* terminalis, paniculata. *Flores* dioici, terminales, (solitarii.) *Stamina* indefinita. *Ovarium* squamis obtectum. *Fructus* exsuccus, 1—spermus. *Albumen* cartilagineo-corneum, sulcis sex exaratum. *Embryo* basilaris.

HAB.—Palma *caespitosa, sub-acaulis.* Folia *pinnata;* vaginae, *et* petioli *infra pinnas spinis plano-subulatis armati;* pinnæ *lineares, vena centrali cujusque paginae setigera.* Paniculæ 4-6-*pedales, erectae, aspectu triste brunnescentes, spathis arctis undique imbricatæ.* Spathae *primariae dorso spinosæ apice in flagellum rostrumve attenuatæ; secundariæ muticæ secus carinam dorsalem parce spinosæ; tertiariæ inermes.* Flores *bracteis pluribus arcte imbricantibus semi-immersi, maximi.* Calyx *membranaceo-chartaceus, trifidus.* Corolla *tripetala, petalis sub-linearibus longis spinoso-cuspidatis, floris foeminei infra medium carinam* (*stamina abortiva*) *apice pennicillatam exhibentibus.* Antherae *lineares, adnatæ.* Styli *tres, intus stigmatosi.* Ovula *solitaria, anatropa.* Fructus *ovatus, rostrato-mammillatus, ovi gallini magnitudine, brunneus. Semen erectum exsuccum.*

50. (1) E. triste.

HAB.—In forests on the Hills about Ching, Malacca, very common. Common in Penang. Mr. Lewes. Malayan name, *Bertam.*

Descr.—A stemless Palm growing in thick tufts, which are surrounded by the debris of the old leaves. *Leaves* numerous, the outer ones spreading, fifteen-twenty feet in length. *Petiole* throughout the lower 7-10 feet, roundish, armed with brown, ascending, flat spines, between the pinnæ unarmed, triangular. *Lamina* in outline oblong-linear : *pinnæ* two or two and a half feet long, narrow, scarcely an inch wide, subulate acuminate, margins when dry much involute, the central vein prominent above, and furnished with distant setæ ; the old ones generally irregularly split at the point.

Inflorescence terminal, paniculate. *Panicles* four-six feet long, in the lower part furnished with a few small leaves, the sheaths of which are much armed, gradually passing into the *spathes,* which are similarly armed and very acuminate, indeed often flagelliferous.

Branches of the panicle flexuose, much imbricated with coriaceous, amplexicaul, brown bractes or spathes, slightly armed along the dorsal carina, or (as the uppermost) unarmed. The lower branches two-three flowered, the upper one-flowered.

Flowers dioicous, terminal, subsessile, very large, surrounded at the base by similar but smaller highly imbricate bractes.

Male Calyx sub-cylindrical, altogether concealed by the bractes, membranaceo-chartaceous, trifid, teeth narrow, acute, with broad sinuses, venation the same as that of the innermost bracteæ. *Corolla* 3-petalled, exceedingly long, (about one and a half inch in length) ; *petals* oblong-linear, somewhat constricted opposite the throat of the calyx, indurated, striated, obliquely ascending, point oblique ending in a very sharp thorny acumen. *Stamina* indefinite ; *filaments* short ; *anthers* long, linear, adnate, of a lilac colour. No rudiment of a female observed.

Female flowers rather longer than the male, otherwise similar. The petals opposite the mouth or opening of the calyx bear a tuft or pennicillus of abortive stamens, which runs down the petal in the shape of a keel.

Ovarium oblong, covered densely with scales, of about the same length as the calyx, sub-trigonal at the apex, 3-celled. *Ovula* solitary, oblong, erect, anatropous. *Styles* three, oblong, flattish, sub-connivent, stigmatose on their inner faces. *Fruit* densely scaly, generally rough from the recurved points of the scales, dark brown, ovate with a stout rostrum or point, terminated by the remains of the styles, surrounded at the base by the now divergent petals often thrown to one side, 1-celled, 1-seeded. Substance very thick at the base, consisting of rust-coloured spongy tissue interspersed with fibres, above thin consisting of fibres alone. *Scales* rough to the touch, lanceolate, with irregular margins, dark brown with paler edges. *Seed* large, covered with a brown membranaceo-cellular covering, surface with six furrows, of which the alternate ones are the largest and most complete, running into each other at both ends. These furrows are filled with the tissue surrounding the seed. *Albumen* equal, horny, cartilaginous, presenting on a transverse section the furrows above-mentioned. *Embryo* basilar.

The leaves of this are I am told applied occasionally to the same purposes as those of Nipa fruticans.

It appears to constitute a distinct genus by its inflorescence, which is scarcely clearly explainable by the use of the terms ordinarily used in descriptions of Palms, by its indefinite stamina and the structure of the seed. No Indian genus of this sub-family, so far as I know, has more than six stamens: and the only approach to this genus in this respect takes place in Ruffia, which genus also has linear oblong cuspidate petals.

(To be continued.)

On the Manufacture of Bar Iron in India. By Captain J. Campbell, *Assistant Surveyor General, Madras Establishment.*

No. 2.

1. In my former paper on this subject, I recommended an investigation of the principles of the simple, and long practised Native method of smelting iron, on the principle, that as excellent iron is sometimes the result of their operations, the same must always be produced if the process admitted of proper regulation. From my increased experience on

this subject, I am now able to state, that the Native process is based upon the most correct scientific principles, and that the operation admits of being regulated with the most exact minuteness.

2. Scientific men in India, where fuel and labour are so cheap, will find the investigation, although difficult, laborious and very complicated, yet both interesting and gratifying, from the surprising and unexpected results which will be met with. Among these, which are not I believe known in Europe, I have found that the products of combustion in blast furnaces is neither carbonic acid, nor corbonic oxide, but a compound, containing I believe, nitrogen, as may be inferred from its very noxious qualities, it being capable of rendering a man insensible for several hours, when freely inhaled; and from the fact, that cyanide of potassium was found by Dr. Clark to be an occasional result in the English blast furnaces, I find also, that cast iron contains a gas, and that oxide of iron enters into its composition.

3. I recommend this subject more particularly to the attention of scientific men in India, because I conceive that among the better qualified scientific of Europe, few are likely to undertake the matter in a proper way, so as to produce results valuable in practice. Men of wealth will naturally prefer giving their attention to more seductive researches, and none but the wealthy could bear the requisite expense, where charcoal sells for 40 rupees a ton.

4. I have been surprised to find how much prejudice prevails among Europeans in India, regarding the quality of the iron produced by the Natives, and how little attention has been given by any one to see if it is fit for use, and if it can be used cheaper than English iron. I may ask if those who have thought upon the subject, suppose that the Natives of India are such fools as to continue to prefer the use of their own iron, while they could buy cheaper

English iron; if it was fit for the purposes for which they require it. Is it not known that gram kettles, sugar boilers, and pans for Percottahs are manufactured in large quantities by the Natives from their own iron; while every workman knows, that the most superior iron is required for these purposes, and that to make the same quality practically termed, "boiler plate," in England, it is necessary to go to the expense of using wood charcoal in the refining process. Is it not known that 18,000 pagodas worth of Native iron are yearly carried from the district of Nuggar, in Mysore, on the Sea Coast, to Mangalore, and is it supposed that this trade could be profitable if really good English iron of equal quality was procurable at the Sea Coast? Even at Bombay the Native iron is so highly valued for boiler rivets, &c. that almost any price would be given for it, if a sufficient supply could be obtained, and yet I am told that the Native iron is "bad bar iron;" that it is "excessively red short;" that it is "intractable under the hammer;" "that it is still to be proved that good malleable iron can be made from the Indian ores;" "that the Indian ores contain nickel, titanium, &c. the proper mode of separating which has not been discovered;" "that the proper flux for the Indian ore has not yet been discovered;" and other nonsense of the same kind.

5. It is possible that some persons may have been deceived by the Natives, who know perfectly by the appearance of the slags the soft iron from the hard and steely; and they preserve the former for their own use, and for those who deal regularly with them, and sell the latter to those who make occasional applications to them. But the greatest difficulty which a scientific enquirer has to overcome, is to avoid deceiving himself, in taking for granted imperfect results, without guarding against the causes of error.

6. It is not easy to say, what would be the best method of introducing into India the manufacture of bar iron; for if

an iron work was set up in the interior, it must necessarily be upon a small scale; and if on a large scale near the sea shore, it would be some time before the superior quality of its products could bear down the opposition from the cheap, but bad iron made in the English manufactories.

7. In my last paper I remarked, that I thought it improbable that European capitalists would be able to make an iron work profitable in India; but I then supposed that the scale of the Native process might be much increased, and still worked with the same ease as the small furnaces; but I have now found that the problem is so complicated, and such nice regulation of all the principles is so absolutely requisite, that it is necessary to use clock-work to regulate the blast; and altogether, no idea of the mode of action could be formed, even if a furnace was examined while at work.

8. It is not probable that "high blast" furnaces can be set to work with any chance of a profitable return in India, because the quantity of iron they produce—about 50 tons a-week—is too large to meet with a ready sale. In consequence of which, the capital sunk, before any returns came in, would be enormous; also the quantity of fuel they require—at least 100 tons a-week—would be difficult to procure, and would soon exhaust the thickest forest in the vicinity of a furnace of this kind.*

9. Even an experienced practical man would find great difficulty in setting to work in India a "high blast" furnace, from the total want of any information regarding the true theories upon which the operation of these furnaces de-

* We have forests enough, and purposes enough in India for the employment of several such furnaces, provided the subject of internal improvement were once fairly taken up. We can do nothing however without cheap iron; and for this reason, we think Capt. Campbell would be profitably employed upon any terms. He should follow out his experiments, and make as much iron as he can. The result will be highly advantageous to the country.—Eds.

pends; for some think, that cast iron is the first product from the ore, and others have published all kinds of wild conjectures on the subject.

10. Mushet found no difficulty in managing the Indian ores in his experiments in the Tintern Abbey charcoal furnaces, but the blowing engine of this furnace had been already properly regulated, and it is probable that Mr. Heath failed in repeating the experiment in India from the want of a practical man to regulate the blast from the newly-erected engine; and it is probable, that a similar difficulty has been found in the experiments with coal, recommended by the Coal Committee of Calcutta.*

11. Even supposing that the coal of Bengal could be brought into use in "high blast" furnaces, yet as the coal and iron ore are as dear as the English, the iron would cost the same price, and would not be better in quality. The cheapest English iron costs at Madras about 80 rupees per ton; but it will hardly stand punching a hole in it, and cannot be worked into any shape where bending is requisite, for it breaks like a carrot when bent hot, beyond a right angle. Even iron which sells in England at from 13£ to 15£ a ton, and at Madras costs retail 160 rupees a ton, cannot be made into horse-shoenails, because it splits open while being worked to a point.

12. Where charcoal is used for refining cast iron, as in making boiler plate and tin plate, the method becomes similar to the French or continental mode of operation, and the expense of the iron which could be made in this manner in India, may be computed from the minute details given by Dr. Ure: 175½ pounds of charcoal and 287 pounds of ore give 135 pounds of cast iron, from which 100 of bar iron are obtained; 149 pounds more of charcoal having been used in the refining forge: thus for every 100 pounds of

* These experiments have not yet been commenced. Captain Campbell could evidently do more single handed than is to be expected from any Committee.

bar iron, 324½ pounds of charcoal and 287 pounds of ore are used, and taking the value of charcoal at 2 annas for 100 pounds, and the ore at 24½ pounds for 1 anna, which is above the price in Southern India, we have 25 rupees a ton for bar iron; but in this the expense of labour for blowing and charging the furnace, and of the labour at the refining hearth and the forge hammer, are not included. However, the French furnaces are also too large, and their produce too great for an infant manufacture.

13. Furnaces in which the ores of iron are reduced at one operation to the malleable state, are called in England "bloomery furnaces." Of these three kinds are known; viz. the simple furnace of the Natives of India; the Catalan forge; and the German *steuch often.* I have stated in my former paper, on the authority of Porter's Chemistry of the Arts, that cast iron was generally made in these furnaces, but of this I have some doubt, and as I know from experience, that such furnaces can be advantageously used for making blooms of malleable iron, I shall consider them as belonging to this class.

14. Bloomery furnaces present the advantage of being able to make any quantity of iron which may be required, with a very trifling outlay of capital. In the little Native furnaces, a few pounds is the result, and in the *steuch often* nearly a ton. The quality of the iron is also much superior to what can be made from cast iron, and I have reason to believe, that all the Danemora Swedish steel iron is made with these furnaces.

15. Bloomery furnaces are without doubt the best adapted kind to an infant manufacture, and were used all over England before the wood fuel began to be scarce; and into India, the use of them on a large scale, might be successfully introduced, but the art of using them has been lost in England. Brongniart has spoken favorably of the Catalan forge, but as the persons who manage them are merely prac-

tical men, who know nothing of the principles of the operation, it would not be easy to establish such furnaces in India: although Mushet states, that they are used in America, expending 10 tons of charcoal to make a ton of bar iron.

16. Of the true principles of the action of bloomery furnaces, nothing whatever seems to be known in Europe; Mushet appearing to think, that the primary produce is cast iron, which becomes refined afterwards by the blast. Dr. Ure seems to entertain the same opinion, but under the article ores in his Dictionary of Manufactures, he has recorded a suggestion, pointing to the correct theory. Berthier (Traite Désessairs par le voie seche,) has also alluded to the correct theory, but has been misled by a fallacious experiment there stated. Thenard (Traité de Chimie) remarks with the acuteness of a philosopher, "on sait que ioxide de fer se réduit au degré du rouge maissant par le gas hydrogène 'carboné et par le carboné; on sait également que la fonte ne se forme dans les hauts fourmeaux quá un très haut degré de chaleur: il suit de lá quelón doit pouvoir extraire le fer de certain minerais, sans être obligé de le transformer on founte;" and as he correctly remarks, this is the principle upon which the Catalan forges, and in fact all bloomery furnaces, work. Hardly half the quantity of charcoal is required which is necessary for making cast iron, and a bloomery furnace properly managed, will even bear a charge of ore of double the weight of the charcoal; which is a larger charge than has ever been used in a high blast furnace, either with cold or hot blast. Mushet has published a paper upon the "Manufacture of malleable iron directly from the ore," but it does not appear, that he knew the principle of his method was that upon which bloomery furnaces act, and he was therefore unable to make the blooms cheaper than cast iron. He states, that although the iron produced was of the finest quality, yet that he found from 24 cwt. to

25 cwt. were required to make a ton of bar iron, and that therefore nothing was gained, as the same could be done by refining and puddling cast iron.

17. The expense of bar iron made in the Native bloomeries is about 90 rupees a ton, and I have made an error in my former estimate, by not making a proper allowance for the waste in forging. It is certain, however, that from the number of men required to work them, the Natives do not earn two annas a day, because they gladly accept that payment for working as common labourers.

18. The Native bloomeries, from their small size, might be called portable furnaces, as they might be carried and worked with advantage in a waggon in the train of an army; and if the method of working them had been known at Jellalabad, they might have been the means of furnishing our beleaguered forces with the iron they required so much for tools.

19. For the expenses of the German "*steuch often,*" as given in Porter's Chemistry of the Arts: supposing the rough lump to be a "bloom weighing 15 cwt.; and supposing this to yield when forged into bar iron 7½ cwt., and supposing that the produce is only 25 per cent. of the ore, then 30 cwt. of ore will be required, which at 24½ pounds for 1 anna, will be 8½ rupees. As about 400 pounds of charcoal are used to make 100 pounds of bar iron, about 30 cwt. of charcoal would be used; and at 100 pounds for 2 annas, this will cost about 4½ rupees; and supposing 8 men for a whole day are required to work the furnace, the labour at 2 annas a day will cost 1 rupee; or 14 rupees for 7½ cwt.; or about 36 rupees a ton for finished bar iron; and as the iron made in these furnaces is of the finest quality, there can be no doubt that they are well suited for introducing the manufacture into India. Although the product of the furnace from the ore is seldom above 35 per cent., yet the produce is really not less than in high blast furnaces,

because in them a portion of the product of the operation unites with the iron formed to make cast iron, which is again separated in the refining furnace in the form of "finery cinder." Besides, what are called the slags of bloomery furnaces are pure silicates of iron, or else pure fused oxide, according as the ore is silicious or not, and is fit for again smelting into cast iron in the high blast furnace, so that no loss really has taken place.

20. The largest furnaces which I have yet tried are very much smaller than the "*steuch often,*" yet from being better managed, expense is much the same—about 35 rupees a ton on the bar iron; but in larger furnaces, the expense will be very much less, and besides $\frac{1}{3}$ of the whole expense is for men's labour in blowing; also the estimate is based upon the equivalent quantity of charcoal, which in my furnaces is not used; the flame of the gases of the furnace being applied to carbonise green brush wood, and the flame from this again might be used to heat the boiler of the blowing engine. Instead of 12 hours being required as in the *steuch often,* to produce the result, in mine three hours is more than sufficient; and each furnace can thus be worked three times a day. I find also that these furnaces cost so little, that with all the apparatus, the capital sunk to make 500 tons of bar iron a month need be only 25,000 rupees, and with 80,000 rupees more for a rolling mill, would give only 10,000£, instead of 27,000£, as required by Dr. Ure's estimate. A rough approximation to the expense of working these furnaces may be made, by estimating the cost in bar iron at sixteen times its weight in firewood.

21. I have had as yet no opportunity of trying coal in bloomery furnaces, but I have no doubt it can be used, because the principles upon which these furnaces act, are applicable to any kind of carbon, and besides Dr. Ure alludes to the use of coke in the Catalonian forges. It is probable therefore that the coal of Bengal can be turned to

useful account in making bar iron, and I hope to be able to make public the result of experiments upon this subject.

22. I have not had opportunities of ascertaining the expense of drawing blooms into bar iron, but I know that even when forged with hand hammers, and the work very carelessly done, that the expense is not more than 30 rupees a ton; but in the little forges which I have used, the waste of metal is enormous, amounting to fully 50 per cent. on the weight of the forged blooms. This great waste would be altogether avoided by using proper air furnaces, for heating the blooms and rough bars, and then it would be no greater than in the English works, which according to Dr. Ure, is only 12 per cent. at the utmost.

23. Rolling mills and tilt hammers on the scale of the English works could hardly be used in an infant manufacture, but it is easy to construct a tilt hammer weighing one or two hundred weight in the head; to be worked by hand by coolies; and I have little doubt, the expense would be so small, as to bear a comparison with that of finished bar iron in the English works; for I find that when the bloomery furnaces are carefully regulated, that the blooms will bear drawing out into $\frac{3}{4}$ inch bar at one operation without cracking at all, and are fit for any purpose without the expense of three-fold re-heating and rolling out operation requisite in the English works.

24. The price of bar iron in the various part of India is very variable, and appears to depend more upon the local information of the Natives, and the number of their furnaces which have been established, and kept in work, rather than upon the supplies of fuel and ore, which occur in so many parts of the country. In Bengal, the navigable rivers afford the means of introducing English iron into the interior, but the quality is so much inferior to the Native iron that even in Boglipoor, the Native furnaces are still working profitably; although I have shewn that they cannot sell their iron

for less than 9£ a ton. In the whole of the Northern Circars, I do not remember to have ever seen a piece of English bar iron, except at the sea ports; the supply used in that country being derived from the mountainous region which bounds it on the West. In Southern India, the price of iron is very variable. At Bangalore, the price is 1½ rupee for the maund of 25 pounds, while in Coimbatore the price is 2 rupees or 2½ rupees for the same quantity. In the vicinity of both these places, Native smelters have been established for ages, but about Vellore, where the art of smelting has probably been partially lost during the wars of the Carnatic, English iron fetches from 2 rupees to 2¼ rupees a maund, and good Native iron is not procurable; probably because the whole supply which is made is forestalled, to make horse-shoes for the cavalry station of Arcot. In consequence, a considerable quantity of English iron is used for smith's work, but further inland than this point, English iron only finds a sale for wheel tyres, for which purpose it can be used cheaper than Native iron.

25. It is supposed by some that the quality of malleable iron produced is dependent upon the composition of the ore which is used, whence the remarks so commonly met with about steel ore, &c. With the pure ores of the peroxide and magnetic oxide, this supposition is altogether groundless, for the quality of the iron produced solely depends upon the management of the smelting process. Even in the ores which contain sulphur, I conceive that it might be purified completely by roasting, and I have little doubt that excellent iron might be made from the English iron stones, if the oxide of iron was separated from the impurities by washing.

26. Magnetic iron ore abounds in the Salem district, in Mysore, and in Coimbatore, and may be either picked up in any quantity on the surface at a very trifling expense, or can be separated from the "friable ferruginous granite," by

beating and sifting, for about 2 rupees a ton. The iron sand is, however, the most universally diffused ore in India, and is found in almost every nullah South of the Toombuddra; and as a single man can collect and wash a bullock load, or 200 pounds, in one day without much trouble, it may be procured in any quantity for about the same expense as the magnetic iron ore; and perhaps the cost might be much decreased, either by washing the sand by machinery, or by separating the pure ore from the silicious sand by electro-magnets.

27. It is not easy to form a correct estimate of the expense of firewood and charcoal, but I find that where wood is plentiful, it can be procured at 1 anna for 300 pounds, and charcoal at 2 annas for 100 pounds. But as a single man can cut and faggot 800 pounds of wood in a day, 1½ rupee a ton would be more than the cost, including carriage for five miles; and if charcoal is required, the wood can be carbonised at very little additional expense, if conical ovens of brick-work are employed.

28. As a locality for a manufactory to supply the demand of the interior parts of India, along the Himalayas to Simla; in the Deyra-Dhoon in Candeish; the Mahabilishwur Hills; the whole range of the Western Ghauts in Travancore, Coimbatore, Salem, North Arcot, Cuddapah along the Western verge of the Gundwana mountains; in Singboom and Boglipoor; there is hardly a spot which would not answer for a manufactory of very considerable size.

29. To open an export trade in iron for the supply of the English market, a manufactory would require to be organised upon an extensive scale; and must be situated adjacent to the sea shore, or near water carriage, to avoid the expense of inland carriage over the bad roads of India. As a locality for this purpose, Hoonoor on the Western Coast would perhaps answer, or Travancore, or Trincomallee in Ceylon, where fuel is abundant; or in Cuttack where iron ore,

woòd, and coal abound. Either Tavoy or Mergui afford great advantages also; or perhaps the water carriage from Rajemal in Bengal, would admit of a large manufactory being established there.

Collections.

We have to acknowledge the following obliging communications of plants. From Mrs. Skipwith, the lady of J. C. Skipwith, Esq. Judge of Tiperah, two well preserved collections from Churra Punjee, containing the following genera:—

Acotyledons.—Lycopodium.

Monocotyledons.—Burmannia. Anthericum. Tradescantia, Aneilema. Pothos. Cæloglossum, Habenaria (2), Anthogonium, Goodyera, Dendrobium (2).

Dicotyledons.—Begonia. Polygonum. Daphine (2). Quercus (2). Impatiens (7). Hypericum. Camellia. Clematis. Drosera. Potentilla. Crotalaria, Smithia, Desmodium, Dalbergia, Parochetus. Berberis. Sonnerila (2), Osbeckia (2), Oxyspora. Dipsacus. Thibaudia. Erigeron, Senecio Gnaphalium, Cacalia. Ophiorhiza. Lobelia. Ligustrum. Pladera, Crawfurdia. Strobilanthes. Utricularia. Buddlæa. Plectranthus, Scutellaria, Colquhounia, Salvia. Cynoglossum.

From Dr. Oxley, Senior Surgeon in the Straits, a small collection from Penang Hill. This does not contain any very noticeable plant, but in a larger collection (of 250 sp.) communicated by him to the late Mr. Voigt, we observed some remarkable plants, particularly an undescribed species of Dorianne, for which we propose the name D. Oxleyanus.*

* Durio *Oxleyanus*, (n. sp.) foliis oblongis obtusis submuticis subtus pubescentibus, alabastris globosis, involucri foliolis rotundatis, calyce urceolato-breviter 4-dentato, petalis dorso subsericeis calyce paullo longioribus, antheris integris, ovario pilis stellatis stipitatis vestito, stylo brevi, stigmate subsimplici.

Hab.—Malacca. *Dorianne Dahown* of the Malays.

Dr. Oxley has been long engaged in collecting the plants of the Straits, and has we believe in his possession, a collection of 1000 or 1200 species.

From the Rev. Mr. White, Chaplain of Singapore, an indefatigable collector, a few plants collected by him in Terra Australis, and a dried specimen (of a branch) of the tree producing that curious sort of Caoutchouc known by the name of Gutta Percha. This specimen enables us to refer the plant to Sapoteæ, which explains the statement of its fruit being edible. It has all the characters of a Chrysophyllum. Mr. White has been also so obliging as to transmit living plants of this, and also of the true Camphor tree, the arrival of which is expected shortly.

From Lieut. Munro, H. M. 39th Foot, who is already distinguished by his investigations of the Flora of the Peninsula of India, a small collection containing a Lycium from between Kurnal and Ferozepore, an Erodium from the Chumbul, and an undescribed Polanisia from Bhurtpore. The Erodium is particularly interesting from its being an Affghan form: the genus has not hitherto been met with in the plains of India.

From J. P. Cathcart, Esq. of Purneah, a small collection containing an undescribed species of Utricularia.

Government having ordered the formation of an Herbaria in the H. C. Botanic Gardens, which will be naturally open

A large and handsome tree, the flowers are much smaller and relatively broader.

The chief differences from Durio zibethinus regard the deep division of the ordinary scales whence stellate hairs result, the shortness of all the parts of the flower, the apparently simple anthers, which consist of a discoid horizontal connectivum with a marginal entire loculus. The fruit, I believe, is not eaten ; its spines are longer.

I have a third species of the genus, the Dorianne Ootang : a fourth Dorianne, the Dorianne Dorianne of the Malays, is my Heteropyxis, a remarkable polypetalous genus of the same family.—W. G.

to the Public, we hope hereafter to be able to communicate to contributors the authentic names of any plants they may send to us. This we conceive is the least return we can offer.

Zoology.

We have been indebted in this department to the Rev. Mr. White, of Singapore, for a collection of Fish from New Holland, which will be noticed in our next number. We are also under many obligations to Capt. Phayre, Principal Assistant to the Commissioner of Arracan, for collections in the same class, from Sandoway on the Malay Coast, in which we find a new species of *Muræna* distinguished by moveable articulated teeth in the front of the jaws, and two oblique rows of fixed teeth on the palate; it forms the type of a new genus *Thærodontis.* Also for two new genera of the same order, having the heart situated far back behind the opening to the gills, forming the types of a newly distinguished tribe of Apodal Fishes; we have named one *Ophicardia*, the other *Ophisternon;* both will appear in the next number, in our promised paper on the Apodal Fishes of Bengal. We have also to acknowledge our obligations for small collections in this class, to Dr. Campbell, of Darjeeling, and Capt. Guthrie, of the Engineers, which have been received some time since; all which we hope shortly to notice in detail.

An inquiry into the distinctive characteristics of the Aboriginal Race of America, read at the Annual Meeting of the Boston Society of Natural History, Wednesday, 27th April, 1842. *By* Samuel George Morton, m. d.

At a meeting of the Boston Society of Natural History, held on the 27th of April, it was unanimously

Voted, That the thanks of the Society be presented to Dr. S. G. Morton, for his eloquent and instructive address, delivered before this

Society at its Anniversary meeting; and that a copy be requested for publication.

It was also

Voted, That the charge of procuring and publishing the same, be assigned to the Publishing Committee.

When these votes were communicated to Dr. Morton, he immediately complied with the request of the Society, and placed his address at the disposal of the Committee.

To the Members of the Boston Society of Natural History.

Gentlemen,—On receiving the highly flattering invitation to deliver your Annual Address, it occurred to me that nothing would be so appropriate as a review of the present state of Natural Science in this country: but having almost simultaneously received the Address of Mr. Teschemacher for the past year, I found it so full and satisfactory on this question as to leave little or nothing for further discussion. I have therefore been induced to seek another field of inquiry, and in so doing, have very naturally turned to a subject which has long occupied my leisure hours, and which, though frequently examined, may yet, I trust, be recurred to with pleasure and instruction. I propose to take a rapid glance at what I conceive to be the peculiar traits of the Aboriginal race of America, as embraced in five principal considerations, viz:—their organic, moral and intellectual characters; their mode of interment and their maritime enterprise; and from these I shall venture to draw a few definite conclusions. I am aware that it may appear presumptuous to attempt so wide a range within the brief limits of the present occasion, especially as some points can be touched only in the most general manner; but my object has been to dwell rather upon some of these which have hitherto received less attention than they obviously deserve, and which are intimately involved in the present inquiry. With this explanation I submit to your indulgent consideration the contents of the following memoir.

S. G. Morton.

Address.

Anthropology, the Natural History of Man, is essentially a modern science. At a time when the study of Nature in her other departments, had been prosecuted with equal zeal and success, this alone, the most important of them all, remained comparatively neglected and unknown; and of the various authors who have attempted its exposition during the past and present centuries, too many have been content with closet theories, in which facts are perverted to sustain some baseless conjecture. Hence it has been aptly remarked that Asia is the country of fables, Africa of monsters, and America of systems, to those who prefer hypothesis to truth.

The intellectual genius of antiquity justly excites our admiration and homage; but in vain we search its records for the physical traits of some of the most celebrated nations of past time. It is even yet gravely disputed whether the ancient Egyptians belonged to the Caucasian race or to the Negro; and was it not for the light which now dawns upon us from their monuments and their tombs, this question might remain for ever undecided. The present age, however, is marked by a noble zeal for these inquiries, which are daily making man more conversant with the organic structure, the mental character, and the national affinities of the various and widely scattered tribes of the human family.

Among these the aboriginal inhabitants of America claim our especial attention. This vast theatre has been thronged, from immemorial time, by numberless tribes which lived only to destroy and be in turn destroyed, without leaving a trace of their sojourn on the face of the earth. Contrasted with these were a few civilized communities, whose monuments awaken our surprise without unfolding their history; and he who would unravel their mysteries may be compared, in the language of the poets, to a man standing by the stream of time, and striving to rescue from its waters the wrecked and shattered fragments which float onward to oblivion.

It is not my present intention even to enumerate the many theories which have been advanced in reference to the origin of the American nations; although I may, in the sequel, inquire whether their genealogy can be traced to the Polynesians or Mongolians, Hindoos, Jews or Egyptians. Nor shall I attempt to analyse the views of certain philosophers who imagine that they have found not only a variety of races, but several *species* of men among the aborigines of this continent. It is chiefly my intention to produce a few of the more strikingly characteristic traits of these people to sustain the position that all the American nations, excepting the Eskimaux, are of one race, and that this race is peculiar, and distinct from all others.

1. *Physical Characteristics.* It is an adage among travellers, that he who has seen one tribe of Indians, has seen all, so much do the individuals of this race resemble each other, notwithstanding their immense geographical distribution, and those differences of climate which embrace the extremes of heat and cold. The half-clad Fuegian, shrinking from his dreary winter, has the same characteristic lineaments, though in an exaggerated degree, as the Indians of the tropical plains; and these again resemble the tribes which inhabit the region west of the Rocky Mountains, those of the great valley of the Mississippi, and those again which skirt the Eskimaux on the North. All possess alike the long, lank, black hair, the brown or cinnamon colored skin, the heavy brow, the dull and sleepy eye, the full and compressed lips, and the salient but dilated nose. These, traits, moreover are equally common to the savage and civilized nations; whether they inhabit the margins of rivers and feed on fish, or rove the forest and subsist on the spoils of the chase.

It cannot be questioned that physical diversities do occur, equally singular and inexplicable, as seen in different shades of color, varying from a fair tint to a complexion almost black; and this too under circumstances in which climate can have little or no influence. So also in reference to stature, the differences are remarkable in entire tribes which, moreover, are geographically proximate to each other. These facts, however, are mere exceptions to a general rule, and do not alter the peculiar physiognomy of the Indian, which is as undeviatingly characteristic as that of the Negro; for whether we see him in the athletic Charib or the stunted Chayma, in the dark Californian or the fair Borroa, he is an Indian still, and cannot be mistaken for a being of any other race.

The same conformity of organization is not less obvious in the osteological structure of these people, as seen in the squared or rounded, head, the flattened or vertical occiput, the high cheek bones, the ponderous maxillæ, the large quadrangular orbits, and the low, receding forehead. I have had opportunity to compare nearly four hundred crania, derived from tribes inhabiting almost every region of both Americas, and have been astonished to find how the preceding characters, in greater or less degree, pervade them all.

This remark is equally applicable to the ancient and modern nations of our continent; for the oldest skulls from the Peruvian cemeteries, the tombs of Mexico and the mounds of our own country, are of the same type as the heads of the most savage existing tribes. Their physical organization proves the origin of one to have been equally the origin of all. The various civilized nations are to this day represented by their lineal descendants who inhabit their ancestral seats, and differ in no exterior respect from the wild and uncultivated Indians; at the same time, in evidence of their lineage, Clavigero and other historians inform us, that the Mexicans and Peruvians yet possess a latent mental superiority which has not been subdued by three centuries of despotism. And again, with respect to the royal personages and other privileged classes, there is indubitable evidence that they were of the same native stock, and presented no distinctive attributes excepting those of a social or political character.

The observations of Molina and Humboldt are sometimes quoted in disproof of this pervading uniformity of physical characters. Molina says that the difference between an inhabitant of Chili and a Peruvian is not less than between an Italian and a German; to which Humboldt adds, that the American race contains nations whose features differ as essentially from one another as those of the Circassians, Moors and Persians. But all these people are of one and the same *race*, and readily recognized as such, notwithstanding their differences of feature and complexion; and the American nations present a precisely parallel case.

I was at one time inclined to the opinion that the ancient Peruvians, who inhabited the islands and confines of the Lake Titicaca, presented a congenital form of the head entirely different from that which characterizes the great American race; nor could I at first bring myself to believe that their wonderfully narrow and elongated crania, resulted solely from artificial compression applied to the rounded head of the Indian. That such, however, is the fact, has been indisputably proved by the recent investigations of M.

D'Orbigny. This distinguished naturalist passed many months on the table-land of the Andes, which embraces the region of these extraordinary people, and examined the desiccated remains of hundreds of individuals in the tombs where they have lain for centuries. M. D'Orbigny remarked that while many of the heads were deformed in the manner to which we have adverted, others differed in nothing from the usual conformation. It was also observed that the flattened skulls were uniformly those of men, while those of the women remained unaltered; and again, that the most elongated heads were preserved in the largest and finest tombs, shewing that this cranial deformity was a mark of distinction. But to do away with any remaining doubt on this subject, M. D'Orbigny ascertained that the descendants of these ancient Peruvians yet inhabit the land of their ancestors, and bear the name of AYMARAS, which may have been their primitive designation; and lastly, the modern Aymaras resemble the common Quichua or Peruvian Indians in every thing that relates to physical conformation, not even excepting the head, which, however, they have ceased to mould artificially.

Submitted to the same anatomical test, the reputed giant and dwarf races of America prove to be the mere inventions of ignorance or imposition. A careful inspection of the remains of both, has fully satisfied me that the asserted gigantic form of some nations has been a hasty inference on the part of unpractised observers: while the so-called pygmies of the valley of the Mississippi were mere children, who, for reasons not wholly understood, were buried apart from the adult people of their tribe.

Thus it is that the American Indian, from the southern extremity of the continent to the northern limit of his range, is the same exterior man. With somewhat variable stature and complexion, his distinctive features, though variously modified, are never effaced; and he stands isolated from the rest of mankind, identified at a glance in every locality, and under every variety of circumstance; and even his desiccated remains which have withstood the destroying hand of time, preserve the primeval type of his race, excepting only when art has interposed to pervert it.

2. *Moral Traits.* These are, perhaps, as strongly marked as the physical characteristics of which we have just spoken; but they have

been so often the subject of analysis as to claim only a passing notice on the present occasion. Among the most prominent of this series of mental operations is a sleepless caution, an untiring vigilance which presides over every action and masks every motive. The Indian says nothing and does nothing without its influence: it enables him to deceive others without being himself suspected; it causes that proverbial taciturnity among strangers which changes to garrulity among the people of his own tribe; and it is the basis of that invincible firmness which teaches him to contend unrepiningly with every adverse circumstance, and even with death in its most hideous forms.

The love of war is so general, so characteristic, that it scarcely calls for a comment or an illustration. One nation is in almost perpetual hostility with another, tribe against tribe, man against man; and with this ruling passion are linked a merciless revenge and an unsparing destructiveness. The Chickasaws have been known to make a stealthy march of 600 miles from their own hunting grounds, for the sole purpose of destroying an encampment of their enemies. The small island of Nantucket, which contains but a few square miles of barren sand, was inhabited at the advent of the European colonies by two Indian tribes, who sometimes engaged in hot and deadly feud with each other. But what is yet more remarkable, the miserable natives of Terra del Fuego, whose common privations have linked them for a time in peace and fellowship, become suddenly excited by the same inherent ferocity, and exert their puny efforts for mutual destruction. Of the destructive propensity of the Indian, which has long become a proverb, it is almost unnecessary to speak; but we may advert to a forcible example from the narrative of a traveller who accompanied a trading party of northern Indians on a long journey, during which he declares that they killed every living creature that came within their reach; nor could they even pass a bird's nest without slaying the young or destroying the eggs.

That philosophic traveller, Dr. Von Martius, gives a graphic view of the present state of natural and civil rights among the American aborigines. Their sub-division, he remarks, into an almost countless multitude of greater and smaller groups, and their entire exclusion and excommunication with regard to each other, strike the eye of the observer like the fragments of a vast ruin, to which the history of the other nations of the earth furnishes no analogy. "This disruption of all the bands by which Society was anciently held together, accompanied by a Babylonish confusion of tongues, the rude right of force, the never ending tacit warfare of all against all, springing from that very disrupture,—appear to me the most essential, and, as far as history is concerned, the most significant points in the civil condition of the aboriginal population of America."

It may be said that these features of the Indian character are common to all mankind in the savage state: this is generally true; but in the American race they exist in a degree which will fairly challenge a comparison with similar traits in any existing people; and if we consider also their habitual indolence and improvidence, their indifference to private property, and the vague simplicity of their religious observances,—which, for the most part, are devoid of the specious aid of idolatry,—we must admit them to possess a peculiar and eccentric moral constitution.

If we turn now to the demi-civilized nations, we find the dawn of refinement coupled with those barbarous usages which characterize the Indian in his savage state. We see the Mexicans, like the later Romans, encouraging the most bloody and cruel rites, and these too in the name of religion, in order to inculcate hatred of their enemies, familiarity with danger and contempt of death; and the moral effect of this system is manifest in their valorous, though unsuccessful, resistance to their Spanish conquerors.

Among the Peruvians, however, the case was different. The inhabitants had been subjugated to the Incas by a combined moral and physical influence. The Inca family were looked upon as beings of divine origin. They assumed to be the messengers of heaven, bearing rewards for the good, and punishment for the disobedient, conjoined with the arts of peace and various social institutions. History bears ample testimony that these specious pretences were employed first to captivate the fancy and then to enslave the man. The familiar adage that "knowledge is power," was as well understood by them as by us; learning was artfully restricted to a privileged class; and the genius of the few soon controled the energies of the many. Thus the policy of the Incas inculcated in their subjects an abject obedience which knew no limit. They endeavored to eradicate the feeling of individuality; or in other words to unite the minds of the plebeian multitude in a common will which was that of their master. Thus when Pizarro made his first attack on the defenceless Peruvians in the presence of their Inca, the latter was borne in a throne on the shoulders of four men; and we are told by Herrera that while the Spaniards spared the Sovereign, they aimed their deadly blows at his bearers: these, however, never shrunk from their sacred trust; but when one of their number fell, another immediately took his place; and the historian declares that if the whole day had been spent in killing them, others would still have come forward to the passive support of their master. In fact what has been called the paternal government of the Incas was strictly such; for their subjects were children, who neither thought nor acted except at the dictation of another. Thus it was that a people whose moral impulses are known to have differed in little or nothing from those of the barbarous tribes, were reduced, partly by persuasion, partly by force, to a state of effeminate vassalage not unlike that of the modern Hindoos. Like the latter, too, they made good soldiers in their native wars, not from any principle of valour, but from the sentiment of passive obedience to their superiors; and hence when they saw their monarch bound and imprisoned by the Spaniards, their conventional courage at once forsook them; and we behold the singular spectacle of an entire nation prostrated at a blow, like a strong man whose energies yield to a seemingly trivial but rankling wound.

After the Inca power was destroyed, however, the dormant spirit of the people was again aroused in all the moral vehemence of their race, and the gentle and unoffending Peruvian was transformed into the wily and merciless savage. Every one is familiar with the sequel. Resistance was too late to be availing, and the fetters to which they had confidingly submitted were soon riveted for ever.

As we have already observed, the Incas depressed the moral energies of their subjects in order to secure their own power. This they effected by inculcating the arts of peace, prohibiting human sacrifices, and in a great measure avoiding capital punishments; and blood was seldom spilt excepting on the subjugation of warlike and refractory tribes. In these instances, however, the native ferocity of their race broke forth even in the bosom of the Incas; for we are told by Garcilaso, the descendant and apologist of the Peruvian kings, that some of their wars were absolutely exterminating; and among other examples he mentions that of the Inca Yupanqui against the province of Collao, in which whole districts were so completely depopulated that they had subsequently to be colonized from other parts of the empire: and in another instance the same unsparing despot destroyed twenty thousand Caranques, whose bodies he ordered to be thrown into an adjacent lake, which yet bears the name of the Sea of Blood. In like manner when Atahualpa contested the dominion with Guascar, he caused the latter, together with thirty of his brothers, to be put to death in cold blood, that nothing might impede his progress to the throne.

We have thus endeavored to shew that the same moral traits characterize all the aboriginal nations of this continent, from the humanized Peruvian to the rudest savage of the Brazilian forest.

3. *Intellectual Faculties.* It has often been remarked that the intellectual faculties are distributed with surprising equality among individuals of the same race who have been similarly educated, and subjected to the same moral and other influences: yet even among these, as in the physical man, we see the strong and the weak, with numberless intermediate gradations. This equality is infinitely more obvious in savage than in civilized communities, simply because in the former the condition of life is more equal; whence it happens that in contrast to a single master mind, the plebeian multitude are content to live and die in their primitive ignorance.

This truth is obvious at every step of the present investigation; for of the numberless hordes which have inhabited the American continent, a fractional portion only has left any trace of refinement. I venture here to repeat my matured conviction that as a race they are decidedly inferior to the Mongolian stock. They are not only averse to the restraints of education, but seem for the most part incapable of a continued process of reasoning on abstract subjects. Their minds seize with avidity on simple truths, while they reject whatever requires investigation or analysis. Their proximity for more than two centuries to European communities, has scarcely effected an appreciable change in their manner of life; and as to their social condition, they are probably in most respects the same as at the primitive epoch of their existence. They have made no improvement in the construction of their dwellings, except when directed by Europeans who have become domiciliated among them; for the Indian cabin or the Indian tent, from Terra del Fuego to the river St. Lawrence, is perhaps the humblest contrivance ever devised by man to screen himself from the elements. Nor is their mechanical ingenuity more conspicuous in the construction of their boats; for these, as we shall endeavor to show in the sequel, have rarely been improved beyond the first rude conception. Their imitative faculty is of a very humble grade, nor have they any predilection for the arts or sciences. The long annals of missionary labor and private benefaction, present few exceptions to this cheerless picture, which is sustained by the testimony of nearly all practical observers. Even in those instances in which the Indians have received the benefits of education, and remained for years in civilized society, they lose little or none of the innate love of their national usages, which they almost invariably resume when left to choose for themselves.

Such is the intellectual poverty of the barbarous tribes; but contrasted with these, like an oasis in the desert, are the demi-civilized nations of the new world; a people whose attainments in the arts and sciences are a riddle in the history of the human mind. The Peruvians in the south, the Mexicans in the north, and the Muyscas of Bogota between the two, formed these contemporary centres of civilization, each independent of the other, and each equally skirted by wild and savage hordes. The mind dwells with surprise and admiration on their cyclopean structures, which often rival those of Egypt in magnitude;—on their temples, which embrace almost every principle in architecture except the arch alone;—and on their statues and bas-reliefs which, notwithstanding some conventional imperfections, are far above the rudimentary state of the arts.*

* I cannot omit the present occasion to express my admiration of the recent discoveries of Mr. Stephens among the ruined cities of Central America. The spirit, ability and success which characterize these investigations are an honor to that gentleman and to his country; and they will probably tend more than

I have elsewhere ventured to designate these demi-civilized nations by the collective name of the Toltecan Family; for although the Mexican annals date their civilization from a period long antecedent to the appearance of the Toltecas, yet the latter seem to have cultivated the arts and sciences to a degree unknown to their predecessors. Besides, the various nations which at different times invaded and possessed themselves of Mexico, were characterized by the same fundamental language and the same physical traits, together with a strong analogy in their social institutions: and as the appearance of the Incas in Peru was nearly simultaneous with the dispersion of the Toltecas, in the year 1050 of our era, there is reasonable ground for the conjecture that the Mexicans and Peruvians were branches of the genuine Toltecan stock. We have alluded to a civilization antecedent to the appearance of the Incas, and which had already passed away when they assumed the government of the country. There are traditional and monumental evidences of this fact which can leave no doubt on the mind, although of its date we can form no just conception. It may have even preceded the Christian era, nor do we know of any positive reasons to the contrary. Chronology may be called the crutch of history; but with all its imperfections it would be invaluable here, where no clue remains to unravel those mysterious records which excite our research but constantly elude our scrutiny. We may be permitted however, to repeat what is all-important to the present inquiry, that these Ancient Peruvians were the progenitors of the existing Aymara tribes of Peru, while these last are identified in every particular with the people of the great Inca race. All the monuments which these various nations have left behind them, over a space of three thousand miles, go also to prove a common origin, because, notwithstanding some minor differences, certain leading features pervade and characterize them all.

Whether the hive of the civilized nations was, as some suppose, in the fabled region of Aztlan in the north, or whether, as the learned

the labors of any other person to unravel the mysteries of American Archæology. Similar in design to these are the researches of my distinguished friend the Chevalier Freidrichthal, the results of whose labors, though not yet given to the world, are replete with facts of the utmost importance to the present inquiry.

Cabrera has endeavoured to shew, their native seats were in Chiapas and Guatimala, we may not stop to inquire; but to them, and to them alone, we trace the monolithic gateways of Peru, the sculptures of Bogota, the ruined temples and pyramids of Mexico, and the mounds and fortifications of the valley of the Mississippi.

Such was the Toltecan Family; and it will now be inquired how it happens that so great a disparity should have existed in the intellectual character of the American nations, if they are all derived from a common stock, or in other words belong to the same race? How are we to reconcile the civilization of the one with the barbarism of the other? It is this question which has so much puzzled the philosophers of the past three centuries, and led them, in the face of facts, to insist on a plurality of races. We grant the seeming anomaly; but however much it is opposed to general rule, it is not without ample analogies among the people of the old world. No stronger example need be adduced than that which presents itself in the great Arabian family; for the Saracens who established their kingdom in Spain, whose history is replete with romance and refinement, whose colleges were the centres of genius and learning for several centuries, and whose arts and sciences have been blended with those of every subsequent age;—these very Saracens belong not only to the same race but to the same family with the Bedouins of the desert; those intractable barbarians who scorn all restraints which are not imposed by their own chief, and whose immemorial laws forbid them to sow corn, to plant fruit trees or to build houses, in order that nothing may conflict with those roving and predatory habits which have continued unaltered through a period of three thousand years.

Other examples perhaps not less forcible, might be adduced in the families of the Mongolian race; but without extending the comparison, or attempting to investigate this singular intellectual disparity, we shall, for the present, at least, content ourselves with the facts as we find them. It is important, however, to remark, that these civilized states do not stand isolated from their barbarous neighbours; on the contrary they merge gradually into each other, so that some nations are with difficulty classed with either division, and rather form an intermediate link between the two. Such are the Araucanians, whose language and customs, and even whose arts, prove their direct affiliation with the Peruvians, although they far surpass the latter in sagacity and courage, at the same time that their social institutions present many features of intractable barbarism. So also the Aztec rulers of Mexico at the period of the Spanish invasion, exhibit, with their bloody sacrifices and multiform idolatry, a strong contrast to the gentler spirit of the Toltecas, who preceded them, and whose arts and ingenuity they had usurped. Still later in this intermediate series were the Natchez tribes of the Mississippi, who retained some traces of the refinement of their Mexican progenitors, mingled with many of the rudest traits of savage life. It is thus that we can yet trace all the gradations, link by link, which connect these extremes together, showing that although the civilization of these nations is fast becoming obsolete, although their arts and sciences have passed away with a former generation, still the people remain in all other respects unchanged, although a variety of causes has long been urging them onward to deep degradation and rapid extinction. Strange as these intellectual revolutions may seem, we venture to assert that, all circumstances being considered, they are not greater than those which have taken place between the ancient and modern Greeks. If we had not incontestable evidence to prove the fact, who would believe that the ancestors of the Greeks of the present day were the very people who gave glory to the Age of Pericles!

It may still be insisted that the religion and the arts of the American nations point to Asia and Egypt; but it is obvious, as Humboldt and others have remarked, that these resemblances may have arisen from similar wants and impulses, acting on nations in many respects similarly circumstanced. "It would indeed be not only singular, but wonderful and unaccountable," observes Dr. Caldwell, "if tribes and nations of men, possessed of similar attributes of mind and body, residing in similar climates and situations, influenced by similar states of society, and obliged to support themselves by similar means in similar pursuits,—it would form a problem altogether inexplicable, if nations thus situated did not contract habits and usages, and, instinctively modes of life and action, possessing towards each other many striking resemblances." Here also we may draw an illustration from the old world; for notwithstanding the comparative proximity of the Hindoos and Egyptians, and the evident analogies in their architecture, mythology and social institutions, there is now little reason to believe them cognate nations; and the resemblances to which we have adverted have probably arisen from mutual intercourse, independent of lineal affiliation. And so with the nations of America. The casual appearance of shipwrecked strangers would satisfactorily explain any sameness in the arts and usages of the one and the other, as well as those words which are often quoted in evidence of a common origin of language, but which are so few in number as to be readily accounted for on the foregoing principle.

The entire number of common words is said to be one hundred and four between the American languages and those of Asia and Australia; forty-three with those of Europe; and forty with those of Africa, making a total of one hundred and eighty seven words. But taking into account the mere coincidence by which some of these analogies may be reasonably explained, I would inquire, in the language of an ingenious author, whether these facts are sufficient to prove a connexion between four hundred dialects of America and the various languages of the old world?

Even so late as the year 1833, a Japanese junk was wrecked on the north-west coast of America, and several of the crew escaped unhurt to the shore; and I have myself seen some porcelain vessels which were saved on that occasion. Such casualties may have occurred in the early periods of American history; and it requires no effort of the imagination to conceive the influence these persons might have exerted, in various respects, had they been introduced to the ancient courts of Peru and Mexico. They might have contributed something to extend, or at least to modify, the arts and sciences of the people among whom they were thrown, and have added a few words to the national language.

I am informed by my friend Mr. Townsend, who passed several months among the tribes of the Columbia river, that the Indians there have already adopted from the Canadian traders several French words, which they use with as much freedom as if they belonged to their own vocabulary.

It follows of course from the preceding remarks, that we consider the American race to present the two extremes of intellectual character: the one capable of a certain degree of civilization and refinement, independent of extraneous aids; the other exhibiting an abasement which puts all mental culture at defiance. The one composed, as it were, of a handful of people whose superiority and consequent acquisitions have made them the prey of covetous destroyers; the other a vast multitude of savage tribes whose very barbarism is working their destruction from within and without. The links that connect them partake of the fate of the extremes themselves; and extinction appears to be the unhappy, but fast approaching doom of them all.

4. *Maritime Enterprise.*—One of the most characteristic traits of all civilised and many barbarous communities, is the progress of maritime adventure. The Caucasian nations of every age present a striking illustration of this fact: their sails are spread on every ocean, and the fabled voyage of the Argonauts is but a type of their achievements from remote antiquity to the present time. Hence their undisputed dominion of the sea, and their successful colonization of every quarter of the globe. The Mongolians and Malays, though active and predatory, and proverbially aquatic in their habits, are deficient in that mechanical invention which depends on a knowledge of mathematical principles; while they seem also incapable of those mental combinations which are requisite to a perfect acquaintance with naval tactics. The Negro, whose observant and imitative powers enable him to acquire with ease the details of seamanship, readily becomes a mariner, but rarely a commander: and history is silent on the nautical prowess of his race. Far behind all these is the man of America. Savage or civilized, the sea for him has had few charms, and his navigation has been almost exclusively restricted to lakes and rivers. A canoe excavated from a single log, was the principal vessel in use in the new world at the period of its discovery. Even the predatory Charibs, who were originally derived from the forests of Guayana, possessed no other boat than this simple contrivance, in which they seldom ventured out of sight of land; and never excepting in the tranquil periods of the tropical seas, when they sailed from shore to shore, the terror of the feebler natives of the surrounding islands. The canoes of the Arouacs of Cuba were not more ingeniously contrived than those of the ruder Charibs

which is the more surprising, since their island was the centre of a great archipelago, and their local position, therefore, in all respects calculated to develope any latent nautical propensities. When Cortez approached in his ships the Mexican harbor of Tobasco, he was astonished to find even there, the sea-port, as it were, of a mighty empire, the same primitive model in the many vessels that skimmed the sea before him. Let us follow this conqueror to the imperial city itself, surrounded by lakes, and possessed of warlike defences superior to those of any other American people. The Spanish commander, foreseeing that to possess the lake would be to hold the keys of the city, had fifteen brigantines built at Tlascala; and these being subsequently taken to pieces, were borne on men's shoulders to the lake of Mexico, and there re-constructed and launched. The war thus commenced as a naval contest; and the Spanish historians, while they eulogize the valour of the Mexicans, are constrained to admit the utter futility of their aquatic defences: for although the subjects of Montezuma, knowing and anticipating the nature of the attacks, came forth from the city in several thousand boats, these were so feebly constructed, and managed with so little dexterity, that in a few hours they were all destroyed, dispersed, or taken by the enemy.

Turning from the Mexicans, we naturally look to the Peruvians for some further advances in nautical skill; but although their country was comparatively a narrow strip of land with an extended frontier on the ocean, we find even here the same primitive vessels and the same timid navigators. It is indeed questionable whether they ever designedly lost sight of land, nor does it appear that they made the sea subservient to their conquests. These were uniformly prosecuted by land, excepting perhaps those of the Incas, in their efforts to subdue the fierce islanders of Titicaca; but even the partial pen of Garcilaso limits all these inventions to log canoes and rafts of reeds; nor does it appear that the ingenuity of these people, so abundantly displayed on many other occasions, had ever added an improvement to the primeval germ of navigation.

Nor are those tribes which depend almost wholly on fish for their daily subsistence, much better provided than the others. The Chenouks and other nations on the western coast of America, have boats hewn with comparative ingenuity from a single plank, and compared to a butcher's tray; but in these frail vessels they keep cautiously within sight of land, and never venture on the water unless the weather is favourable to their enterprise. It is to be observed, however, that when the Indians are compelled to carry their boats across portages from river to river, they construct them of birch bark, and with a degree of ingenuity and adaptation much above their usual resources. Thus boats that would carry nine men do not weigh over sixty pounds, and are therefore conveyed with ease to considerable distances. This is almost the only deviation from the log canoe, and is equally characteristic; for it is common among the interior Indians of both North and South America, and was noticed by De Solis in the Mexican provinces.

Inferior in these respects to the other tribes are the Fuegians; a people whom perpetual exposure and privation, and the influence of an inhospitable climate have reduced to a feeble intelligence,—the moral childhood of their race. Not even the stimulus of necessity has been able to excite that ingenuity which would so amply provide for all their wants; and they starve amid the abundant stores of the ocean, because they possess no adequate means for obtaining them. The Falkland and Malouine islands in but fifty degrees of South latitude, South Georgia, New South Shetland, and some smaller islands in nearly the same parallel, were at their discovery, entirely uninhabited; nor is there any evidence of their ever having been visited by any American tribe. Yet they possess seals and other marine animals in vast numbers, and in these and all other respects appear to be not less productive than the region inhabited by the Eskimaux.

It is generally supposed that nautical enterprise results from the necessity of the case, in nations proximate to, or surrounded by the sea. We have seen, however, that the natives of the islands of the Gulf of Mexico were exceptions to the rule; and we find another not less remarkable in the archipelago of Chiloe, on the coast of Chili. These islands are seen from the shore, and have a large Indian population which depends for subsistence on fish taken from the surrounding ocean; yet even so late as the close of the past century, after more than two hundred years of communication with the Spaniards, their boats appear not to have been the least improved from their original model. The padre Gonzalez de Agueros, who resided many years among these islanders, describes their canoes as composed of five or six boards narrowed at the ends and lashed together with cords, the seams being filled with moss. They have sails, but neither keel nor deck; and in these frail and primitive vessels the inhabitants commit themselves to a tempestuous sea in search of their daily food. The same miserable vessels are found in exclusive use in the yet more southern archipelago of Guaitecas, in which a spare population is distributed over eight hundred islands, and depends solely on the sea for subsistence. The mechanical ingenuity of these people, therefore, is not greater than that of the other Indians; but from constant practice with their wretched boats, they have acquired a dexterity in the use of them unknown to any other tribe, and in some instances, under the direction of the Spaniards, have become comparatively good sailors.

De Azara mentions a curious fact in illustration of the present inquiry. He declares that when his countrymen discovered the Rio de la Plata, they found its shores inhabited by two distinct Indian nations, the Charruas on the north, and the Patagonians on the south; yet strange to say, these restless people had never communicated with each other for war or for peace, for good or for evil, because they had neither boats or canoes in which to cross the river.

The Indian is not defective in courage even on the water; but he lacks invention to construct better vessels, and tact to manage them. When he has been compelled to defend himself in his frail canoe, he has done so with the indomitable spirit of his race; yet with all their love of war and stratagem, I cannot find any account of a naval combat in which Europeans have borne no part.

The Payaguas Indians at one period took revenge on the Spaniards by infesting the rivers of Paraguay in canoes which they managed with much adroitness; and darting from their lurking places, they intercepted the trading vessels going to and from Buenos Ayres, robbing them of their goods, and destroying their crews without mercy. Such was their success in these river piracies that it required years of war and stratagem on the part of the Spaniards to subdue them.

The only example of a naval contest that I have met with, is described by Dobrizhoffer to have taken place between the so-called Mamalukes of St. Paulo, in Brazil, and their enemies the Guaranies. The former were a banditti derived from the intermarriage of the dregs of Europeans of all nations with the surrounding Indians; and assisted by two thousand of their native allies, they came forth to battle in three hundred boats. The Guaranies, on the other hand, had five ships armed with cannon. But it is obvious from this statement, that European vessels and European tactics gave the battle all its importance. It took place on the river Mborore, in Paraguay; but after all, both parties finding themselves out of their element on the water, at length abandoned their vessels by mutual agreement, and fought to desperation on shore.

It is said of the inhabitants of New Holland, that their only substitute for a boat is a short and solid log, on which they place themselves astride, and thus venture upon the water. Even this, the humblest of all human contrivances, was in use among the Indians of the Bay of Honduras, who had learned to balance themselves so dexterously standing upon a log, as to be able in this position to pursue their customary occupation of fishing in the adjacent sea.

In fine, his long contact with European arts, has furnished the Indian with no additional means of contending with the watery element; and his log canoe and boat of birch bark, are precisely the same as at the landing of Columbus.

5. *Manner of Interment.* Veneration for the dead is a sentiment natural to man, whether civilized or savage; but the manner of expressing it, and of performing the rites of sepulture, differ widely in different nations. No offence excites greater exasperation in the breast of the Indian than the violation of the graves of his people; and he has even been known to disinter the bones of his ancestors, and bear them with him to a great distance, when circumstances have compelled him to make a permanent change of residence.

But the *manner* of inhumation is so different from that practised by the rest of mankind, and at the same time so prevalent among the American natives, as to constitute another means of identifying them as parts of a single and peculiar race. This practice consists in burying the dead in the *sitting posture;* the legs being flexed against the abdomen, the arms also bent, and the chin supported on the palms of the hands. The natives of Patagonia, Brazil and Guayana; the insular and other Charibs, the Florida tribes, the great chain of Lenape nations, the inhabitants of both sides of the Rocky mountains, and those also of Canada and the vast North-western region, all conform with occasional exceptions, to this conventional rite. So also with the demi-civilized communities from the most distant epochs; for the ancient Peruvians, to whom we have already so frequently referred, possessed this singular usage, as is verified by their numberless remains in the sepulchres of Titicaca. They did not, however, bury their dead, but placed them on the floors of their tombs, seated and sowed up in sacks. The later Peruvians of the Inca race followed the same custom, sometimes inhuming the body, at others placing it in a tower above ground. Garcilaso de la Vega informs us, that in the year 1560 he saw five embalmed bodies of the royal family, all of whom were seated in the Indian manner, with their hands crossed upon the breast, and their heads bent forward. So also the Mexicans from the most ancient time had adopted the same usage, which was equally the privilege of the king and his people. The most remarkable exception to the practice in question, is that in which the body is dissected before interment, the bones alone being deposited in the earth. This extraordinary rite has prevailed among various tribes from the southern to the northern extremity of their range, in Patagonia, Brazil, Florida and Missouri, and indeed in many intervening localities; but even in these instances the bones are often retained in their relative position by preserving the ligaments, and then interred in the attitude of a person seated. An example among very many others is recorded by the Baron Humboldt, in his visit to a cavern-cemetery of the Atures Indians, at the sources of the Orinoco; wherein he found hundreds of skeletons preserved each in a separate basket, the bones being held together by their natural connexions, and the whole disposed in the conventional posture of which we are speaking.

I am well aware that this practice has been noticed by some navigators among the Polynesian islands; the instances, however, appear so few as rather to form exceptions to the rule, like those of the Nassamones of northern Africa: but I have sought for it in vain among the continental Asiatics, who, if they ever possessed it, would have yet preserved it among some at least of their numberless tribes.

After this rapid view of the principal leading characteristics of the American race, let us now briefly inquire whether they denote an exotic origin; or whether there is not internal evidence that this race is as strictly aboriginal to America as the Mongolian is to Asia, or the Negro to Africa.

And first, we turn to the Mongolian race, which, by a somewhat general consent is admitted to include the Polar nations, and among them the Eskimaux of our continent. It is a very prevalent opinion that the latter people, who obviously belong to the Polar family of Asia, pass insensibly into the American race, and thus form the connecting link between the two. But without repeating what has already been said in reference to the Indian, we may briefly advert, for the purpose of comparison, to the widely different characteristics of the Eskimaux. These people are remarkable for a large and rather elongated head, which is low in front and projecting behind; the great width and flatness of the face is noted by all travellers: their eyes are small and black, the mouth small and round, and the nose is so diminutive and depressed, that on looking at a skull in profile the nasal bones are hardly seen. Their complexion, moreover, is comparatively fair, and there is a tendency throughout life to fulness and obesity. The traveller Hearne, while in company with a tribe of northern Indians, mentions a circumstance which is at least curious, because it shows the light in which the Eskimaux are regarded by their proximate neighbours on the south. He was the unwilling witness of a premeditated and unprovoked massacre of an entire encampment of Eskimaux, men, women, and children; and it is curious to remark that the aggressors apologised for their cruelty not only on the plea of ancient feud, but by asserting that their unoffending victims were a people of different nature and origin from themselves, even in respect to sexual conformation.

The moral character of the Eskimaux differs from that of the Indian chiefly in the absence of the courage, cunning, cruelty and improvidence so habitual in the red man, who, in turn, is inferior in mechanical ingenuity, and above all in aquatic exercises. The Eskimau, notwithstanding the intense cold of his climate, has been called an amphibious animal, so readily and equally does he adapt himself to the land or water. His boat is an evidence of mechanical skill, and the adroit manner in which he manages it is a proverb among mariners. The women are not less expert and enterprising than the men: each possesses a boat of peculiar and distinctive construction; and Crantz informs us, that children of the tender age of seven or eight years commence the unassisted management of their little vessels.

How strongly do these and other traits which might be enumerated, contrast with those of the Indian, and enforce an ethnographic dissimilarity which is confirmed at every step of the investigation!

Some writers, however, think they detect in the Fuegian a being whose similar physical condition has produced in him all the characteristics of the Eskimau; but we confidently assert that the latter is vastly superior both in his exterior organization and mental aptitude. In truth the two may be readily contrasted, but not easily compared. The Fuegian bears a coarse but striking resemblance to the race to which he belongs, and every feature of his character assists in fixing his identity. The extremes of cold, with their many attending privations, by brutifying the features and distorting the expression of the face, reduce man to a mere caricature, a repulsive perversion of his original type. Compare the Mongols of Central Asia and China, with the Polar nations of Siberia. Compare also the Hottentot with the contiguous black tribes on the north; the Tasmanian negro with the proper New Hollanders; and lastly, the wretched Fuegian with the Indian beyond the Magellanic Strait; and we find in every instance how much more the man of a cold and inhospitable clime is degraded, physically and intellectually, than his more fortunate but affiliated neighbor. The operation of these perverting causes through successive ages of time, has obscured but not obliterated those lineaments which, however modified, point to an aboriginal stock.

Without attempting to enter the fathomless depths of philology, I am bound to advert to the opinion of Mr. Gallatin, that all the nations from Cape Horn to the Arctic Ocean, have languages which possess "a distinct character common to all, and apparently differing from those of the other continent with which we are acquainted;"

an analogy, moreover, which is not of an indefinite kind, but consists for the most part in peculiar conjugational modes of modifying the verbs, by the insertion of syllables. It has been insisted by some writers that this analogy proves the cognate relation of the Eskimaux and Indians. This, however is a mere postulate; for from the evidence already adduced in respect to the ethnographic difference between these people, we have a right to infer that the resemblance in their respective languages has not been derived by the greater from the lesser source,—not by the Americans from the Eskimaux, but the reverse: for the Asiatics having arrived at various and distant periods, and in small parties, would naturally, if not unavoidably, adopt more or less of the language of the people among whom they settled, until their own dialects finally merged in those of the Chepewyan and other Indians who bound them on the south.

The Eskimaux, it may be remarked, at the present time extend much further south, and are much more numerous on the western than on the eastern coast of America, being found as low down as Mount St. Elias; south of which, contrary to what is observed on the opposite side of the continent, they become more or less blended with the Indian tribes, and have imparted to the latter some portion of their mechanical ingenuity. This difference in the extent and influence of the western and eastern Eskimaux, is explained by the proximity of the former to Asia; and a redundant population has even forced some of them back to the parent hive, whither they have carried a dialect derived from the cognate tribes of America. Such are the Tsutchchi, who thus form a link between the Polar nations of the two continents.

It is a common opinion, also, that America has been peopled by the proper Mongols of central and eastern Asia; and volumes have been written on supposed affinities, physical, moral and intellectual, to sustain this hypothesis. We have already glanced at the Mongolian features, as seen, though rudely and extravagantly developed, in the Polar nations; but there are some characters so prevalent as to pervade all the ramifications of the great Mongolian stock, from the repulsive Calmuck to the polished and more delicately featured Chinese. These are the small, depressed, and seemingly broken nose; the oblique position of the eye, which is drawn up at the external angle; the great width between the cheek bones, which are not only high but expanded laterally; the arched and linear eyebrow; and lastly, the complexion, which is invariably some shade of yellow or olive, and almost equally distant from the fair tint of the European and the red hue of the Indian. Without attempting a detailed comparison, we may briefly observe that the Mongolian, in his various localities, is distinguished for his imitative powers and mechanical ingenuity, and above all for his nautical skill, in which, as we have suggested, he holds a place next to the nations of the Caucasian race. In fine, we are constrained to believe that there is no more resemblance between the Indian and the Mongol in respect to arts, architecture, mental features and social usages, than exists between any other two distinct races of mankind. Mr. Ranking has written an elaborate treatise to prove that the Mongols, led by a descendant of Genghis Khan, conquered Peru and Mexico in the thirteenth century; but in the whole range of English literature there cannot be found a work more replete with distorted facts and illogical reasoning. The author begins by the singular assertion that "when Cuzco was founded by Manco Capac, none of the civilization introduced by the Peruvians and Mexicans was in existence;" thus overlooking the cultivated tribes who preceded the Inca family, and disregarding also the various demicivilized nations which successively followed each other in Mexico, before that country fell under the rule of the Aztecs. Mr. Ranking introduces the Mongols in large ships, with all the appliances of war, not even excepting elephants; and in order that the Tartar general may correspond to Manco Capac, he is made to enter Peru by the Lake Titicaca, upwards of an hundred miles from the sea. Such statements may seem too absurd for sober discussion; but they are not more so than various other subterfuges which have been resorted to in explanation of the precise manner in which the new world has been peopled from the old.

But there is not a shadow of evidence that the Mongols ever reached America in ships excepting by mere accident; and therefore their number must have always been too small, and too badly provided, to have dreamt of conquest in a country which has had a population of millions from immemorial time.

There is a third view of this question which remains to be noticed; for, allowing that the Eskimaux and the cognate Polar nations are not the progenitors of the American race; and admitting also that the Mongols of central Asia could never have arrived in any requisite number by a direct voyage from one continent to the other, yet it is supposed by many learned men that these Mongols could have reached America by slow journeys from their own distant country; and that their hieroglyphic charts delineate many of the incidents of their journey: but there is no positive evidence in regard to direction and localities, although these, by a very general consent, are placed in the north and north-west. Cabrera, on the contrary, after the most patient research, aided by unusual facilities for investigation, traces the primal seat of the civilized nations of America to southern Mexico, where the ruined cities of Copan, Uxmal and Palenque, point to an epoch seemingly much more remote than any antiquities contained in the present metropolis of that country.

If we conventionally adopt the more prevalent opinion, and trace the Aztecs back to California or the strait, we have after all but a vague tradition of a handful of persons, who, for all we know to the contrary, may have been as indigenous to America as any people in it. The aborigines of this continent have always been of nomadic and migratory habits; a fact which is amply illustrated in the traditional history of Mexico itself. So also with the barbarous tribes; for the Lenape, the Florida Indians, the Iroquois, the insular Charibs and many others, were intruding nations, who, driven by want, or impelled by an innate and restless activity, had deserted their own possessions to seize upon others which did not belong to them. These nations, like their more polished neighbors, were in the constant practice of recording the events of their battles and hunting excursions by hieroglyphic symbols, made, according to circumstances, on trees, skins or rocks; and this rude but expressive language of signs, has been justly regarded as the origin of the picture-writing of the Mexicans. "The difference between them," observes Dr. Coates, "does not appear greater than must necessarily exist between ignorant warriors and hunters in a simple form of society, and those of the members of a complicated state, possessed of property, and even, as described by Clavigero, of a species of science and literature."

This gradation of the ruder into the more perfect art of hieroglyphic writing, not only affords an additional argument for the unity of orgin of the American nations, but also constitutes another proof of the distinctness of their race; for this picture-writing, even in its most elaborate forms, bears no other than the most general resemblance to any exotic hieroglyphics, nor indeed has a real equivalent been detected between them. We may therefore be permitted to repeat our conviction that the annals of the Mexicans bear no indisputable evidence of immigration from Asia; but, on the other hand, that they are susceptible of as many different interpretations as there are theories to be supported.

It is remarked by Dr. Coates, that the Mongolian theory, which we are now considering, is objectionable on account of its vastness. "To derive the population of the whole of the American continent from the north-western angle, requires the supposition of a continued chain of colonies during a long succession of ages, acquiring and using an immense diversity of languages, and pursuing each other along the huge ridge of the great American Andes, from Prince William's Sound in the far north, to the extremity of Terra del Fuego, a distance of one hundred and fifteen degrees of latitude, or of eight thousand miles. This long succession of occurrences is absolutely necessary to the theory; which is thus liable to the difficulty of requiring two extensive hypotheses at once. Several hundred colonies must be imagined to have issued from the same point, all completely isolated, as their languages abundantly show, unconnected by peaceful intercourse, but urging each other by war and the destruction of the game, throughout a third part of the circumference of the globe.

"The traces of such a series of human waves would be naturally looked for in a tendency to advance population in the north, from which they emanated, and where the pressure must have been greatest and the colonization of longest duration. Nothing like this is observed; the population of South America, and of Darien, Guatimala and Mexico, being much greater in proportion than that of any country farther north. The marks of early civilization, too, one of the most important proofs of long residence in a fixed spot, are all, as in the older world, in favor of the tropical climates."*

We may further inquire, how it happens that during the lapse of more than three hundred years since the discovery of America, there has not been an authenticated immigration from Asia? The long and desolating wars which have driven whole nations from the central to the northern parts of that continent, have not supplied a single colony to the New World. Nay, if such colonization had occurred within a thousand or two thousand years, would we not now possess more indubitable evidences of it in language, customs and the arts?

We propose in the next place, to make a very few observations in reference to the idea that America has been peopled by the MALAY race, which, in the ordinary classification, includes the Malays proper of the Indian Archipelago, and the Polynesians in all their numberless localities. These people, however, have so much of the Mongolian character, that nearly the same objections arise to both. The head of the Malay proper, is more like that of the Indian, because it not unfrequently presents something of the vertical form of the occiput; and the transverse diameter, as measured between the parietal bones, is also remarkably large. But excepting in these respects, the osteological developement coincides with that of the Mongolian; while the whole category of objections which we have just urged against the latter people, is equally valid in respect to the whole Malay race. For independently of differences of organization, how great is the disparity in their arts and social institutions! So great, indeed, that to account for it, Dr. Lang, one of the most ingenious supporters of the theory, insists on an intellectual degeneracy, consequent to change of climate and circumstances. "It is an easy and natural process," says he, "for man to degenerate in the scale of civilization, as the Asiatics have evidently done in travelling to the northward and eastward. He has only to move forward a few hundred miles into the wilderness, and settle himself

* On the Origin of the Indian Population of America. By B. H. COATES, M. D. 1834.

at a distance from all civilized men, and the process will advance with almost incredible celerity. For, whether he comes in contact with savages or not, in the dark recesses of the forest, his offspring will speedily arrive at a state of complete barbarism."

We confess our difficulty in imagining how the Polynesians, themselves a barbarous people, though possessing some of the attributes of civilized life, should become savages in the tropical regions of America, wherein the climate must be as congenial to their constitutions as their own, and the various other external circumstances are calculated to foster rather than to depress the energies of a naturally active and intelligent people. But the general prevalence of easterly winds is adverse to the colonization of America from the islands of the Pacific; for the nearest of these islands is one thousand eight hundred miles from the American coast; and when we reflect on the many difficulties which the mere distance opposes to navigation in small vessels, and the absolute necessity for food and water for a long period of time, we feel compelled to believe that America has received very feeble if any accessions to its population from the Polynesian islands. Such voyages, if admitted, could only have been accidental; for it is not to be supposed that these islanders would have attempted remote discoveries on the vast Pacific ocean in the very face of the trade winds; and a successful issue is among the least probable of human events.

Even admitting that the Polynesians have accomplished all that the theory requires, how does it happen that on reaching the continent of America, they should all at once have relinquished their intuitive fondness for the water, forgotten the construction of their boats, and become the most timid and helpless navigators in the world?

A comparison of languages, moreover, gives no support to the Polynesian hypothesis; for all the zeal and ingenuity which have been devoted to this inquiry, have tended only to disclose a complete philological disparity.

The theories to which we have thus briefly adverted, would each derive the whole American population from a single source; but various others have been hazarded of a much more complex nature, by which the Indian nations are referred to a plurality of races, not even excepting the Caucasian. For example, the Peruvians, Muyscas and Mexicans, are by some advocates of this system, supposed to be Malays or Polynesians, and all the savage tribes Mongolians ; whence the civilization of the one and the barbarism of the other. But we insist that the origin of these two great divisions must have been the same, because all their ethnographic characters, not excepting the construction of their numberless languages, go to enforce an identity of race.

Another doctrine which has had many disciples, (among whom was the late Lord Kingsborough, author of *Mexican Antiquities*) teaches that the whole American population is descended from the Jews, through the ten lost tribes which were carried away by Salmanazer, King of Assyria. Here again the differences of physical organization should set this question at rest for ever ; but independently of these, can we suppose that people so tenacious as the Jews, of their literature, language, and religion, should not have preserved a solitary unequivocal memorial of either among the multitudinous tribes of this continent, if any direct affiliation had ever existed between them ? In short, we coincide in opinion with a facetious author who sums up all the evidence of the case with the conclusion, that "the Jewish theory cannot be true for the simple reason that it is impossible."

We feel assured that the same objection bears not less strongly on every other hypothesis which deduces any portion of the American nations from a Caucasian source. In order to solve the problem of the origin of the monumenta of America, independently of any agency of the aboriginal race, an opinion has been advanced that they are the work of a branch of the great Cyclopean family of the old world, known by the various designations of the Shepherd Kings of Egypt, the Anakim of Syria, the Oscans of Etruria, and the Pelasgians of Greece. These *wandering masons*, as they are also called, are supposed to have passed from Asia into America at a very early epoch of history, and to have built those more ancient monuments which are attributed to the Toltecan nation. This view, supported as it is by some striking resemblances, and especially in architectural decoration, leaves various important difficulties entirely unexplained : it necessarily presupposes a great influx of foreigners to account for such numerous and gigantic remains of human ingenuity and effort, at the same time that no trace of this exotic family can be detected in the existing Indian population. They and their arts are equally eradicated; and we can only conceive of the presence of these migratory strangers in small and isolated groups, which might have modified the arts of an antecedent civilization, while they themselves were too few in number to transmit their lineaments to any aboriginal community.

Closely allied to this theory, is that of our ingenious countryman, Mr. Delafield, who derives the demi-civilized nations of America from "the Cuthites who built the monuments of Egypt and Indostan." He supposes them to have traversed all Asia to reach Behring's Strait, and thus to have entered America at its northwest angle, whence they made their way by slow journeys to the central regions of the continent. Our objections to this theory will be found in what has been already stated; and we may merely add, that the *route* by which the author conducts his pilgrim adventurers, appears to constitute the least plausible portion of his theory. Mr. Delafield supposes the barbarous tribes to be of a different stock, and refers them to the Mongolians of Asia; thus adopting the idea of a plurality of races.

We shall lastly notice an imaginative classification which separates the aborigines of America into four *species* of men, exclusive of the Eskimaux. This curious but unphilosophical hypothesis has been advanced by Bory de St. Vincent, a French naturalist of distinction, who considers the civilized nations to be cognate with the Malays, and designates them by the collective name of the *Neptunian species;* while to his three remaining species,—the Columbian, the American and the Patagonian, he assigns certain vague geographical limits, without establishing any distinctive characteristics of the people themselves. The system is so devoid of foundation in nature, so fanciful in all its details, as hardly to merit a serious analysis; and we have introduced it on the present occasion to illustrate the extravagance and the poverty of some of the hypotheses which have been resorted to in explanation of the problem before us.

Once for all I repeat my conviction, that the study of physical conformation alone, excludes every branch of the Caucasian race from any obvious participation in the peopling of this continent. If the Egyptians,* Hindoos, Phenicians or Gauls have ever, by accident or design, planted colonies in America, these must have been, sooner or later, dispersed and lost in the waves of a vast indigenous population. Such we know to have been the fact with the Northmen, whose repeated, though very partial settlements in the present New England States, from the tenth to the thirteenth centuries, are now matter of history; yet, in the country itself, they have not left a single indisputable trace of their sojourn.

In fine, our own conclusion, long ago deduced from a patient examination of the facts thus briefly and inadequately stated, is, that the American race is essentially separate and peculiar, whether we regard it in its physical, its moral, or its intellectual relations. To us there are no direct or obvious links between the people of the old world and the new; for even admitting the seeming analogies to which we have alluded, these are so few in number and evidently so casual as not to invalidate the main position: and even should it be hereafter shown, that the arts, sciences and religion of America, can be traced to an exotic source, I maintain that the organic characters of the people themselves, through all their endless ramifications of tribes and nations, prove them to belong to one and the same race, and that this race is distinct from all others.

This idea may at first view seem incompatible with the history of man, as recorded in the Sacred Writings. Such, however, is not

* With respect to the Egyptians and Hindoos as involved in this question, I can speak without reservation. Through the kindness of an accomplished gentleman and scholar, George R. Gliddon, Esq., late United States Consul at Cairo, I have received ninety heads of Egyptian mummies from the tombs of Abydus, Thebes and Memphis; and I unhesitatingly declare, that, with a very few exceptions, which have a mixed character, and resemble the Coptic form, the conformation throughout is that of the Caucasian race. In every instance in which the hair has been preserved, it is long, soft and curling, and indeed as silky as that of the most polished Europeans of the present time. I am now preparing, with the title of *Crania Ægyptiaca*, a brief exposition of the facts connected with these interesting relics of antiquity.

I possess also about thirty crania of the Hindoos, among which there is not one that could be mistaken for an Indian skull. In fact there is an obvious contrast between them in all respects excepting the internal capacity, which is nearly the same in the Hindoo and Peruvian.

the fact. Where others can see nothing but chance, we can perceive a wise and obvious design, displayed in the original adaptation of the several races of men to those varied circumstances of climate and locality, which, while congenial to the one, are destructive to the other. The evidences of history and the Egyptian monuments go to prove that these races were as distinctly stamped three thousand five hundred years ago as they are now; and, in fact, that they are coeval with the primitive dispersion of our species.

Bengal Isinglass.

The following certificate relative to the quality of Bengal Isinglass, must be very gratifying to those who are interested in the introduction of new staple productions of this country. It would appear from the advices received on the subject by the last Mail, that the article from the first proved superior to what it was acknowledged to be by buyers, who seem to have been chiefly anxious to obtain it as cheap as possible.

It may be unreasonable to blame them for this, although they have undoubtedly counteracted their own interests by depreciating the article below its fair value, as compared with the Isinglass of other countries. The samples sent into the market, though large, were only submitted experimentally in order to ascertain the quality of the article, and the unbiassed opinion of dealers and manufacturers as to its real value. Had the buyers and manufacturers received them in this light, and fairly and readily acknowledged the result in the first instance, it would have led at once to the necessary steps being taken in Bengal, where the experiments originated, in order to ascertain the nature and source of the supply.

At present, this great practical object, like some others, seems likely to be allowed to stand over for a time until revived again by accident, and this merely for want of that attention to the fisheries of the country which their importance demands.

The first essential step in the matter would be, a proper investigation of the habits of the Suleah fish, as to the period of its approach to, and departure from, particular points of the coast, the variations as to time and place of the shoals, and the certainty and extent to which fisheries for this species might be carried on.

Messrs. J. Cockburn *and Co.*

Romford Brewery, Jan. 23, 1844.

Dear Sirs,—I am much gratified in being able to report most favourably of the East India Isinglass our firm had of you, having found that it dissolves very freely in sours to a firm clear jelly, and makes capital finings, especially for brown and running Beers. I have tried it on our own, and found that the Beer was quite bright in eight hours after fining, and have no doubt but that if the quality is still kept to that already sent, it will in a great measure supersede the higher priced Isinglass.

I am, Dear Sirs,
Yours most sincerely,
(Signed) H. Smith,
For Ind and Smith.

P. S.—I have given a portion to my brother to report upon, and his analysis was 95 @ 96 per cent. of gelatine, and 5 per cent. of animal fibre, insoluble in acids.

On the above we may remark, that the quality may be still farther greatly improved, and never be inferior to that which has already been sent home from Bengal.

THE

CALCUTTA JOURNAL

OF

NATURAL HISTORY.

Apodal Fishes of Bengal. By J. McClelland, *Bengal Medical Service.*

Artedi, the author whose classification of fishes formed the basis of the system proposed by Linnæus in regard to these animals, distinguishes two great classes, cartilaginous and bony, as relates to the material of which the skeleton is composed. The cartilaginous are, as every body knows, the Sharks, Rais, Lampreys, &c.

The fishes with bony skeletons being by far the most numerous and diversified, are divided into three orders, according as the gills are supported by bony arches, and the fins by rays or spines.

Linnæus introduced another element into the principle of their classification, founded on their peculiarities in regard to ventral fins, which simplified their arrangement greatly. The following are the brief expressive characters by which the great Swedish naturalist distinguished the class of fishes into six orders:—

1. *Apodal.*—Ventral fins, none.
2. *Jugular.*—Gills bony, ventral fins placed before the pectorals.

3. *Thoracic.*—Gills bony, ventral fins placed directly under the throat.
4. *Abdominal.*—Gills bony, ventral fins placed behind the throat.
5. *Branchiostegius.*—Gills without bones.
6. *Chondropterigius.*—The skeleton cartilaginous.

The number prefixed to each order is not here to be supposed as having any reference to its relative rank in regard to organization; the arrangement of Linnæus had for its object merely the convenience of students, and not the arrangement of Species according to their natural affinities. In order however, to render the series more natural, the Apodal fishes should stand 5th in accordance with the scale proposed by Cuvier, in which case the 6th order should then become 1st in place of apodes, in accordance with the views of Mr. MacLeay and of Mr. Swainson. To render the series perfectly natural, the orders themselves would require revision, together with the families and genera of which they are composed.

The object of the present paper is a revision merely of the Apodal order, founded on the results of an examination of Asiatic, but particularly of Bengal, species.

The results will shew how highly essential such a revision had become, and that it could not be any where better effected than upon the spot where such numerous undescribed and unknown forms of the peculiar animals in question occur.

It may indeed have fallen into hands unfitted for the task, but the advantages of position, and the extensive assistance derived from friends who have supplied specimens from many distant places, more than counter-balance the author's incapacity, as compared with the nature and object of the undertaking.

The Apodal order in the *Systema Naturæ* of Linnæus, consists of all bony fishes without ventral fins, as follows:—

1. Muræna. 5. Anarrhichas.* 9. Xiphias.*
2. Gymnotus. 6. Ammodytes. 10. Sternoptyx.*
3. Gymnothorax. 7. Ophidium. 11. Leptocephalus.
4. Trichiurus.* 8. Stomateus.*

The five genera marked with an asterisk are transferred to other orders by Cuvier, who introduces in their place, certain genera which were subsequently discovered.

With regard to the original genera, as well as those which have been subsequently introduced, such only as are represented by Indian species will be here noticed.

In the *Systema Naturæ* as well as in the *Règne Animal*, the genera all stand unconnected. In the latter they are said to form but a single family, distinguished " by their elongated shape, thick soft skin, which almost renders their scales invisible. They have few bones, and no cæcal appendages to the pyloris." The following is the order in which they are placed by Cuvier.

Order.	Family.		
Malacopterygii, Apodes.	Anguilliformes, Cuv.	*Anguilla*, Cuv.	
		Conger, Cuv.	
		Ophisurus, Làcep.	
		Muræna, Thunb.	
		Sphagebranchus,* Bl.	
		Monopterus,* Commers.	
		Synbranchus, Bl.	
		Alabes, Cuv.	
		Saccopharyux, Mitch.	These genera being all natives of Europe and America have no East India species.
		Gymnotus, Làcep.	
		Carapus, Cuv.	
		Sternarchus, Schn.	
		Gymnarchus, Cuv.	
		Leptocephalus, Penn.	
		Ophidium, Linn.	
		Fœrasfer, Cuv.	
		Ammodytes, Lin.	

The following is a brief notice of the genera as they stand in the *Règne Animal*:—

1. *Anguilla*, Cuv. Of this there are several species in the East, all which are distinct from those of Europe.

2. *Conger*, Cuv. Of this genus there are no species in India. The one referred to it by Cuvier from Russell's Indian Fishes is quite distinct, and forms a separate genus.

which is here named *Muræncsox*, of which we have several species, occupying in India an equivalent place with the Congers of Europe.

These three genera have the pectoral fins distinctly developed, and the dorsal and anal united, as well as other common characters. It is proposed to distinguish them as a separate family, which is here named ANGUILLIDÆ.

3. *Ophisurus.* Of this genus there are several species in India. It possesses, in common with the genus *Leptognathus* of Mr. Swainson, the naked tail caused by the termination of the dorsal and anal before they reach the end of that organ, for which reason it is proposed to form these genera into a family here named OPHISURIDÆ, sufficiently distinguished from the first by the interruption of the dorsal and anal, as already noticed, as well as by their small pectorals.

Sphagebranchus imberbis, Laroach, Annal du Museum xiii. Muræna maculosa, Cuv. figured as Ophisurus ophis, Làcep. 11, t. 6, f. 2, and Muræнophis Colubrina, Làcep. V. t. 19, f. 1, form a third genus, which is here named *Ophithorax.* It is distinguished by the smallness of the pectorals, and also belongs to the *Ophisurid*æ.

4. The genus *Muræna,** it is also proposed to raise to the rank of a family, MURÆNIDÆ. The Bengal species present the palatines so compressed, that the teeth peculiar to these bones occupy the place of those of the vomer. Species in which the teeth of both palatines form a single row along the centre of the roof of the mouth, it is proposed to distinguish as a genus here named *Lycodontis.* Those in which there are separate ranges of palatine teeth, anteriorly, though they may be united posteriorly, it is ventured to name *Thærodontis.* Both these genera are distinguished by the articulation of long, scattered, conical teeth in front of the jaws to a moveable pedicle, by which means they are capable of being raised or retracted, according to circumstances.

* *Gymnothorax* Bl. and *Murænophis,* Lacepede.

5. The species described in Russell's Indian Fishes, No. 37, as *Manti Bukram-paum,* and referred by Cuvier to the genus Spagebranchus, Bl. belongs to the genus *Dalophis* of Rafinesque, which, as well as the genus *Gymnomuræna,* Làcep., and *Uropterygius concolor,* Rüppell's fishes of the Red Sea,* belong to *Murænidæ.*

The three families above noticed have the branchial apertures double, the heart situated between them, and the intestinal aperture at, or before the middle of the body; it is here ventured to name them as a tribe, ANGUILLIFORMES.

6. The following families are, on the contrary, distinguished from them by the heart being placed behind the branchial apertures, and the intestinal aperture far behind the middle of the body; they are here, as a tribe, named OPHICARDIDES. For a time I felt disposed to follow the example of other writers in referring to *Synbranchus, Monopterus, Sphagebranchus,* and *Apterichthes* of the *Règne Animal,* certain Bengal species which have inconsiderately been supposed to belong to those genera.

7. The supposed genus Sphagebranchus has been a receptacle for species with or without pectoral, or indeed any, fins whatever. Some of the species referred to it belong to *Ophisuridæ* and *Murænidæ,* others will be found either to belong to the various genera of one or other of the above tribes, according as the intestinal aperture is at the middle of the body or further back towards the tail. That the genus Sphagebranchus is unnatural, no further evidence is necessary, than the number of very opposite forms that have been referred to it. The only Indian species that has been supposed to belong to it, is certainly a *Dalophis* of Mr. Swainson.

8. The Apterichthes, are Sphagebranchi without fins. The only one I have seen described, is the Apterich. cæca, Laroach, Annal du Mus. xiii. t. 21, f. 6. It is here referred

* This work contains numerous Indian species, and ought to be in every public Library.

to the *Gymnomuræna* of Làcepede, the intestinal aperture being stated to be before the middle.

9. The genus *Monopterus* depends only on the MS. description of a single specimen found by Commerson in the Straits of Sunda. The branchial apertures are said to be united under the throat in a transverse fissure divided in the middle by a partition, and the teeth are said to be like those of a card. In the *Règne Animal* it is said, there are six rays in each branchial membrane, and a species of *Synbranchus* figured under another name, (Làcep. vol. V. xvii, 3,) is supposed by Cuvier to be the species described by Commerson. In the original description, (Làcep. vol. ii. p. 140,) it is said there are but three rays in the branchial membrane. Of four different genera inhabiting India, that which comes nearest to the description of Commerson's species, has five rays in the branchial membrane, of a size not likely to allow of their being mistaken.

I have been unable therefore to refer any species to the genus *Monopterus*, however I felt inclined to do so, because of the uncertainty of the characters assigned to it, and the number of genera presenting a very considerable diversity of structure, which almost equally approach it in appearance.

10. Several Indian species have been referred to the genus *Synbranchus*, Bl. They are nevertheless, perfectly distinct from that genus.

The *Synbranchi* properly so called, with a longitudinal fissure under the throat, are all natives of the coast of Guinea. One of them, *Synbranchus immaculatus*, is said to be found at Surinam and Tranquebar; on what authority the latter locality is stated by Làcepède, does not appear. We may be pretty certain, however, that the Tranquebar species is either the *Cuchia* of Buchanan or the *Dondoopaum* of Russell, since no species having a single longitudinal branchial aperture under the throat, has been found in

India by any author. Thus the error of confounding our Indian species with the *Synbranchi* of Bloch, and *Unibranchapertura* of Làcepede, would appear to have originated in a mistake regarding the locality of one of the species.

Synbranchus is an Ophicardious genus, having a single longitudial aperture under the throat, several rows of small blunt conical teeth, and a blunt round muzzle without tubulated nostrils. They are said to be furnished with a long narrow natatory air-vessel. Their branchiæ are not described further than that the membrane contains six strong rays.

11. The remaining genera, with the exception of *Alabes*, are all composed of species which are foreign to India. *Alabes*, however, depends upon a small species of the Indian ocean, which differs from *Synbranchus* in the presence of pectoral fins. American and European genera, appear to be deficient in Ophicardious forms, which would seem to be chiefly confined to Africa and Asia. Whether from geographical or other causes, there seems, as far as relates to fishes, a much greater uniformity between India, the coast of Guinea, and the eastern coasts of China to the 30° N. Lat., than with any other corresponding tracts of the same extent.

12. *Synbranchus*, *Saccopharynx* and *Alabes* are the only genera hitherto known in which we can, *a priori*, suppose the heart to be situated behind the branchial apertures; as they have not been examined with a view to this point, it remains to notice briefly the general peculiarities of several Bengal genera, here for the first time brought forward in which this peculiarity is most remarkable.

First. Pneumbranchus. The intervals between the branchial arches are nearly obliterated. The place of pectinated branchial combs is supplied by means of a sack which opens into the mouth over the end of the first arch on either side, the body is cvoered with small imbricated scales, the teeth are placed in two rows, one on the palatines and the other on the maxillaries.

Second. Ophicardia. The branchial arches are open and free, the gills are slightly pectinated, the teeth are disposed in a band on the palatines and another on the maxilliaries, no scales.

Third. Ophisternon. The gills are fully pectinated, the branchial membranes of both sides are united in one common cavity, the eyes are placed near the extremity of the muzzle, no scales.

In these genera there are no teeth on the vomer, and the gills have bony arches, though not pectinated in some. In these respects, as well as in regard to the single branchial aperture under the throat, they correspond with *Synbranchus*, Bl. with which they form one common family, Synbranchidæ.

13. The next family to be noticed, is distinguished by the almost total absence of bony arches to the gills; these last are somewhat fan-shaped, from which circumstance the family is named Ptyobranchidæ.

Of this family I have as yet found but one genus, Ptyobranchus; it is possessed of pectoral fins; the fins are all supported by rays as in ordinary fishes; there are two apertures to the branchiæ, and the palatines are compressed so as to form a single row of teeth on the roof of the mouth, corresponding with those of the vomer in other genera, as already pointed out in some of the *Murænidæ*. Hence the disposition of the Apodal order will stand as follows:—

ORDER APODES.

Tribe.	Family.	Genus.
ANGUILLIFORMES, J. M.	Anguillidæ, J. M.	*Anguilla*, Cuv. *Conger*, Cuv. *Murænesox*, J. M.
	Ophisuridæ, J. M.	*Leptognathus* Swains. *Ophisurus*, Làcep. *Ophithorax*, J. M.
	Murænidæ, J. M.	*Dalophis*, Rafinesque. *Thærodontis*, J. M. *Muræna*, *prop.* (J. M.) *Lycodontis*, J. M. *Gymnomuræna*, Làcep.

Tribe.	Family.	Genus.
		Alabes, Cuv.
OPHICARDIDES, J. M.	SYNBRANCHIDÆ, J.M.	*Ophicardia*, J. M.
		Pneumabranchus, J. M.
		Ophisternon, J. M.
		Synbranchus, Bloch.
	PTYOBRANCHIDÆ, J.M.	*Ptyobranchus*, J. M.
	{American and European groups are omitted.}	

14. It will be necessary now to point out wherein the terms ***Anguillidæ***, ***Murænidæ***, and ***Synbranchidæ*** as here used, imply a different meaning from the sense in which they are employed by Mr. Swainson in his work on the classification of Fishes. The arrangement proposed by this author, differs from that of Linnæus in omitting the jugular and thoracic orders, and introducing cartilaginous and semi-cartilaginous fishes as two distinct orders in their place, thus making the spinous fishes the first, and the soft-finned the second order, placing *Apodal* fishes last. The *Apodal* fishes he disposes as follows:—

	Family.	Genus.
ORDER V.—APODES, Sw.	MURÆNIDÆ, Sw.	*Anguilla*, Sw.
		Ophisoma, Sw.
		Ophisurus, Lacep.
		Leptognathus, Sw.
		Pterurus, Sw.
		Muræna, Sw.
		Nettastoma, Raf.
		Pachyurus, Sw.
		Muræna, Antiq.
		Dalophis, Raf.
		Ophiognathus, (*Saccopharynx*), Harwood.
		Ichthyophis, Less.
		Alabes, Cuv.
	SYNBRANCHIDÆ, Sw.	*Sphagebranchus*, Bl.
		Monopterus, Commers.
		Synbranchus, Bl.
		Ophichthes, Sw.
	STERNARCHIDÆ, PTEROMYZONIDÆ, CYCLOPTERIDÆ.	*No Bengal species known of the first and third of these proposed families, and the second belongs to cartilaginous fishes.*

Thus it will be seen, that the *Murænidæ* of Swainson not only embrace both the *Murænidæ* and *Anguillidæ*, but several Ophicardious genera: for it must be observed that, Pterurus and Pachyurus, Swains. are genera founded upon an imperfect knowledge of two drawings of *Ptyobranchus*, derived by Mr. Gray from the Buchanan MSS.* and erroneously named by him as two genera, Moringua and Rataboura.

The *Murænidæ* of Swainson thus contain some species with, and some without bony arches to the gills; some species with, and some without pectoral fins; some with one, and others with two branchial apertures; some having the heart placed before, and some with that rather important organ behind the branchial apertures. It is consequently an unnatural family, composed of all varieties of form and structure, brought together without due regard to character and affinity.

Of the *Synbranchidæ* of Swainson it is necessary to observe, that the genus *Synbranchus* of Bloch, is the only one having any reference to nature. It has already been shewn that the *Sphagibranchi* of Bloch, are an assemblage of species referable to several genera, and probably to more than one family. It is unnecessary to repeat what has been said above of the genus *Monopterus*. As to *Ophichthes*, Swainson, it is sufficient to say that it is intended for the *Cuchia* of Buchanan, although it makes the under-jaw shorter than the upper, the nostrils single, and the body without scales—characters any one of which it does not possess. The term *Anguillnæ* occurs in the text of Mr. Swainson as intending to imply a subdivision of *Muraenidæ*, not to be found in the Synopsis of his work.

* Vid. Asiat. Res. Bengal, vol. xix. p. 221.

II.—*On the characters of Apodal Fishes.*

1. For want of a due regard to the proper characters by which to distinguish the animals of this order, together with the great uniformity in external shape which they present, great inaccuracies are to be found in the notices of naturalists regarding the identity and distribution of the species.

To obviate this, as well as to introduce more exactitude into our views and observations regarding them, the following remarks are brought together, as a summary of those characters which appear to be of most utility in the practical examination and discrimination of these groups.

In the order of fishes now under consideration, the abdominal fins, corresponding with the lower extremities, are wanting; hence the name *Apodal.**

The absence of ventral or abdominal fins, is therefore an essential character of the *Order*, although other fins are frequently deficient in like manner. The pectoral fins are also wanting in two-thirds of the known species, the caudal fin is absent probably in one-tenth of the species; and some are without any fins whatever, unless we can allow a mere fold of the skin, unsupported by fin-rays, to be such. These membranous expansions are however, scarcely to be regarded as fins strictly speaking, any more than the analogous organs of the *Manatus* and other marine Mammalia, in which instead of rays, we find all the bones proper to limbs of quadrupeds. Indeed these finless fishes have

* As the anterior extremities of other vertebrated animals are represented in fishes by the pectoral fins, so the posterior extremities are represented by the ventrals. The functions of the posterior extremities are subject to fewer modifications than the anterior which, serve as hands, feet, or wings, according to the order of nature to which the animal belongs. Throughout the whole of the vertebrata, with the exception of fishes and marine mammalia, the functions of the posterior extremities are the same. Hence we have one reason for coinciding with Mr. MacLeay, in regarding fishes as the most imperfect of *vertebrata*. Vid. *vol.* II. *p*. 263.

been justly regarded as bearing a very near approximation to serpents.

The fin-rays in this order, particularly those of the dorsal and anal fins, are generally composed of a single piece, neither jointed nor branched, but shaped like the bony spines of other fishes, from which they differ in always being soft, nevertheless the rays of the caudal fin when present, are frequently finely jointed and a little branched, as well as those of the pectorals.

2. *Branchial Apertures.*—These organs which are constant throughout the class, are subject to many peculiarities. In cartilaginous fishes, they consist of several simple transverse fissures on each side. In fishes possessed of a bony skeleton, there is a single aperture on either side, and this is usually furnished with a bony frame-work, consisting of a posterior jamb which is fixed to, or forms a part of the bones of the shoulder, and a lid, consisting generally of one or more thin bony plates called opercula, which are connected by means of a hinge-like joint to the bones of the head. This apparatus peculiar to fishes, is highly characteristic of them, since there is nothing like it in any other class of animals.

In the order now under review, the branchial apertures have lost the posterior jamb, as well as the bony plates forming the operculum, and these parts where they do exist at all in this order, are found to do so only in a minute rudimental form. The branchial apertures in Apodal fishes are therefore soft and contracted, and in some, they are both united in a single opening, of which there is no example in any other order.

3. *Branchial Rays.*—The rays supporting a membranous valve situated beneath the operculum, called the *branchial,* or branchiostegal rays, are peculiar to fishes having a bony skeleton. They undergo a great many singular changes in the order now under review. In some they

are very strong and bony, in others long, slender, and cartilaginous; in others soft and thread-like, and so slender as to be scarcely perceptible. They are, however, as well as the operculum always present, but occasionally in so slight a degree, as to render their utility in the economy of some species very doubtful.

4. *Dentition.*—The teeth are generally disposed in rows and bands, except in one or two genera in which they are crowded. They are disposed on either side of both jaws. The bones on which the teeth are situated are the palatines, maxillaries, intermaxillaries, lower maxilla, and vomer; together with the pharangeal bones connected with the last branchial arch.

These bones undergo a great diversity of form, producing corresponding changes in the distribution and situation of the teeth; the most important of which is, the contraction of breadth in the palatines of *Murænidæ.* Generally throughout the order, wherever there is but a single row of teeth on the edge of the upper jaw, that row is planted on the maxillaries. The palatine teeth in such cases occupy a position corresponding with those of the vomer in other orders.

There are usually four clusters or rows of minute teeth, situated at the entrance of the œsophagus. The teeth are conical, rather short and obtuse in some; long, sharp and slender in others, and generally slightly hooked or recurved towards the points.

In some, the vomer teeth are compressed; in others, conical. This last kind are sometimes fixed to a moveable pedicle, and are capable of being retracted or drawn flat down upon the jaws. This peculiarity, if it exists in European species at all, has hitherto been overlooked by naturalists.

5. *Colour.*—This is generally connected with the scales of fishes. The species composing the order now under review, have been generally supposed to present their scales

buried in the cells of a thick skin; but the truth is, some are totally without any traces of scales whatever; some have regular imbricated scales as in ordinary fishes; and others have scales with approximated edges, not imbricated as in ordinary fishes, but disposed in groups of a tessellated form. In all cases when present, the scales are minute; the cuticle is thick and opaque, somewhat thicker than in other fishes.

The colours of Apodal fishes in general are little diversified, and whatever variation there is, runs for the most part through particular genera. There are no species presenting vivid colours, and there are perhaps no more than two or three colours observable in various shades throughout the order; viz. dark olive-green, passing into black, and reddish, or yellowish-white.

The lower parts of the body as far back as the intestinal aperture, are generally a dirty white; and above dark olive-green is the prevailing colour; sometimes the sides and upper parts are more or less distinctly marked and clouded with rings of these colours, occasionally obsure; sometimes they are marked with more distinct spots of dark, or blackish green on a lighter ground; more rarely these parts are marked with small marbled specks; and more rarely still, the body is dirty-whitish, with, or without dark spots.

6. *General form.*—As regards their outward appearance there is little variety, and such as we do observe, seems to belong to, or run through particular genera. They are all extremely elongated, and more or less cylindric. The tail is generally more compressed than the body, and the anal and dorsal fins which have no immediate relation to any organs of the higher classes of vertebrate animals, are the most constant of all such appendages to the outward form in this order. On the other hand, the pectoral and caudal fins are frequently wanting; the ventrals are always wanting in this order, which gives them a naked uniform appearance, resembling the form of a serpent.

This is particularly the case with certain genera, in which there is no appearance of any fins whatever, beyond a mere duplicature of the skin near the end of the tail.

7. The *head* is very variable in its shape throughout this order; in some species it is depressed and triangular; in others conical; in others, narrow and high behind the eyes; but in all the muzzle is narrow. The nostrils have two apertures on either side; one generally tubular placed near the extremity of the muzzle, the other generally placed far back, sometimes even behind the eyes. The eyes are always small, and placed laterally. The mouth is generally moderately cleft, but always extending back as far at least as the eyes. The intestinal aperture is variously placed according to the internal structure of these animals.

8. *Internal structure.*—Having noticed briefly those parts which are best calculated to afford the means of distinguishing the genera and species of this order, it remains to point out one or two circumstances of primary importance that have been overlooked in their structure, and which must in future exercise a great influence with regard to their general arrangement.

First, as to the situation of the heart. In some we find this organ placed as in ordinary fishes near the gills, or at least no farther back than the branchial apertures.* In these the intestinal aperture is placed about the middle, or sometimes before the middle of the body. In others, we find the heart placed considerably behind the branchial apertures, leaving a long thorax which carries the abdominal cavity farther back as in serpents, and places the intestinal aperture considerably behind the middle of the body, reducing proportionally the length of the tail. The East Indian species

* Le cœur des poissons est situé dans une cavité particuliére, creusée dans l'angle que laissent entre'elles en arriére les deux ouies, ou fentes branchiales, &c. *Cuvier Lecons d'Anat. Comparée t.* iv. *p.* 226.

possessed of this peculiarity are without any air-vessel,* but they have all an extremely elongated liver, either extended to, or situated at the posterior extremity of the abdomen.

The heart is enclosed within a strong serous membrane or pericardium, which is united externally to the parieties of the thorax, forming a partition between that cavity and the abdomen. The heart is fixed within the pericardium merely by the great blood vessels passing to and from it. It is of a short compact oval figure generally in *Anguilliformes*, but larger, more oblong and pointed at the extremities in *Ophicardides*. In the former the branchial vessels generally pass directly to and from the apex of the heart; in the latter they seem to pass with the great aortic and venous vessels which enter and emerge about the middle of the heart between that organ and the spine. The heart consists generally of a single ventricle and auricle. In some the ventricle appears to be double, as in *Ophicardia Phayriana;* in others the auricle performs the function likewise of a ventricle, transmitting a portion of the blood by the branchial arteries to the gills, as in those cases in which the branchial vessels emerge from the apex of the heart.

9. With regard to the gills; in some these are fully developed as in ordinary fishes, consisting of pectinated combs supported by smooth bony arches. In others, the gills retaining their pectinated form, have lost the bony arches which ordinarily support them. In others, the bony arches are indeed found as naked symbols, but without function or use, having no gills strictly speaking, or pectinated branchial combs attached to them.

Thus oscillating as it were between fishes and amphibia, they preserve the decided characteristics of the former, presenting at the same time, many decided relations to the latter. The want of pectinated gills is compensated for by means of

* Cuvier assigns this organ to the genus *Synbranchus*, Bl. We do not however find it in any of the East India Ophicardians.

a branchial sack of which there is no other example in the animal kingdom, and which seems to be a special provision by means of which, nature passes from the purely aquatic type, to animals adapted to the respiration of air.

Affinities of Apodal Fishes.—The sequence of genera resulting from the Analysis of Indian species as far as it goes, corresponds nearly with that previously attained by Baron Cuvier, as may be seen on comparing the order as it stands p. 153, with our own results p. 158-59.

The nine first genera of Cuvier's list, p. 153, form the only portion of the order which we have been able to illustrate with Indian species. Two of the genera we have been unable to adopt, and to the remaining seven, we have added ten additional genera, the whole being separated into two tribes and five families, to which we have endeavoured to assign natural characters.

Without referring to the general affinities of Fishes,* it will be sufficient on the present occasion to notice those of Apodal species merely.

Commencing with the genus *Anguilla,* Cuv. we perceive a very great difference of form between the flat, triangular, depressed head, tessellated scales, and broad projecting lower jaw of *Anguilla brevirostris,* as compared with the naked skin, and compressed narrow head of *Anguilla acutirostris* which leads to the genus *Conger,* in which the head is narrow, and the jaws and fins more elongated, passing into the form of *Murænesox.* From this last the transition is easy and natural to the genus *Leptognathus* of Swainson, both these genera having elongated narrow pointed jaws. In the first, the dorsal fin attains its maximum development, having advanced in front of the pec-

* On this subject the reader is referred to the letter of Mr. W. S. Macleay, vol. ii. p. 263. It would be difficult to express the extent of our obligations to that great naturalist, for the rough outline in question.

torals. In the second, that organ begins to lose a portion of its importance, and its connection with the anal by means of the caudal fin, becomes interrupted and broken off. This change exercises an important influence over the habits of these animals, and introduces another family, *Ophisuridæ*, of less rapacious habits than the last.

It is composed of species which, from the absence of the caudal fin, are less capable of making the violent and sudden spring essential to the more rapacious kinds, and for which they are so well adapted.

Nothing can be more simple and complete than the transition by which nature passes here from one extreme to another, in the organization and functions of animals.

The change from *Anguilldæ* to *Ophisuridæ*, where these families approach each other by means of *Murænesox* and *Leptognathus*, affords an interesting instance of the ease with which the most opposite characters become blended together in the works of nature. The essential character of the family to which *Leptognathus* belongs, consists in the want of a caudal fin, but as it is still necessary to retain some function of the preceding genus to which its structure is allied, the extremities of the anal and dorsal are rendered broad and dilated, so as to compensate in this species for the imperfections of the family to which it belongs.

Passing through the *Ophisuridæ*, we find the pectoral fins begin to diminish in size until they become barely perceptible as in Sphagebranchus imberbis, and some other species of which we make the proposed genus *Ophithorax*. These last form a natural transition to the *Murænidæ*, in which there are no pectoral fins whatever.

The first genus of *Murænidæ* affords some species evincing an affinity to the preceding family, by the absence of the caudal fin; and one of them, *Dalophis*, which leads us back again to the ordinary type, presents a repetition of the increased development at the end of the dorsal and anal, thus tending once more to the restoration of the caudal fin, which we are thus led to expect as one of the characters of the remaining genera.

Passing through this family we find the development of the vertical fins gradually diminish on the anterior parts of the body, until we arrive at the *Gymnomaræna* of Làcep. in which the only fin they possess is confined to the extremity of the tail.

We know how differently the structure of an animal may turn out to be on examination, from what we previously expect to find it before hand. Not having met with any species of *Alabes* or of *Saccopharynx*, it is with some doubt therefore, that we refer to them in this place. They are distinguished from all preceding fishes, by having but a single branchial aperture. Hence they appear to form a transition from the Anguilliform to the Ophicardian type: but which of the two tribes they really belong to, can only be determined by their further examination. The single branchial aperture indicates a form, leading either to, or from, the family *Synbranchidæ* from which it is distinguished by the presence of pectoral fins. In the order of affinities, the genus *Ophisternon* seems to succeed next after the American genus *Saccopharynx*, particularly if we may judge of the form of the body, and the situation of the eyes close to the end of the muzzle. In this genus the branchiæ are fully developed, although provided with only one large external aperture. In the next genus *Ophicardia*, the pectinations of the branchiæ become less marked; both these genera are without scales. They are followed by *Pneumabranchus*, in which the gills are supplied with a peculiar sack on either side for the respiration of air. The external aperture leading to the gills in the last three genera, is transverse; in the two last, it diverges internally on either side by a short passage to the branchiæ. These genera are followed by *Synbranchus*, which is composed of species distinguished from them by a longitudinal opening to the branchiæ, but in which the gills appear to be fully developed.

This genus coming after, as it could not (in consequence of the longitudinal direction of the branchial aperture) come before *Pneumabranchus*, evinces a return of the affinities from the Amphibious character of that genus. This is still more perceptible in the succeeding genus *Ptyobranchus*, in which the restoration of the pectoral fins evinces a return of the affinities from the Amphibious type to the ordinary character of fishes, still better marked by two branchial apertures, as well as two pectoral fins.

Thus we observe in passing from one extremity of the order to the other, a regular succession of affinities leading from a short flat, to an elongated narrow head, and from thence to a prominent development of fins on the anterior parts of the body, with a corresponding deficiency behind; from thence we return again to the great development of fins behind, with a corresponding deficiency on the anterior parts, thus completing the circle of the first tribe. Recommencing again where we left off, we pass through species almost destitute of any fins whatever, and losing even the gills of fishes which become partially replaced by organs suited to amphibious respiration. Still led by the succession of affinities, we are conducted back to the characteristic form of fishes, distinguished once more by fins and gills.

The result is, that the affinities of Apodal fishes are circular throughout the order, as well as in each of the minor groups here proposed, and that they will be found to afford numerous analogous, or corresponding points with the various other orders of fishes.

III.—*On the Classification of Apodal Fishes.*

The following is the manner in which we dispose of the classification of this order, founded on the characters of Indian species.

Class Pisces.

Ord.—MALOCOPTERIGII APODES, *Linn.*

Fishes of an elongated cylindric shape, with soft branchial apertures, smooth skin; covered with a thick mucus, without external bony spines, or ventral fins. Their skeleton presents little more than the bones of the head and spinal column, which last is greatly developed. Their teeth are generally either numerous, or very prominent. The intestines are narrow, and short, without cæca.

The nasal apertures are double on either side, and the two openings are placed wide apart: one being generally near the eyes, the other, which is mostly tubular, is near the end of the muzzle.

The pores from which the mucus exudes, are situated along the muzzle and lateral line.

I.—*Tribe,* ANGUILLIFORMES, J. M.

The heart is situated between the branchial apertures, which are small, and placed one on either side. The stomach is a long blind sack, with the entrance to the intestine situated in front, near that of the œsophagus, where it is guarded by a strong valve. The vent is never behind the middle. The gills are pectinated, supported by bony arches.

This tribe forms three Families, which include most of the European genera, and some which belong to India. They are distinguished by a short trunk, scarcely exceeding half the length of the tail.

I.—*Family,* ANGUILLIDÆ, J. M.

Pectoral fins distinct. Dorsal and anal united with the caudal fin, so that the latter can only be distinguished from *them by its finer rays, which are all articulated to two little bony pedicles. The tail is compressed.*

Obs.—The species of this Family are each furnished with an elongated natatory bladder, and teeth on the vomer, as well as palatines.

1. Gen. *Anguilla*, Cuv.

Jaws depressed. Dorsal commencing at a considerable distance behind the pectorals, teeth conical, short, and disposed in broad bands; anterior nasal apertures tubular.

The Bengal species of this genus, are distinguished by small naked scales, disposed in a tessellated form, even on the fins.

2. Gen. *Conger*, Cuv.

Dorsal commencing at, or a little behind the pectorals. Head compressed, rostrum conical, soft and fleshy, presenting short tubular nasal apertures; teeth short and conical, disposed in broad bands.

3. Gen. *Muraenesox* J. M.

Dorsal commencing before the pectorals; jaws prolonged, narrow, and dilated at the apex. The upper-jaw longer than the lower. A row of long, prominent, distant teeth on the vomer. The palatine teeth disposed in short, oblique, single lines; rostrum smooth and hard; anterior nasal aperture consists of a fissure placed over the middle of the upper-jaw on either side.

II.—*Family*, Ophisuridæ, J. M.

With small pectorals, and no caudal fin; the dorsal and anal terminating before they reach the end of the tail, which is thick and naked.

The anus is situated before the middle of the body; the tail is consequently much elongated.

1. Gen. *Leptognathus*, Swainson.

Pectoral fins conspicuous, jaws prolonged, attenuated and pointed, armed with sharp scattered teeth. Dorsal and anal expand towards the tail, where they terminate.

2. Gen. *Ophisurus*, Làcep.

Body little compressed ; rostrum conical ; upper-jaw longer than the lower, anterior aperture of the nostrils tubular ; teeth round, mammillary and blunt, disposed in three broad bands above, and two on the lower-jaw.

3. Gen. *Ophithorax*, J. M.

Pectoral fins very small, so as to be scarcely perceptible ; body compressed.

III.—*Family*, MURÆNIDÆ, J. M.

Have no trace of pectoral fins ; the head is short, narrow and small ; the palatines form a narrow arch behind the vomer, in which there is sometimes but a single row of teeth. The tail is long.

1. Gen. *Dalophis*, Rafin.

Dorsal and anal terminate before they reach the end of the tail, which is naked. Upper-jaw much longer than the lower ; the eyes are placed near the muzzle, which is narrow.

2. Gen. *Muræna*, *Prop*. J. M.

The dorsal commences behind the branchial apertures ; there is a single row of teeth on each jaw, together with a row on the palate. Tail compressed.

Some have the palate smooth.

3. *Lycodontis*, J. M.

Dorsal commencing before the branchial apertures. Tail compressed. They have a single row of teeth on the palate, and two rows on either side of both jaws. The inner row, together with a few scattered prominent teeth at the apices of the jaws, sharp, hooked, moveable, and capable of being retracted.

4. *Thærodontis*, J. M.

Dorsal commencing at the head, or nape. Tail compressed. A single row of sharp teeth on the maxillaries, and a double row of scattered pointed teeth on the centre of the palate, with a few scattered, prominent, retractile teeth at the apex of the upper and lower jaw.

5. *Gymnomuræna*, Làcep.

Body and tail almost cylindric; neither dorsal nor anal fins are perceptible, but the caudal is distinct.

II.—*Tribe*, OPHICARDIDES, J. M.

The heart is situated behind the branchial apertures, and the intestinal outlet far back. The tail is consequently short. The trunk is long and cylindric; the dorsal and anal fins when present, are placed far back on the latter third of the entire length.

Two families of this tribe are already distinguished by their long trunk, and short tail.

I.—*Family*, SYNBRANCHIDÆ, J. M.

Have but a single external opening situated under the throat, and leading to the gills, which are supported by bony arches. Two rows, or, in some, two broad bands of teeth on the edges of the upper, and one either side of the lower jaw.

Their only fins consist of a duplicature of the skin unsupported by rays, forming an adipose dorsal and anal united at the end of the tail, which is compressed, and narrow, like the point of a two-edged sword. Branchial rays few in number, and short.

The stomach is a simple tube, having the pyloric orifice at the hinder, or opposite end from the œsophagus. The intestine is straight and continuous with the stomach, but narrower.

1. Gen. Ophicardia, J. M.

Two broad bands of teeth on the upper, and one on the lower-jaw; a single transverse opening under the throat, diverging on either side to the gills, which consist of three slightly pectinate fleshy combs; no scales, five rays in each side of the branchial membrane. There is but one species known, and this has no air-vessel.

2. Gen. Pneumabranchus, J. M.

A single transverse opening under the throat, diverging to the branchiæ on either side, which have three short arches without pectinated combs, but provided with a branchial sack which opens over the first arch. There are two rows of sharp hooked teeth in the upper, and one on the lower jaw; and the body is covered with minute imbricated scales. Six strong bony rays on each side of the branchial membrane.

There are three species known. In these no air-vessel has been observed.

3. Gen. *Synbranchus*, Bl., *Unibranchapertura*, Làcep.

There is a single longitudinal or round aperture under the throat, common to both branchiæ; six strong rays in the branchial membrane; air-bladder long and narrow. The teeth are said to be blunt.

4. Gen. Ophisternon, J. M.

A single transverse opening under the throat, common to both branchiæ, consisting of four fully developed combs on each side, without a central partition. Eyes very small, and placed almost at the end of the muzzle; teeth in broad bands; five cartilaginous branchial rays; no air-vessel, nor scales.

II. *Family*, Ptyobranchidæ, J. M.

Have two external openings leading to the gills, which are fan-shaped and pectinated, but almost, if not quite unsupported by bony arches. About eleven slender, long branchial rays. Fins supported by short cartilaginous rays.

But one genus known of this family.

1. Gen. Ptyobranchus, J. M.

Body cylindric from the eyes almost to the caudal fin. Head small and conical; two small pectoral fins. The dorsal commences farther back than the anal, both are long, narrow, rounded, and connected to a very short square caudal, by means of a narrow raphe sunk in the tail.

The liver is elongated; the stomach is a narrow blind sack, with the intestine given off in front, as in *Anguilliformes.* They have no air-vessel.

Part 3.—Description of Species.

ANGUILLA, Cuv.

All the East Indian species of this genus I have seen, are distinguished from those of China and of Europe by a peculiar tessellated disposition of the scales. These are disposed in zigzag lines, traversing all parts of the body. The head is broader, but lower than the body. The lips thick and fleshy. The jaws flat, the lower jaw is the longer and broader of the two. In some, the dorsal occupies two-thirds of the back, in others it is shorter. The fin rays are slender, minutely articulated, and very finely branched.

Those of the caudal may be distinguished from the others by their being all fixed to two bony pedicles, whereas those of the dorsal and anal, have each a distinct pedicle to itself.

They have a long thin air-vessel, two short lobes to the liver, and a stomach consisting of a capacious blind sack, with the intestine joined to it in front, where there is a strong valve.

ANGUILLA *BREVIROSTRIS*. *Pl.* v. *fig.* 1.

The dorsal occupies rather more than two-thirds of the entire length. The distance of the intestinal aperture from the muzzle, is equal to about 4-10ths of the entire length. The fin rays are,

P. 18 : D. 290 : A. 254 : to the middle of the caudal.

There are three close-set rows of conical hooked teeth forming a narrow wedge-shaped band on either side of the jaws, spreading out in front. The middle row consists of larger teeth than the others. There is a wedge-shaped band of teeth on the vomer, the same as on the edges of the jaws.

Colour dark greenish brown above, and reddish yellow below.

This Eel is generally found from 20 inches to 2 feet in length, and is not uncommon in the Calcutta market.

HAB.—Bengal and Arracan.

It is probably, the species described by Dr. Buchanan as *Muræna anguilla,* Làcep. It is certainly very distinct both from the common European species described and figured under that name, and the *Chowloo Pamoo* of Russell's Indian Fishes, which was also supposed to be *Muræna anguilla* of Làcepede. Now the European species is said to have about 100 rays in the dorsal fin, while our Bengal species has 290. Again, it is different from Russell's species, in which the dorsal commences a very short distance in front of the intestinal aperture, whereas it begins in the Bengal species at the anterior third of the body.

Such mistakes on the part of Buchanan and Russell regarding the common species of India, are the best proof of the necessity that existed for the revision of those characters upon which the better discrimination of these animals depend.

This Eel was brought to me under the Native name *Bangoosh.* The late Dr. Lumqua, a Chinese Physician who resided many years in Calcutta, assured me that a species of Eel bearing this name afforded Isinglass. It could not however be this species, and I should doubt much whether Dr. Lumqua's Bangoosh belong to the present order.

2. ANGUILLA *BICOLOR. Pl.* vi. *fig.* 1.

The dorsal occupies rather more than half the entire length, and commences exactly over the anus. The jaws are depresed, the upper rather shorter and narrower than the lower jaw. The breadth of the head about equal to that of the body. The distance from the base of the pectorals to the end of the nose, equal to one-third of the interval from the nose to the commencement of the caudal. The teeth are fine, like the pile of velvet, consisting of a broad band on either side of the jaws, and another on the vomer. The fin rays are.

P. 18 : D. 245 : A. 221.

The colour above, is dark olive-green or brown, and white below.

One of the specimens examined was about 2 feet in length.

Hab.—Sandoway on the Malay coast, from whence it has been obligingly forwarded to Calcutta by Captain Phayre, to whom we are indebted for its discovery.

This is perhaps the species named by Russell *Chowloo Pamoo.* It is still more distinct from the European species than the last; and the dorsal fin is situated much farther back than in the following species.

3. ANGUILLA *ARRACANA. Pl.* vi. *fig.* 2.

Dorsal commences at a distance in front of the anal, equal to twice the depth of the body; the interval from the pectoral fins to the muzzle, is also equal to about two diameters of the body. The fin rays are:—

P. 20 : D. 275 : A. 141.

The head is depressed, but little wider than the body. The upper jaw is a little narrower and shorter than the lower.

Colour mottled green, minutely dotted.

Hab.—Sandoway on the Malay Coast.

We are indebted to the kindness and zeal of Capt. Phayre for this species, which is nearly allied to *A. nebulosa.* Length 12 inches, but it is probably found much larger.

4. ANGUILLA *NEBULOSA*. *Pl.* v. *fig.* 2.

The dorsal commences rather before the anterior third of the body, and at a distance in front of the anus equal to the interval from the base of the pectorals to the eyes; the head is scarcely broader than the body.

The fin rays are

P. 20 : D. 306 : A. 248 : to the middle of the caudal.

There are 9 or 10 long slender rays in either branchial membrane.

Colour green above variegated with darker shades: below white. Young individuals are not variegated.

Hab.—Bengal, and Sandoway, where it is met with generally about 20 inches to 2 feet in length. This species differs from *A. arracana* chiefly in the dorsal being shorter, though it contains more numerous, and consequently finer, rays.

5. ANGUILLA *VARIEGATA*. *Pl.* 9. *fig.* 7.

The head is triangular and broader than the body, which is variegated with black irregular marks. The colour of the lower parts is white. Each pectoral fin contains 24 rays.

Hab.—Behar.

This species is supposed by Buchanan (Gang. Fishes, p. 23,) to be *Murœna maculata*, Lacèp. (*Hist. des Poissons, p.* 265,) one of the fishes of the Nile. The fin rays of the Nilotic species as given by Làcepede are however as follows:—

P. 9 : or thereabouts : D. 43 : A. 36 : C. 110.

Now Buchanan gives 24 rays to each pectoral of the Gangetic species, and although the rays of the other fins were not ascertained by him, we may conclude from this fact, as well as from the excellent drawing Buchanan has left of the Gangetic species, that it is quite distinct from that of the Nile; the more particularly as we have not been able to identify a single species of the Ganges, with any of those of the Nile. The drawing has been copied into Hardwicke's Illustrations of Indian Zoology by Mr. Gray, under the every way erroneous name of *Murœna bengalensis*. Buchanan expressly states, that he found it only in the Ganges, where that river passes through Behar; and I have never myself been able to find it in Bengal. The drawing here given, is from Buchanan's collection.

This species is nearly allied to that which is described, (Proc. Zool. Soc. 27th Nov. 1838,) in a paper on the Fishes of the Deccan, by Colonel Sykes, as *Anguilla Elphinstonei*. Indeed it may probably turn out to be the same, in which case the latter name will have the priority of that which is here proposed.

5. There is a remarkable species described by Buchanan, (Gangetic Fishes, p. 24,) as an inhabitant of the estuaries of the Ganges, under the name of *Muræna vamos,* which I have never met with. The upper-jaw is much longer than the lower. The head is described as oval, and nearly twice as broad as the body; the eyes small and placed near (the crown?) "*high up.*" The body is slender, of a dirty brownish-green above; below, dingy white. There may be several other species of this genus in India, but these are all I have met with in the lower provinces.

MURÆNESOX, J. M.

This genus is distinguished from the Congers of Europe, by its peculiar dentition, and long slender pointed jaws, hard lips, and the absence of tubular nasal apertures. The species occupy an equivalent place in the East, with the Congers of the Western world.

They usually possess two or more rows of teeth on the edges of the jaws, besides a few scattered, prominent, conical hooked teeth at the apex of each jaw, which is slightly dilated and rounded for their reception. There is also a notch in the upper-jaw behind the apex, for the reception of the cluster of large teeth at the apex of the lower jaw, which is shorter than the upper.

The stomach is a blind sack with a very short intestine given off from it at the anterior extremity. The liver, though large, is short, and placed in front of the stomach, enveloping the pyloric valve. The air-vessel is almost a third of the entire length, tapering equally at either end to a round point. The heart is placed as in ordinary fishes, near the branchial apertures. There are twenty-one long and slender branchial rays, and four branchial combs, supported by slender bony arches on either side. There is a row of very prominent distant teeth along the middle of the vomer, surrounded by a compact row of very small close-set teeth.

1. MURÆNESOX *EXODENTATA. Pl.* viii. *fig.* 4.

This species is distinguished by a row of long, distant, conical teeth on the vomer, with a parallel row of small close-set palatine teeth at each side, and an outer row of similar small teeth on the edge of the maxillaries. Between the maxillary and palatine row, there is a short narrow band of palatine teeth near the base of the upper jaw on each side. There are three rows of close conical teeth on each side of the lower jaw, the middle row more prominent than the others. There is a fourth row composed of prominent, strong, conical teeth directed obliquely outward from the external edge of the lower-jaw along its entire length, besides three or four large prominent conical teeth at the apex, which are slightly hooked. The jaws are widely cleft and narrow; somewhat dilated and round at the muzzle, which is without tubular nostrils. The intestinal aperture is situated at the middle of the body. The dorsal commences over the branchial apertures, which are situated a short distance in front of the pectorals. The pectorals are long and narrow, consisting of about fourteen rays. The lateral line consists of a double row of pores. There are about 269 rays in the dorsal, and 90 in the anal fin, to the middle of the caudal.

The colour above is light bluish or lead grey; below white. The fins partake of the colours of the adjoining parts, with the addition of a darker tinge along the margins of the dorsal and anal.

This description is derived from two fine specimens received in 1838, from my friend Capt. Richard Lloyd, then Officiating Marine Surveyor General, who obtained them in the Bay of Bengal, near the Islands on the Arracan Coast. They were both of the same size, namely, four feet in length, and were called Bamboo Fish by the sailors, from their peculiar shape.

2. MURÆNESOX *LANCEOLATA*. *Pl.* vi. *fig.* 3.

This species has the jaws slender, and greatly prolonged like the last; the aperture of the mouth being equal in length to half the distance from the muzzle to the branchial apertures. The apex of the lower jaw is armed with a cluster of long radiating conical and slightly hooked teeth, for the reception of which there is a large corresponding semi-circular notch in the upper jaw.

The distance from the muzzle to the fore part of the eye, is equal to a third of the distance from the former to the branchial aperture. There is a row of eight or ten long teeth, with lanceolate points on the vomer. Two rows of small teeth on the upper jaw, the inner one short and oblique, the outer terminating in front of the vomer; besides a row of small close-set teeth surrounding those of the vome; each side of lower jaw presents three rows of conical teeth.

There are 305 rays in the dorsal fin, with a proportionately large number in the anal; the pectorals are long and narrow, containing about 14 rays.

The anterior nasal aperture is situated behind the great notch in the upper jaw, and is slightly emarginated, but not tubular. The intestinal aperture is situated before the middle.

Colour blue or brownish grey above, silvery white below, without distinct dark margins to the fins.

Hab.—Bengal.

The specimen described is 2 feet and 4 inches in length.

3. MURÆNESOX *HAMILTONIÆ. Pl.* viii. *fig.* 3.

Muræna Bagio, Buch.

The distance from the muzzle to the back part of the eyes, equal to one-third of the distance from the former to the branchial apertures. Pectoral fins short, six or eight tricuspid teeth on the vomer.

The fin rays are

P. 12 : D. 260 : A. 220.

This species is noticed on the authority of Buchanan, whose drawing is here given. I have not met with it, although Buchanan remarks that it is found in the estuaries of the Ganges, and there can be little doubt of the species being more numerous than we imagine.

4. MURÆNESOX *BENGALENSIS.*

The distance from the muzzle to the back part of the eyes is equal to about a third of the interval from the muzzle to the branchial apertures. There are three to six or more tricuspid teeth on the vomer; and two rows of teeth on the sides of the lower jaw; the principal row is large, compressed and hooked, the outer row small and conical. The dorsal and anal fins are emarginated with black; the fin rays are

P. 15 : D. 244 : A. 202—Branchial rays 21.

The intestinal aperture is considerably in front of the middle.

Hab.—Bengal.

5. The Taleo paum of Dr. Russell, Indian Fishes, No. 36, vol. 1, is also no doubt a distinct species, which from its golden yellow colour, is inserted in the synopsis as *Murænesox aurea.*

OPHISURUS, *Lacèp.*

The Indian species of this genus have a peculiar structure of the branchial rays hitherto unnoticed. Buchanan indeed remarks, (*Gangetic Fishes, p.* 19.) that no rays can be distinctly seen in the species of this country. They are, however, very distinctly seen on dissection, and even in dried specimens, if the branchial membrane be distended, the adjoining soft parts will shrink; in which condition the rays are brought into view, presenting a very beautiful structure of decussating curves.

The teeth are round, disposed in three bands on the upper jaw; the middle band on the vomer extends from the back part of the palate to the apex of the jaw, the others terminate obliquely against this, before they reach the apex.

The gills consist of four double combs, supported by slender bony arches, the heart is situated between the pectorals; the liver is large, and envelopes the œsophagus; the stomach is a large blind sack as in the genus *Anguilla*, Cuv. with the intestine given off at its anterior extremity, from whence it proceeds straight to the vent.

An oval glandular organ occupies a cavity in the anterior part of the tail; but there is no prolongation of the intestine in these species beyond the intestinal aperture, as said by Cuvier to be the case with European species.

The species of this country which I have met with, in addition to those noticed by Buchanan, are three. They are however most difficult to determine, and for this reason, no less than on account of their singular structure and form, they ought to be made the subject of special investigation.

The result would be the establishment of several species, which we cannot now distinguish with certainty. It might also cast much additional light upon the order to which they belong.

1. OPHISURUS *ROSTRATUS*, Buch.

Distinguished by a very small perfectly conical head and round tail scarcely at all compressed.

The pectorals are narrow and rather long, containing about 11 rays, the eyes are high and rather approximated together on the crown.

Colour greenish-yellow above, yellowish-white below.

This is a small species, an adult taken caught in the act of spawning, not exceeding nine inches in length.

HAB.—Bengal.

This species is figured in Buchanan's drawings under the name here given. I have not met with it, but it is closely allied to *Oph. minimus*, from which it only differs in having a square muzzle.

2. OPHISURUS *VERMIFORMIS*, *Pl.* xii. *fig.* 2.

The distance from the point of the muzzle to the eyes, is equal to $\frac{1}{4}$ of the distance from the eyes to the pectorals. The distance from the muzzle to the pectorals, is equal to the distance from the pectorals to the commencement of the dorsal, and to about $\frac{1}{11}$ part of the entire length. The muzzle is long and narrow. There are 9 rays in each of the pectorals, these fins are long and narrow. There are 22 rays in the branchial membrane. The muzzle is long and narrow. The body long and very slender, terminating in a sharp round pointed tail. The body is dotted with dark green above. The lateral line is marked with a few distant pores, like minute spots.

HAB.—Bengal.

This is the smallest species of *Ophisurus* I have seen. It differs from *O. hyala*, Buch. in the spots on the lateral line being more distant and minute. It is also a far more slender species.

3. OPHISURUS *MINIMUS*, *Pl.* x. *fig.* 3.

The distance from the point of the muzzle to the eyes, equal to 1-5 of the distance from the eyes to the pectorals. The distance from the muzzle to the branchial apertures, is equal to the distance from these to the commencement of the dorsal.

The muzzle short and very narrow, the eyes are placed high, close to each other, and to the muzzle; the pectorals are rather long and narrow, each contains about 12 rays. The branchial membrane contains about 24 rays on either side. The body is cylindric and strong, terminating in a tapering sharp-pointed tail.

Colour above light green, minutely dotted along the back.

Hab.—Bengal.

This species differs from *O. vermiformis*, in being of much more robust proportions; and from *O. hyala*, in the distance and size of the pores or spots on the lateral line, which in the former are barely perceptible.

4. OPHISURUS *CAUDATUS*, *Pl.* xii. *fig.* 3.

The head is small, the tail is thick and heavy. The distance from the base of the pectorals to the commencement of the dorsal, is only equal to half the distance from pectorals to the extremity of the snout.

The distance from the pectorals to the end of the muzzle, is equal to $\frac{1}{10}$th of the entire length. The pectoral fins are narrow and pointed, each contains about 13 rays.

Colour above dark green, below reddish yellow. The branchial rays are covered with a thick integument, so as to conceal their exactnumber.

The remaining two, are *Ophisurus harancha*, and *Ophisurus Boro*, Buch.

These are figured in Hardwicke's Illustrations, from copies of the MSS. drawings of Dr. Buchanan.

LYCODONTIS, *N. Gen.*

This genus is composed of such species of the Linnæan genus *Muræna* as have the palatine teeth in a single row extending along the centre of the roof of the mouth, behind the vomer. The body is slightly compressed; and the dorsal commences in front of the branchial apertures; the front of each jaw is armed with long sharp articulated teeth, attached to a flexible pedicle; they are capable of being retracted or raised according to circumstances.

Synodontis, Cuv. among the Siluridæ, is the only example known in the animal kingdom, in which the teeth are fixed to a flexible pedicle. It may be presumed therefore, that this peculiarity in the Muranidæ has never been pointed out. Buchanan, the only author who seems to have examined the Indian species of this family, overlooked altogether the peculiarity of their dentition.

Another peculiarity consists in the malar, nasal, and palatines being consolidated with the vomer, forming the anterior part of the upper jaw, from which the maxillaries and intermaxillaries are displaced, so as to form the sides, rather than the front, of the mouth. Here they give insertion to two rows of teeth, corresponding with those of the palatine bones in all other genera.

1. LYCODONTIS *LITERATA*. *Pl.* vii. *fig.* 2.

The head is compressed and narrow, raised abruptly over the eyes.

The body is long and compressed, of uniform depth, and slender for its length.

Colour, olive-green above, and all except the head uniformly marked with fine white irregular streaks, resembling a written character. The dorsal fin commences in front of the branchial apertures, the anal commences at the middle of the body.

The jaws are narrow, of equal length and widely cleft, having two rows of teeth on the sides, the outer row terminating on either side below the eyes, the inner row is continued round the apex of the jaw at wider intervals, and together with three prominent hooked teeth, corresponding with those of the vomer near the apex, are retractile.

There are 121 vertebræ, 334 rays in the dorsal, and 182 in the anal fin.

Hab.—Bengal. It is a common fish in the Calcutta market.

This species is usually met with about 12 to 18 inches in length.

2. LYCODONTIS *PUNCTATA. Pl.* vii. *fig.* 3.

The head is compressed, forehead raised abruptly over the eyes, and the lower jaw is shorter than the upper. The branchial aperture is placed on either side at a distance from the eyes, equal to twice the height of the head. The body is dark olive-green, mottled with round white spots which disappear in the adult state, first upon the body, and lastly on the fins.

The outer small maxillary teeth, are continued round the apex of the jaws, one tooth occurring alternately at each interval between the large retractile teeth.

There are 392 rays in the dorsal, and 190 in the anal. The intestinal aperture is situated about the middle.

Hab.—Bengal.

This species is common in the vicinity of Calcutta, and is generally found about a foot, or 18 inches in length.

3. LYCODONTIS *LONGICAUDATA. Pl.* viii. *fig.* 2.

Murænophis sathete, Buch.

The ventral aperture is considerably before the middle of the body, the tail is consequently very long and slender. The head is conical, the jaws of equal length; body greenish-brown above, without spots; the fins darkish; the dorsal contains 484 pointed rays imbedded in fat, the anal 394. There are 211 vertebra.

Hab.—Bengal, where it attains a great size, the specimen described was upwards of 5 feet in length.

The drawing here given is from Buchanan's MSS. collection.

This is one of the largest and most important fishes of the family in Bengal; the species are reckoned wholesome and good, and are eaten by all classes of the native population.

THÆRODONTIS, *N. Gen.*

In this genus there are two distinct rows of teeth on the back part of the palate, behind the retractile teeth on the vomer near the apex of the upper jaw. The edges of both jaws are armed with a single row of prominent teeth; the crown is high and rounded.

1. THÆRODONTIS *RETICULATA. Pl.* vii. *fig.* 1.

The crown is high and rounded, the body slightly compressed, the dorsal commences at the branchial apertures, and the intestinal aperture is placed near the middle. Colour black, marked with white lines disposed in a pentangular form, dividing every part of the body and fins into large pentangular spots.

Hab.—Malay Coast, where it was obtained at Sandowy by Captain Phayre, Principal Assistant to the Commissioner of Arracan.

The specimen obtained was 20 inches in length; it is one of the most striking and remarkable species of apodal fishes hitherto described.

It is distinguished by the brilliant contrast in its colours, pure ivory black, subdivided by narrow snow-white lines, disposed in a pentangular manner over every part of the body, head, and fins, even on the sides and roof of the mouth.

OPHICARDIDES,* *N. Trib.*

The remaining species belong to a very distinct tribe from those just gone over, it may be necessary therefore to preface the description of them, by a few remarks on their general characters and peculiarities.

The heart is situated far behind the branchial apertures, and not between, or close to these organs as in the last tribe, a peculiarity which of course must affect not only the arterial system of these animals, but every part of their structure and even external form.†

The effect of this altered position of the heart upon the external form of the present tribe, is to lengthen the body

* For Etymology, see Gen. *Ophicardia.*

† I have already adverted to the circumstance of Mr. Walker having undertaken an investigation of the comparative anatomy of the *Cuchia.* The field of inquiry will now be considerably widened, by the undescribed forms closely allied to, though differing essentially from that remarkable animal. The object proposed by Mr. Walker will thus assume an additional degree of interest and importance.

by creating two long distinct cavities in the trunk, as in animals provided with lungs, instead of a single cavity as in other fishes. The abdomen being removed back to make way for a lengthened thorax, occupied only by the branchial arteries, œsophagus, and heart; the intestinal outlet is carried back to the latter third of the body. The tail is consequently short. The membranous expansion representing the dorsal fin, advances a little in front of the ventral aperture. There is no air-vessel in any of the species of Bengal, although Cuvier states, that in the genus *Synbranchus,* Bl., that organ is fully developed. In some, the stomach is a *cul-de-sac,* with the intestine given off in front as in *Anguilliformes;* in others, it is continuous with the stomach, and together with that organ, forms a straight tube extending from the œsophagus to the vent. The liver is very long and narrow; in some, it is chiefly developed at the further extremity of the abdomen; in others it occupies the usual position behind the midrif; but notwithstanding such apparent transposition of this organ, its attachment to the lower surface of the midrif appears to be an universal condition in all animals; and in this instance the difference is merely in the increased length of the capsular ligament.

In all the species, the entrance to the œsophagus is guarded by two groups of very small, but sharp pharangeal teeth on either side.

The gills undergo many singular modifications in this tribe.

In some, they are without bony arches; in others while bony arches are present, they are almost destitute of pectinated combs. In some, the gills on either side are contained in two distinct cavities; in others, both gills are contained in one common cavity. In some, the want of pectinated combs or gills, is supplied by a membranous sack, by which the functions of respiration are effected.

The manner in which this function is performed in the genus *Pneumabranchus*, is as follows: the head is raised to the surface, and the muzzle projected sufficiently to emerge the apex of the jaws, slightly open at the end. The dilatation of the branchial sack on either side (which is provided with proper muscular apparatus for the purpose) then takes place, and this organ distended with air, the animal descends; and after the lapse of some moments, the air gradually allowed to escape by the mouth, ascends in globules to the surface of the water. The animal then ascending again to repeat the same operation at certain intervals.

The only genus of this tribe hitherto known, is *Synbranchus*, Bl. or what Lacèpède named *Unibranchapertura*.

But although that genus is well characterised in the *Régne Animal*, the adjoining forms peculiar to the East required to be properly known and understood, before the peculiar characters of *Synbranchus* could be well appreciated. In this way we can account for the peculiarities of that genus not being more prominently brought forward by preceding writers, particularly the illustrious Cuvier. When ever we are led upon any occasion a little farther than that great man has gone, we should ascribe it no less to the assistance we derive from the profound observations he has left for our guidance in the study of Fishes, than to the accidental circumstance of being more favourably placed with regard to some peculiar object of investigation.

Even with regard to *Synbranchus*, the few words expressed in the *Régne Animal*, regarding the stomach and intestines of that genus, apply not only to it, but equally so to the other genera here described, although they were unknown to the illustrious author.

I have been induced to make these remarks, lest the proposal of any changes in the classification of these animals, emanating from so obscure a quarter, might appear as either self-sufficient on my part, or to arise from an improper distrust of the observations of others, who have gone before me, on the same subject.

OPHICARDIA,* *N. Gen.*

Of this genus but a single species has as yet been discovered, and for this we are indebted to Capt. A. P. Phayre, the principal civil officer at Sandoway, on the Arracan Coast. In gratitude for the kindness and liberality with which he has placed his collections at our disposal, as well as in justice to the interest and importance of the discovery, we have dedicated the species to his name.

1. OPHICARDIA *PHYARIANA*, *Pl.* xii. *fiig.* 1.

In this singular species the intestinal aperture is placed at the posterior fifth of the length. The head is short, raised and round, larger in diameter than the body, the adjoining portion of which is, towards the head, augmented; the jaws are depressed, the upper jaw is rather more prominent than the lower, the muzzle is rounded, having two short tubular nostrils at the extremity.

The body is not compressed, but is slightly conical from the head to near the vent; the tail from thence becomes much compressed and very narrow. The tail is emarginated with an adipose duplicature of the skin like the blade of an oar.

The outer band of teeth on the upper jaw expands in front on either side, without meeting the opposite corresponding band, thus leaving a narrow vacant space at the apex. There are three strong branchial arches, with slight fleshy very short pectinated gills, like the teeth of a saw.

There are five branchial rays on each side, the first larger and stronger than the others, and isolated from them, standing considerably in front. The branchial rays are strong and bony.

There are no scales distinguishable in the skin, even with the microscope.

The colour above is dusky-brown, minutely dotted with brownish-black, the lower parts are of a somewhat lighter shade.

The length of the specimen is about 20 inches.

* Etym. ὄφις, a Snake; and, καρδια, the heart.

The stomach is an expansion of the œsophagus into a long spindle-shaped wide tube, tapering equally at either end, and contracting gradually behind into a narrow intestine, which again gradually expands almost to the size of the stomach; the whole, including the œsophagus being one continuous straight tube. There seems to be no pyloric valve, the contraction of the first portion of the intestine answering the purpose of one.

The liver consists of a single elongated lobe of great length, commencing immediately behind the pericardium. It envelopes the lower surface of the stomach, and terminates about the middle of the abdomen.

Hab.—Sandoway on the Arracan Coast. As already remarked, we have been indebted to the zeal and kindness of Captain Phayre, Principal Assistant to the Commissioner of Arracan, for the only specimen hitherto found.

PNEUMABRANCHUS STRIATUS. *Pl.* xiii.

Unibranchapertura Cuchia, Buch.

This species was first noticed by Buchanan Hamilton in his work on the Fishes of the Ganges, p. 16, who referred it to the genus *Unibranchapertura* of Lacèpède, or what is the same thing, *Synbranchus*, Bl.

The whole form of the animal, says Buchanan, having no vestige of a fin, resembles strongly a serpent. In stating it to be without any vestige of a fin, as well as devoid of scales, Buchanan proves that he examined it very carelessly.

But there was no such thing as accurate observations in this particular order of Fishes, prior at least to the publication of the *Régne Animal.* Even since then, from the great general sameness of these animals, different species and even genera have been described under the same name.

The head is somewhat depressed and triangular, being rather broader than the body, while it becomes considerably narrower at the muzzle; the jaws are both precisely of the same length. The lips are soft, so as to allow of a little tube-like aperture being formed between them at the apex of the muzzle, which seems to be in some degree essential to the peculiar manner in which the functions of respiration are performed. The lower jaw is narrower at the apex than the upper, and the muzzle being raised to the surface of the water, the animal by laterally contracting the fleshy lips of the upper jaw against the sides of the lower, is enabled to inhale, or supply the branchial sacks with air. This done, it descends, occasionally discharging a portion of the air which escapes in bubbles to the surface of the water until the sacks are collapsed, when after a time the animal again raises itself slowly to repeat the same operation.

One of the favourite positions of the animal is to remain floating perpendicularly with the muzzle at the surface. In this position it remains as if asleep, perfectly motionless for hours, like an inanimate object. From this position it sometimes sinks unconsciously to the bottom of the water; and, after discharging the air, as already described, again becomes lively, ascending to the surface, swimming and darting actively for a time in a vertical position, and again becomes torpid as before.

The colour of the upper parts is dark olive-green, with small round black spots dispersed equally over every part above the lateral line. The lower parts of the body are yellow, mottled with lighter and darker specks.

The lateral line is white, and occasionally appears to be sunk, so as to form a channel in either side. There are two other short white lines, one extending from a few irregular little white streaks near the angle of the mouth, forms a slight bend over the branchial region, and extends a short way along the lower part of either side; the other commences with a slight reflex streak behind the eye, and extends a short way between the last described streak and the lateral line.

The vent is placed at a distance of three-fourths of the entire length from the muzzle. The tail from thence becomes gradually compressed and narrow. For the first-third of its length, the upper margin of the tail is round, the remaining two-thirds of its length it is sharp-edged above, representing the dorsal, and for a little more than one-third below, representing the anal fin; but these are little more than narrow fringes formed by the mere reflection of the skin in this situation.

The body is covered on every part with fine oval imbricated naked scales, except the lateral line, which is without them. These scales are smooth, composed of radii and concentric lines parallel with the margin. They are very perceptible to the naked eye in the living animal. They are I should think about half the size of the scales of the European tench. They are oval, broader at the free end than the other; their figure presents various degrees of obliquity, according to the part of the body on which they are placed, as in ordinary fishes. *See figs.* 3, 6.

The teeth are conical, sharp and hooked; they consist of two rows on the upper jaw; the outer row placed on the intermaxillaries is composed of about 30 very fine sharp teeth, which at the apex form a crescent with those of the opposite side. The palatine teeth form an inner row. They are stronger, placed at intervals from each other, short, hooked and sharp. Their number varies a little in different individuals, but they are generally twelve or thirteen on either side. The lower jaw is furnished with a single row (about 20 in number) of precisely similar, but smaller teeth than those of the palatines; the edge of the jaw becomes broader in front at the symphysis, where the teeth become somewhat crowded. *See fig.* 2*a. b.*

The gills have three strong, short bony arches; but no branchial combs, except a few thick fleshy points on the outside of the middle arch. The intervals between the branchial arches are nearly obliterated by means of a membrane, in which there is only a narrow aperture behind each arch, as well as the opening in front of the first arch. *See fig.* 4.

Over the end of the first arch, there is a narrow aperture leading into a moderate sized sack, which as well as the membrane between the branchial arches is lined with a fine net-work, consisting of the extreme branches of the branchial arteries and veins, which form numerous little vascular tufts dispersed over every part of the inner surface of these organs. *See fig.* 5.

These perform the office of gills, for effecting the aëration of the blood through the medium of water as well as air.

The animal is thus enabled to live for a time in either medium, although both are essential.

A little behind the upper end of the third arch, there is a lunate group of fine sharp pharangeal teeth, at the entrance to the œsophagus as usual throughout apodal fishes, together with a row of similar teeth extending from the posterior horn of the above group on one side, to the corresponding portion of that of the opposite side, thus forming a strong armature of sharp hooked teeth, guarding the entrance to the throat. The great length of the œsophagus in ophicardious as compared with other species, renders the function of pharangeal teeth very important, in order to arrest the entrance of food until it is reduced to a state in which it is likely to afford least danger to the animal by causing obstruction, which from the nature of the prey, would be liable to happen

The diaphragm separating the cavities of the thorax and abdomen, is placed at a distance behind the branchial apertures greater than these are from the extremity of the muzzle, or equal to about one-third of the distance from the branchial apertures to the vent. The thorax is consequently equal to half the length of the abdominal cavity; it contains the œsophagus, the heart, and aorta, together with the branchial arteries and veins.

The abdomen is occupied for the first two-thirds of its length by the stomach and liver; the former in the left, the latter in the right side. The latter third of the cavity is occupied with two oval bodies placed on either side closely connected with the blood-vessels, which I suppose to be the kidneys, and the intestine together with the ovarium. I observe no valve or distinct separation between the stomach and intestine, but a gradual contraction from the former to the vent; both organs apparently forming a straight tube with the œsophagus, merely dilated for the stomach, and contracted from thence gradually to the vent.

These observations must, however, be regarded as a mere cursory statement, intended to shew the general peculiarities of the species, and not be received as an exact description of its structure.

I have had two live *Cuchia* by me now for a period of twelve months; they are still as well as when I first obtained them, though from an ignorance of their proper food, as well as a desire to know how long they are capable of existing without any, they had nothing to eat during that period to within the last few months, when some small fish and shrimps were put alive into the vessel. For some time they appeared to regard the strangers with indifference, when they became suddenly roused from their usual lethargy, and with a few sudden darts devoured the whole of the shrimps. Some dead shrimps were afterwards introduced, but these as well as small fish both live and dead, the *Cuchia* evinced no appetite for; so that the prejudice of the natives against the *Cuchia,* as an article of food, spoken of by Buchanan, is not perhaps owing to the uncleanness of its habits. The Europeans are therefore perfectly right in eating it as an eel, whatever the natives of Bengal may think of the matter. This species seems to be very abundant throughout Bengal, as well as Assam; and generally, I should suppose in all the slow running streams and estuaries of the plains and coasts of India.

I have found the number of vertebra in this genus to be about 150.

PNEUMABRANCHUS LEPROSUS.

Specific character.—Body uniformly of a pale yellowish white both above and below, with irregular angular spots of various size dispersed here and there over the upper parts of the body. The narrow membranous expansion representing an adipose dorsal, commences almost as far forward as the vent. This species attains about 2 feet or upwards in length, and is of gross proportions.

HAB.—Bengal.

PNEUMABRANCHUS ALBINUS.

Colour uniformly orange yellow, with the exception of a livid appearance about the muzzle, and a black half moon-like zone over the eye, without any appearance of distinct lateral or other lines. Pupils black, irides narrow and bright golden-yellow, surrounded by a livid zone.

HAB.—Bengal.

This variety attains about 18 inches in length, and is of more slender form than either of the others.

While these species are remarkable for the singular transformation of the gills, by means of which they are capable of existing either in water or air for a considerable period, those of the following genus are no less singular for the peculiar transposition of the eyes, and of the liver; two organs which are usually more constant in their position than any other.

OPHISTERNON.* *N. Gen.*

The head is rounded slightly at the occiput, but depressed and elongated in front. The eyes are remarkably small, and placed almost at the extremity of the muzzle. The body is elongated and cylindric, the tail is broad, as well as the adipose expansion forming the dorsal and anal fins; the former commences before the anus, the latter close behind that organ, and both meet to form a round caudal.

The branchiæ of both sides are contained in a single cavity, to which there is one large transverse aperture placed under the throat. The gills consist of four single

* Which means, the trunk is formed like that of a snake.

branchial combs on either side, supported by bony arches. There are five or six short semi-cartilaginous rays in either side of the branchial membrane. The skin is soft and thin, without scales; there are two bands of teeth on either side of the upper jaw, and one on each side of the lower. The stomach and intestines form a straight tube, the former dilated, and the latter contracted into a very narrow tube, and then dilating again to form the rectum.

The liver is situated on the right side at the hinder part of the abdomen, along with the rectum, and is of a long narrow shape, connected however with the diaphragm by means of a very long capsular ligament.

There is no air-vessel.

The naked skin without any trace of scales, as well as the structure and peculiar form of the abdominal viscera, and of dentition, evince an intimate affinity between *Ophicardia*, and *Ophisternon;* while the form of the branchial aperture and arches, proves them to be distinct genera.

OPHISTERNON BENGALENSIS, *Pl.* xi. *Fig.* 1.

The head is a little raised at the crown and depressed towards the eyes which are small, and placed on the muzzle before, and external to the posterior apertures of the nostrils. The muzzle is narrow, long, and slightly recurved, the jaws are of equal length, the membranous expansions on the tail representing the dorsal and anal fins, are broad, the former advances in front of the anus, the latter commencing close behind that organ, and both united at the end of the tail. The lateral line is narrow, and situated high on the side. The body is cylindric, but rather larger before than behind. The middle of the tail is a little deeper than the body at the anus.

There is a single large opening under the throat, communicating at once with the branchial combs on both sides, which are all contained in the same cavity without any partition; they are supported by bony arches. The anus is placed at the posterior 4th of the length. There are two bands of teeth on the upper jaw, the outer band on the maxillaries forming a crescent in front under the apex of the jaw, and becoming narrower from thence towards the corner of the mouth. The inner band on the palatines continues round the apex, and of equal breadth to the corners of the mouth. The lower jaw also presents a broad band of teeth on either side, broader at the symphisis than anywhere else. There are five short cartilaginous branchial rays, and the branchial combs are single upon each arch.

The stomach and intestines form one continuous straight tube extending to the vent. The liver is straight, and long, occupying the whole length of the abdominal cavity on the right side of the intestines and stomach. Small detached glands seem to adhere to the latter at various intervals, which are perhaps equivalent to the spleen.

There is no air vessel.

Hab.—Bengal where it is rather common. Length 2 feet.

The whole physiognomy of this animal is very distinct from that of the *Cuchia*, yet I have been unable to learn whether the natives make any distinction between them, nor do I find it, alluded to by Buchanan or any other author.

Colour bluish black, or brown on every part of the body, except a little dirty-white beneath the jaws.

OPHISTERNON HEPATICUS, *Pl.* xi. *fig.* 2.

The head is short and raised, the muzzle round and little depressed, the eyes very small, placed a little before the posterior openings of the nostrils. The jaws are short, the outer band of teeth on the upper jaw narrow, consisting almost of a single row of sharp hooked teeth on the sides, becoming broader in front, where it is recurved at the apex of the jaw. The palatine or inner band is broad at the apex, and becomes rather narrower towards the sides; of the jaw the lower maxilla also presents one broad band at either side, increasing in breadth towards the apex, where there is a narrow blank space in the middle free from teeth. The dorsal and anal fins are narrow, as well as the tail, which is not so deep as the body. The body is cylindric, but of larger diameter at the head than at any other part.

The heart is situated about twice the length of the head behind the branchial apertures. The stomach and intestines form one continuous straight tube with the œsophagus, the different divisions of which are only to be distinguished by their size. The stomach is at first rather wide, then becoming gradually narrower, contracts into a very narrow intestine, and then expands again into a rather wider intestine corresponding with the colon and rectum. The liver which in the last species was greatly elongated, in this presents the singular character of being developed entirely at the hinder part of the abdominal cavity, in close contact with the colon and rectum, supported however by means of a long capsular ligament to its usual attachment with the diaphragm on the right side. The skin is thin and smooth, without any trace of scales whatever.

This new important species is a native of the Arracan Coast, where it was discovered by Captain Phayre, to whom I have been indebted for much kind and liberal assistance in the investigation of the fishes of this portion of the Bengal territories. We may still anticipate further discoveries in this quarter through the kind assistance of Captain Phayre, and several other distinguished public Officers employed on the same Coast from Chittagong to Mergui, who have already evinced an enlightened regard for the investigation of the natural productions of the provinces intrusted to their care. Until these enquiries are brought to a close, it would be premature in this place to offer any further general observations on the affinities of the order.

II.—PTYOBRANCHIDÆ, *N. Fam.*

Gills pectinated, fan-shaped, unsupported by bony arches, branchial apertures distinct, and placed in front of small pectorals. Teeth on the centre of the palate; intestinal aperture situated about the latter third of the length.

1.—PTYOBRANCHUS. *N. Gen.*

Head small, with a narrow conical round muzzle, without tubular nostrils. They have a long cylindric body like a reed, terminating abruptly at the end of the tail; dorsal and anal narrow, supported by pointed rays, and connected with the caudal by means of a narrow raphe, more or less conspicuous in different species.

Obs.—There are about eleven rays in the branchial membrane, no air vessel. The maxillary and intermaxillary teeth form an interrupted row with the palatines. The lateral line is placed on the middle of the side.

There are many species, in all which the dorsal commences behind the anal.

The two first species of this remarkable genus, are the most singular forms of the tribe to which they belong. They are of plain colours, excessively simple shape, and great length in proportion to the diameter of the body. About six years ago I received one of them in a collection of fishes from Mr. Rose, who described it as very destructive to the embankments thrown up against the Sea along the low coasts about Hidgelee and Cuttack.

The remaining species are small, seldom exceeding from six inches to a foot in length, are of more showy colours, and common about Calcutta. Buchanan was acquainted with more than one species, and has left drawings of two, which seem to have fallen into the hands of Mr. Gray, who makes as many genera of them. He does this merely from characters derived from Buchanan's drawings, which in this case happen to be deficient in those points selected as generic distinctions.

1.—PTYOBRANCHUS ARUNDINACEUS. *Pl.* x. *fig.* 1.

The body is from twenty inches to two feet in length, and scarcely $\frac{3}{10}$ to $\frac{2}{5}$ of an inch in diameter. The intestinal aperture is placed at, or a little behind the latter third of the length, and the tail is of uniform size and thickness with the body, to within about an inch of the end, when it becomes slightly compressed, and terminates in a thick wedge, with a very short square caudal fin.

The anal fin commences at a distance behind the anus equal to its own length, the dorsal commences at the middle of the tail, and over the middle of the anal fin. Both dorsal and anal fin are low and rounded, each terminating in a narrow raphe, or line, which connects it with the caudal. The jaws are of about equal size.

The fin rays are, P : 10 : D. 40 : A. 40 : caudal about 44.

Colour dark olive-green above, greenish white below, and greyish on the sides.

Hab.—Bengal.

2. PTYOBRANCHUS GUTHRIANUS. *Pl.* x. *fig.* 2.

This species is elongated like the last, but the tail is not so clumsy, being a little more compressed, and terminating in an oval point. The pectorals are very small, but the other fins are a little more prominent than in the last species, and the rays in the narrow raphe connecting the dorsal and anal with the caudal, may be counted with care.

The fin rays are, P. 11 : D. 36 : A. 44 : C. 64 or, about 115 rays from the commencement of the dorsal to the middle of the caudal, and 143 from commencement of the anal to the middle of the dorsal, including the rays of the narrow raphe connecting those fins with thecaudal, as nearly as I can ascertain.

Colour dark brownish green, of a lighter shade below, but no white.

HAB.—Bengal.

I have taken the opportunity of naming this species in honor of Captain C. S. Guthrie of the Bengal Engineers, for the service rendered by him to natural history, in the discovery of *Cervus frontalus,* described vol. iii. p. 401 of this Journal.

3. PTYOBRANCHUS ERYTHREUS. *Pl.* ix. *fig.* 3.

In this species the anal fin commences near the anus, and contains 50 or more distinct rays before it slopes into a narrow radiated raphe, which connects it with the caudal. The dorsal contains about 40, and the caudal 70 or 80 distinct rays, which in the narrow prolongations connecting these fins together, become so short as to render them difficult to count, particularly in specimens that have been in spirits. I have, however, counted about 134 from the commencement of the anal to the middle of the caudal, and 125 from thence to the commencement of the dorsal.

The tail is compressed, and lanceolate at the point. The colour above is red, minutely speckled with black dots, below reddish white.

HAB.—Bengal.

4. PTYOBRANCHUS MULTI DENTATA. *Pl.* ix. *fig.* 4.

Tail thick and broad at the point, the rays of the raphe not distinguishable. The fin rays are.

D. 42 : A. 36 : C. 64. Colour red.

HAB.—Bengal.

5. PTYOBRANCHUS PARVIDENTATA, *Pl.* ix. *fig.* 5.

Head small, tail slightly tapering and compressed, with a lanceolate caudal fin; only 4 teeth on the centre of the palate, forming a short row approaching close to the apex of the jaw. There are about 30 teeth on each side of the upper jaw. The fin rays are.

P. 11 : D. 31 : A. 38 : C. 60.

Colour, purple above the lateral line, minutely dotted, and white below.

Length 10 inches.

HAB.—Bengal.

6. PTYOBRANCHUS GRACILIS. *Pl.* ix. *fig.* 6.

Head very small, and the muzzle very narrow and pointed. Body slender; 22 teeth on either side of the lower jaw, and 10 on the vomer. Tail narrow, compressed, and lanceolate.

HAB.—Bengal.

ERRATA.

For *Anguilliformes*, pp. 155, 158, 166, 171, 176, 189, read ANGUILLIDES.

For *Lycodontis*, pp. 154, 158, 173, 185, 186, 187, and where ever it occurs in the preceding pages, read STROPHIDON.

IV.—*Description of Plates.*

Pl. V. Fig. 1. a. b. c. *Anguilla brevirostris* J. M. half the natural size. A, is a portion of the skin with the scales, natural size, shewing their shape and distribution; b. teeth of the upper, and c. those of the lower jaw, natural size.

Fig. 2. *Anguilla nebulosa,* J. M. half the natural size; a. a portion of the skin showing the disposition of the scales natural size.

Pl. VI. Fig. 1. *Anguilla bicolor,* J. M. half size; a. teeth full size.

2. *Anguilla arracana,* J. M. natural size; a. teeth full size.

Pl. VII. Fig. 1. *Thærodontis reticulata,* J. M. half size, with the disposition of the teeth represented full size.

2. *Strophidon literata,* J. M. natural size, with the disposition of the teeth enlarged.

3. *Strophidon punctata,* J. M. natural size, with the teeth somewhat enlarged.

Pl. VIII. Fig. 1. *Strophidon maculata,* J. M. or, Muræno-phis tile, Buch. from a drawing in the Buchanan collection, Bot. Gard. Calcutta.

2. *Strophidon longicaudata,* J. M. from a drawing in the Buchanan collection, marked by that author as *Murænophis sathete.*

3. *Murænesox Hamiltonii,* J. M. from a drawing in the Buchanan collection, marked *Muræophis Bazi.*

4. *Murænesox exodontata,* J. M. head and jaws natural size, and a reduced figure of the whole.

Pl. IX. Fig. 3. *Ptyobranchus erythreus,* J. M. natural size, three figures, one representing the external form, another the internal struture, and a third the jaws and branchial rays enlarged ; a. a. branchial rays, i.i. the lower jaw separated at the symphisis ; l.l. the hyoid bones, m.m. small opercula, b.b. the gills natural size, c. the branchial arteries, d. the heart, n.n. pericardium forming the diaphragm, e. the liver raised from its place to show the continuation of the œsophagus ; h. f. the stomach ; g. the intestine.

4. *Ptyobranchus multidentata,* J. M. natural size, with the teeth enlarged.

5. *Ptyobranchus parvidentata,* J. M. natural size, with the teeth enlarged.

6. *Ptyobranchus gracilis*, J. M. natural size.

7. *Anguilla variegata*, J. M. from a drawing in Buchanan's collection, a copy of which seems to have fallen into the hands of Mr. Gray, by whom it is given in Hardwicke's illustrations of Indian Zoology, (without acknowledgment of the original source from whence it was derived) as Anguilla Bengalensis, although it is unknown in Bengal.

Pl. X. Fig. 1. *Ptyobranchus arundinaceus*, J.M. natural size, with the teeth 1.a. magnified to about thrice the size of the jaws; 1.b. section of the body.

Fig. 2. *Ptyobranchus guthrianus*, J. M. natural size, 2.a. the teeth and jaws magnified to thrice the natural size; 2.b. section of the body.

Fig. 3. *Ophisurus minimus*, J. M. natural size, 3. a. the teeth represented thrice the natural size, 3.b. the section of the body, and 4 the lower surface of the head, showing the disposition of the branchial rays.

Pl. XI. Fig. 1. *Ophisternon bengalensis*, J. M. natural size, a. the maxillary band of teeth, and c. the palatine band; b. the teeth of the lower jaw.

2. *Ophisternon hepaticus*, J. M. half size, fig. 4, the teeth of both jaws a little more than natural size.

Pl. XII. Fig. 1. *Ophicardia phayriana*, J. M. natural size, with 1.a. teeth of the upper jaw; c. the band of teeth on the lower; and 1.b. the branchial combs and rays natural size.

2. *Ophisurus vermiformis*, J. M. natural size.

3. *Ophisurus caudatus*, J. M. natural size.

4. *Ophisurus harancha*, Buch. natural size.

Pl. XII. Fig. 1. *Pneumabranchus striatus*, J. M. natural size, with a figure representing the lower surface of the head and external branchial aperture, 2. the jaws and teeth; a. the upper, b. the lower jaw; 3. a scale magnified; 6. a portion of the skin taken from the lateral line which together with the scales on either side are magnified about twice the natural size; 4. the outside of the branchial apparatus; a. b. c. the arches of the gills; f. the branchial rays; g. the operculum magnified about twice; 5. inner view of the branchial apparatus; a. b. c. the arches; d. entrance to the sack, e. h. pharangeal teeth; i.i.i. apertures between the branchial arches.

Pl. XIV. Internal structure of Apodal Fishes.

I. The stomach, intestine, and heart in the genus *Anguilla*, Cuv.

II. The stomach, and air vessel in the genus *Murænesox*, J. M.

III. The stomach, intestines, and heart in *Ophisurus*, Lacep.

IV. The same in the genus *Strophidon*, J. M.

V. The same in the genus *Pneumabranchus*, J. M.

VI. The same in *Ophisternon*, J. M.

VII. The same in *Ptyobranchus*, J. M.

1, the stomach; 2, the intestine; 3, the entrance to the throat; 4, the anus, (5, Fig. V. and VI. the liver); 6, the heart marking its relative situation with the entrance of the throat.

7, the heart magnified, showing A. the auricle, B. (and B. B. in some) the ventricle; g. the descending, and b c. the ascending *vena cava;* e. the ascending, and f. the descending aorta, d. c. B. Fig. V. the muscular portion of the ventrical, detached from the auricle, shewing 4, semilunar valves at c. communicating between the auricle A. and ventricle B. in the genus Pneumabranchus.

V.—*General Synopsis of Apodal Fishes.*

The following Synopsis shows the position of the Bengal species in the general classification of the fishes of this order, here rendered as complete in regard to foreign species, as the works of reference to which I have excess would admit of. It is however very imperfect, and can only be useful as bringing together all the well known and authentic species for the convenience of students. The species of Upper India, of the Mountain Provinces of Kemaon, Sekim, Nipal, Girwal, &c. have yet to be added to the list. This can now be done by any one commonly versed in such enquiries, although I may say without arrogance that no subject could be involved in greater obscurity than this, when the present task was undertaken. Of 100 known species, it will be seen from the table of Geographical distribution, with which this paper is concluded, that 37 belong to Asia, 24 to Europe, 17 to America, and 17 to Africa. It will be seen however, that of the 37 Asiatic species, 26 are peculiar to Bengal alone, and if we include Arrakan as a portion of the Province, Bengal in that case affords one-third more species than all Europe, and twice as many as North and South America together. From the same table we also learn, that Apodal Fishes prevail most in variety as we approach the tropics. Thus, while North America has but six species, South America possesses eleven; and while Great Britain has only six, the Mediterranean has also eleven; and the Nile contains but five species, while the lower Ganges contains twenty-six.

The same table likewise shows that there are several genera, but no species common to Europe and Asia, while there is no genus common to Asia and America.

Ord.—APODES. Linn.

Tribe.—ANGUILLIDES. Nob.

The anus is near the middle of the body. The heart situated between the branchial apertures, which are double. Gills pectinated, supported by bony arches.

I. *Fam.*—ANGUILLIDÆ, Nob.

Pectoral fins distinct; dorsal and anal fins united; branchial rays slender. Two nostrils on either side, one before the eye, and the other near the end of the muzzle.

I. *Gen.*—ANGUILLA, Cuv.

Dorsal commencing far back behind the pectorals, teeth conical, sharp and disposed in bands. Anterior nostrils tubular.

ANGUILLA ACUTIROSTRIS. Yarr. *Brit. Fishes*, ii. 284. *Muræna anguilla*, Lacep. 11-284.	Head convex at the crown, compressed, but depressed towards the jaws. Lower jaw longer than the upper, mouth slightly cleft with a narrow band of small teeth on each side of the jaws. Dorsal occupies more than two-thirds of the back, and the anal more than half the length. HAB.—Europe.
ANGUILLA LATIROSTRIS, Yarr. *British Fishes*, ii. 298.	Head rounded behind, but flattened before the eyes; jaws broad and blunt, lower jaw broader and longer, than the upper; mouth widely cleft, teeth forming a broad band on either side of both jaws. Dorsal and anal fins broad. HAB.—Europe.
ANGUILLA MEDIOROSTRIS, Yarr. *British Fishes*, ii. 301.	Jaws widely cleft but narrow, lower jaw longer than the upper, pectorals nearer to the head than in either of the other species. HAB.—Europe.
ANGUILLA LONGICOLLA, Cuv. Lacep. ii. 3. *f.* 3.	Upper jaw longer than the lower. Dorsal and anal fins narrow. HAB.—Europe.

ANGUILLA MACROPTERA, Nob. *Calcutta Jour. Nat. Hist.* iv. *t.* xxv. *f.* 1.	Lower jaw narrower and considerably longer than the upper. Head narrow. Two uniform rows of obtuse conical teeth on each side of both jaws, as well as on the vomer. The interval from the branchial apertures to the anus, is equal to half the distance from the anus to the end of the caudal, and to the whole distance from the extremity of the muzzle to the commencement of the dorsal; 11 long slender cartilaginous branchial rays. HAB.—Chusan and Ningpoo in China.
ANGUILLA SINENSIS, Nob. *Calcutta Journ. Nat. Hist.* *t.* xxv. *f.* 2.	Three rows of obtuse short conical teeth on each side of the upper jaw, the middle row forming a culminating ridge. A broad band of similar teeth on the vomer and on both sides of the lower jaw. 10 very slender branchial rays. HAB.—Chusan and Ningpoo, China.
ANGUILLA ELPHINSTONEI, Sykes. *Proc. Zool. Soc. 27th Nov.* 1838.	Head flat, lower jaw longer than the upper, colour dark green, blotched with black. HAB.—Western India.
ANGUILLA NEBULOSA, Nob. *t.* v. *f.* 2.	Body clouded with dark irregular streaks. Dorsal commences before the anterior-third of the body; the anal commences before the middle. The fin rays are, P. 20: D. 306: A. 248. Branchial rays long and slender, 9 on each side. Scales naked, and small, disposed in a tessellated form not imbricated. Head narrow. HAB.—Bengal and Arracan.
ANGUILLA VARIEGATA, Nob. *Anguilla Bengalensis, Gray Hard. Illust. Ind. Zool. t.* xi. *f.* 7.	Head flat and triangular, body variegated, scales naked and tessellated. HAB.—Ganges at Behar.
ANGUILLA BREVIROSTRIS, Nob. *t.* v. *f.* 1.	Dorsal commences before the anterior third of the back, and the anal fin before the middle; colour above olive green, below yellowish white; the fin rays are P. 18 : D. 290 : A. 240. HAB.—Bengal and Arracan.

ANGUILLA BICOLOR, Nob. *Chowloo Pamoo, Russell Ind. Fishes? t.* vi. *f.* 1.	Dorsal begins near the middle of the back and occupies little more than half the length. Head of about equal breadth with the body. Teeth like the pile of velvet. The fin rays are P. 18 : D. 245 : A. 221. Colour dark green above, below white. HAB.—Arracan.
ANGUILLA ARRACANA, Nob. *t.* vi. *f.* 2.	Body clouded. Dorsal begins about two diameters of the body in front of the anal. Head depressed, but little wider than the body. The fin rays are P. 20: D. 275: A. 141. HAB.—Sandoway on the Arracan Coast.

II. *Gen.*—CONGER, Cuv.

Head conical, slightly depressed, muzzle round, with the upper jaw a little longer than the lower. Dorsal commencing behind the pectoral fins; anterior nostrils tubular.

CONGER VULGARIS, Cuv. *Yarr. Brit. Fishes*—11 *p.* 304.	Head conical and depressed; jaws furnished with strong teeth, forming a broad band on each side, lips fleshy; colour pale brown above, and white below the lateral line. Dorsal and anal edged with black. HAB.—Coasts of Europe.
CONGER MYRUS, Linn.	Is smaller than the above, with a broad band across the occiput, and two rows of dots on the nape. Colour all whitish. HAB.—Mediterranean.
CONGER BALEARIS, Cuv. *Laroach An. du Mus.* xiii. *t.* 20. 3.	The upper jaw depressed, the lower margin of the head straight; colour greenish yellow. Dorsal commencing over the branchial apertures. HAB.—Ivica
CONGER MYSTOX, Cuv. *Larooch An. du Mus.* xiii. *t.* 25. *f.* 10.	The upper jaw longer than the lower; upper lip broad and flabby. Pectorals situated high on the shoulder, the dorsal commencing a little behind them; colour grey. HAB.—Ivica.

CONGER AMERICANA, Forks. *Rüppell's Fishes of the Red Sae, and Northern Africa, t.* 29, 1.	Jaws of nearly equal length, provided with a row of thickly set fine hooked teeth. Dorsal commences behind the pectorals. Colour dark greenish grey above, white below, both colours forming incomplete bars on the sides. HAB.—Red Sea.
CONGER LONGICOLLIS, Cuv. *Lacep.* 11. *t.* 3. *f.* 52.	Upper jaw longer than the lower. N. B.—No detailed description has been given of it, but according to Cuvier, it has been figured in Lacepe for the Myre.

III. *Gen.*—MURÆNESOX, Nob.

Jaws elongated and narrow, without tubular nostrils; a row of prominent distant sharp teeth along the centre of the vomer, with a row of short conical teeth on either side of the same. Several large scattered teeth at the apex of the jaws.

MURÆNESOX TRICUSPIDATA, Nob. *Cal. Jour. Nat. Hist. vol.* iv. *t.* xxiv. *f.* 1.	Vomerial teeth compressed and tricuspid, presenting sharp cutting edges before and behind. Two rows of teeth on each side of the lower jaw. HAB.—Bengal and China.
MURÆNESOX LANCEOLATA, Nob. *t.* vi. *f.* 3.	Vomerial teeth long, with a single lanceolate point, with cutting edges before and behind. Two rows of teeth on each side of the lower jaw. HAB.—Bengal.
MURÆNESOX EXODENTATA, Nob. *t.* vi. *f.* 3.	Vomerial teeth long and conical. Two rows of teeth on each side of the lower jaw, and a third outer row of lateral teeth presenting their points horizontally outwards. HAB.—Bay of Bengal.
MURÆNESOX SERRADENTATA, Nob. *Ophidum talabon, Russ. Ind. Fishes, No.* 38.	Vomerial teeth serrated. HAB.—Coromandel Coast.
MURÆNESOX HAMILTONII, Nob. *t.* viii. *f.* 3.	Jaws seem shorter than those of the others. HAB.—Bengal.

II. *Fam.*—OPHISURIDÆ. Nob.

Have pectoral fins, but no caudal. Dorsal and analt erminating before they reach the end of the tail.

IV. *Gen.*—Leptognathus, Swains.

Pectoral fins conspicuous; jaws prolonged, narrow, and pointed, armed with sharp scattered teeth.

Leptognathus oxyrhynchun, Swains. *Fishes and Amph.* 1-221.	Dorsal and anal expand towards the end of the tail, where they terminate. Hab.—Coast of Sicily.

V. *Gen.*—Ophisurus, Lacep.

Head conical, upper jaw longer than the lower, teeth conical, in broad bands; branchial rays numerous and decussate with those of the opposite side.

Ophisurus fasciatus, Lacep. *Ed.* 1831—iii. *p.* 63.	25 transvese bands separated by narrow intervals. Hab.—Unknown.
Ophisurus serpens, Lacep. ii. *p.* 198.	No spots, or very small ones. Hab.—Italy and adjoining parts of Europe.
Ophisurus hijala, Buch. *Gang. Fishes, t.* 5 *f.* 5.	Dark green above, white below; a row of pale spots on the lateral line. The head is wider than the body, the eyes are placed high on the sides of the head. P. 8: D. 230 to 240: A. 170. Hab.—Bengal.
Ophisurus boro. Buch. *Gang. Fishes, p.* 20.	Head wider than the body, eyes half way up on the sides of the head; colour above black, beneath yellow, pectoral fins minute and round. P. 11: D. 330: A. 270. Hab.—Bengal.
Ophisurus harancha, Buch. *Gang. Fishes, p.* 20, *Calcutta Jour. Nat. Hist.* v. *t.* xii. *f.* 4.	Pectoral fins terminating in a narrow point, P. 12: D. 345: A. 240. Hab.—Bengal.
Ophisurus rostratus, Buch.	Small conical head, eyes, high, pectorals long containing 11 rays each, tail conical and terminating in a round point. Hab.—Bengal.

OPHISURUS MINIMUS. Nob. *t.* x. *f.* 3.	Muzzle short and narrow, eyes placed near each other toward the crown; branchial membrane contains 24 rays. Tail sharp and tapering. HAB.—Bengal.
OPHISURUS VERMIFORMIS, Nob. *t.* xii *.f.* 2.	Long narrow slender body, terminating behind in a long conical round pointed-tail. Rostrum long and pointed, under jaw terminating in a narrow point. Pectorals long and contain 11 rays. HAB.—Bengal.

VI. *Gen.*—OPHITHORAX, Nob.

Pectoral fins very small, so as to be scarcely perceptible.

OPHITHORAX OPHIS. *Ophisurus ophis, Lacep.*	Dorsal fin broad, anal narrow, body and dorsal covered with large round spots. Pectoral fins very minute. HAB.—Seas of Europe.
OPHITHORAX COLUBRINA. *Murænophis Colubrina, Lacep.* *t.* v. *p.* 642. xix. *f.* 1.	Fifteen transverse bands. Pectoral fins almost imperceptibly small. HAB.—New England.
OPHITHORAX IMBERBIS. *Sphagebranchus imberbis Loaoach An. du. mus.* xiii. 25. *f.* 18.	Body elongated and nearly cylindric, tail compressed. Dorsal fin more elevated in front than towards the end of the tail, and is contained in a fissure in the back: the anal fin is parallel throughout, and is contained in a fissure in the tail. The tail is equal to half the length of the body. The eyes are very small and situated near the extremity of a narrow muzzle. HAB.—Mediterranean.

III. *Fam.*—MURÆNIDÆ. Nob.

No trace of pectoral fins. The branchial rays long and filiform, anterior apertures of the nostrils tubular.

VII. *Gen.*—DALOPHIS, Rafinesq.

Branchial apertures placed under the throat. Dorsal and anal terminating before they reach the end of the tail which is naked. Dorsal begins near the branchial apertures.

DALOPHIS SCARPA, Raf. *Swains. Nat. Hist. Amph. and Rept.* 11, *p.* 221.	Dorsal and anal increase in breadth before they reach the end of the tail where they terminate abruptly. HAB.—Coasts of Sicily.
DALOPHIS ORIENTALIS, Nob. *Mauntibukram paun. Russell Ind. Fishes No.* 37.	Dorsal and anal of uniform breadth with a cluster of large mucus pores on the top of the head. HAB.—Coromandel Coast.
DALOPHIS RÜPELLIÆ, Nob. *Muræna Reticulata, Fauna North. Africa, p.* 117.	Colour flesh red with eighteen transverse bands, between the two first of which upon the head there is a bright yellow appearance. Teeth strong and hooked : the dorsal commences before the branchial apertures. N.B.—This cannot, as Dr. Rüppell supposed, be *M. Reticulata,* Bl. or *Murænophis colubrina,* Lacep. which has small pectoral fins, and was placed on that account by Baron Cuvier in the genus *Ophisurus,* and is besides a native of New England. HAB.—Red Sea.
DALOPHIS GEOMETRICA. *Muræna Geometrica, Rupp. Fishes of the Red Sea. In Faun. North Africa, t.* 30 *f.* 1.	Dorsal and anal of uniformly narrow and continued to the end of the tail : a lateral row of mucus pores on either side of the crown joined to a cross row behind; colour light brown, mottled with dark brown spots. Several rows of teeth in the centre of the mouth. HAB.—Red Sea.
DALOPHIS TIGRINA. *Muræna Tigrina, Rüpp. Fishes of the Red Sea. In Fauna North Africa, t.* 36. *f.* 2.	Dorsal commences over the branchial apertures and form a narrow continuation round the end of the tail, the anus is placed at the anterior third of the body which is marked with brown spots, several rows of hooked teeth on the jaws and palate, HAB.—Red Sea.

VIII. *Gen.*—MURÆNA. Nob.

Dorsal commences behind the branchial apertures: palatine bones compressed so as to form a narrow ridge along the roof of the mouth, where there is a single irregular row of teeth in addition to a single row on the maxillaries.

MURÆNA HELANA, Linn. *Murænophis Helana, Lacep.* v. 627.	Dorsal commences as far behind the branchial apertures as these are from the muzzle. Maxillary teeth sharp and widely set. There are a few irregular large spots on the body and tail intermixed with small spots. HAB.—Seas of Europe.
MURÆNA CATENULA. *Murænophis Catenula, Lacep.* v. 628.	Head and mouth small, furnished with a single row of small, pointed, and very close set teeth, and (two rows on the palate, Bl.) palate smooth. The dorsal commences further behind the branchial apertures than these are from the vent, and the spots on the body are of the form of links of a chain. HAB.—Unknown.
MURÆNA PANTHERINA. *Murænophis Pantherina, Lacep.* v. 628.	Branchial apertures at a distance from the head, equal to the length of this last part. The dorsal commences as far behind the branchial apertures as these are from the head. Colour like that of a Panther HAB.—Unknown (Dutch collection.)

IX. *Gen.*—STROPHIDON. Nob.

III.—*Dorsal commencing at the nape, two rows of teeth in the maxillaries, with a few scattered conical moveable prominent teeth at the apex of the jaws, a single irregular row on the palate.*

MURÆNA FLAVIMARGINATA, Rüpp. *Fishes of the Red Sea. In Fauna Northern Africa, t.* 30. *f.* 3.	Colour yellowish brown, with numerous dark brown spots. Dorsal and anal edged with yellow. Jaw of nearly equal length. HAB.—Red Sea.
4. STROBHIDON GRISEA. *Murænophis Grisea, Lacep.*	Muzzle round, upper jaw thicker and longer than the lower: anus situated before the middle, general colour brown and white disposed in small streaks. HAB.—New Britain.
5. STROPHIDON AFRICANA. *Murænophis Africana, Lacep.*	Mouth and teeth large, those in front of the jaws larger than the others. Body and tail marbled, anus situated at the middle. HAB.—The Coast of Guinea.

STROPHIDON ECHIDNA, *Murænophis Echidna, Lacep.*	Head small, depressed, nape very high, mouth widely cleft, with many bristling sharp teeth; colour, variations of black and brown in distinct zones HAB.—New Britain and Amboyna.
STROPHIDON UNICOLOR. *Murænophie Unicolor Loroach. Annal du Mus.* xiii. xxv.	Two rows of teeth in the upper, and one in the lower jaw. Body cylindric, anus situated at the middle; nape high. HAB.—Ivica.
STROPHIDON LITERATA, Nob. vii. 2.	Mouth widely cleft, jaws of equal length, 3 long retractile conical teeth in a row near the apex of the upper jaw in front of the central palatine row, and two interrupted rows on each side, the inner row composed of prominent distant teeth; colour dark green above, with short white interrupted streaks: 334 rays concealed in the dorsal, and 182 in the anal fin. HAB.—Bengal.
STROPHIDON HEPATICA. *Muræna Hepatica Rupp. Faun. North Africa, p.* 120.	Liver brown colour. The anal fin commences at the middle of the body: fin very broad and elevated. N.B.—The peculiarities of dentition are not stated. HAB.—Red Sea.
STROPHIDON PUNCTATA, Nob. vii. 3.	Head raised abruptly over eyes, body marked with round spots particularly in the young. The outer row of small teeth on the upper jaw is continuous round the apex alternately with the large teeth of the inner row. There are 392 rays concealed in the dorsal, and 190 in the anal fin. HAB.—Bengal.
STROPHIDON MACULATA. *Murænophis tile baim Buch. M.S. Drawings* viii. 1.	Probably the young of the above.
STROPHIDON LONGICANDATA, Nob. *Murænophis Sathete, Buch.*	Head conical, jaws of equal length, dorsal commencing half way between the branchial aperture and head, contains 484, and the anal 384 concealed rays; colour olive green, without spots. HAB.—Bengal.

X. *Gen.*—Thærodontis, Nob.

IV. *Dorsal commencing at the nape, a double row of teeth along the centre of the palate, and a single row on the maxillaries, together with several long moveable hooked conical teeth near the apex of the jaws.*

Thærodontis nigricans. *Murænophis Nigricans, Lacep. Encyc. Method. Gronov. Zooph.* 163.	*The anus nearer to the tail than it is to the head* which is flat; jaws long, muzzle round, teeth of the upper jaw and those at apex of the lower, larger than the others. Hab.—South America.
Thærodontis reticularis. *Gymnothorax Reticulatus, Bl.* 416.	Head and mouth small, each jaw furnished with a row of pointed irregular long teeth, anus rather beyond the middle, reticulated brown spots and bands on the back, diminishing on the sides, obscure brown spots on the dorsal. Hab.—Tranquebar.
Thærodontis stellata. *Murænophis Stelata, Lacep. et Commers.*	Dorsal narrow, two longitudinal rows of spots on each side. The upper jaw is more advanced than the lower, the anus situated about the middle. Hab.—New Britain.
Thærodontis reticulata, Nob. vii. 1.	Crown high and rounded, every part of the body is marked with black pentangular spots, separated by narrow white lines of the same form. The teeth are sharp and hooked, consisting of a single row on the edges of both jaws, and a double row on the centre of the back part of the palate, and 3 moveable fangs in a central row near the apex of the upper jaw. Hab.—Arracan.
Thærodontis cineraceus. *Muræna Cineraceus, Rupp. Fauna North Africa, p.* 120. *Museum of Frankfort.*	The anus is situated a little in front of the middle; fins grey, colour ash grey with a blackish edging to the fins, eight or ten dark lines over the opercula. N.B.—The peculiarities of its dentition requires to be pointed out. Hab.—Mohila on the Red Sea.

THÆRODONTIS OPHIS. *Muræna Ophis. Rupp. Faun. North Africa, t.* 29. *f.* 2.	Yellowish colour, marbled with many fine citron yellow and dark brown spots. The anal fin commences rather behind the middle. N.B.—It is merely said of the dentition that the mouth is provided with a row of remarkable strong conical hooked teeth, so as to render the bite dangerous. HAB.—Red Sea.
THÆRODONTIS FLAVIMARGINATA. *Muræna flavimarginata, Rupp. Faun. North Africa, t.* xix. *f.* 3.	Colour yellowish brown, with chesnut brown spots, with a yellow edging to the fins; jaws and palate furnished with a single row of strong teeth. N.B.—Dr. Ruppell supposes this species to be *Murænophis gris,* Lacep. in which however there are two rows of teeth on the edge of the jaws, while in this there seems to be but one row. HAB.—Red Sea.

XI. *Gen.*—GYMNOMURÆNA, Lacep.

The body and tail almost cylindrical, neither dorsal nor anal fins, and the caudal is sometimes wanting.

GYMNOMURÆNA DOLIATA. *Lacep.* v. *t.* 19, *f.* 4.	Without caudal or other fins. Body marked by alternate transverse bars of brown and white. Upper jaw a little longer than the lower. HAB.—New England.
GYMNOMURÆNA MARMORATA, *Lacep.* v. *p.* 648.	The lower jaw a little longer than the upper; a slight rudimental caudal, anus nearer to the head than the tail. HAB.—Europe.
GYMNOMURÆNA CONCOLOR,* *Uropterygius Concolor, Ruppell. Fishes of the Red Sea in Faun. North Africa.*	Two rows of sharp teeth on each jaw, with one on the palate, colour uniformly liver brown, caudal distinct. HAB.—Red Sea.

* The bite of this species is said by Lacepede to be poisonous.

GYMNOMURÆNA CÆCUS. MURÆNA CÆCUS, Linn. *Apterichthus Cæcus Loroach. Ann. du Mus.* 13, *t.* 21, *f.* 6.	Body long, and tapering from the intestinal aperture to the point of the tail. Head conical, terminating in a narrow pointed muzzle—no fins. Teeth small at the base, and large and distinct from each other at the apex of the jaws.

Tribe.—OPHICARDIDES. Nob.

The heart situated far behind the gills, and the anus behind the middle of the body.

I. *Fam.*—SYNBRANCHIDÆ, Nob.

A single external opening leading to the gills which are supported by bony arches, no fins beyond a slight duplicature of the skin, forming an adipose dorsal and anal united at the end of the tail. Anterior nostrils tubular.

I. *Gen.*—OPHICARDIA, Nob.

Jaws depressed, gills small, consisting of 3 *slightly pectinated combs, to which there is a single transverse external opening, diverging to a small internal opening on either side. Teeth disposed in broad bands on either side as well as on the maxillaries.*

OPHICARDIA PHAYRIANA, Nob. xii. 1	Having five strong bony branchial rays on either side, the first isolated in front of the others and much larger. The body is cylindric, without scales, and very long. The tail very short and compressed, the anus situated at the posterior fifth of the entire length. Head short and convex at the crown. HAB.—Sandoway.

II. *Gen.*—PNEUMABRANCHUS, Nob.

Head depressed, 3 *branchial arches, the intervals between them almost obliterated by means of a vascular membrane which lines a blind sack opening on either side over the first* *arch, performing the functions at once of lungs and gills. The body is covered with small imbricated scales. The branchial apertures and fins as in Ophicardia, but the ventral aperture is not quite so far back.*

Pneumabranchus striatus, Nob.
Unibranchapertura Cuchia, Buch. xiii.

Colour above olive green, with small round black spots; two or three white streaks extending a short way along the sides from the back of the head. Below yellowish-white. The anus is at a distance of 3-4th of the entire length from the muzzle. The tail is compressed and narrow. The reflection of skin representing the dorsal fin, occupies the latter two-thirds of the tail.
Hab.—Bengal.

Pneumabranchus leprosus, Nob.

Body yellowish white, with a few irregular dark spots of various size scattered over the body. And the membranous expansion representing an adipose dorsal commences almost as far forward as the vent.
Hab.—Bengal.

Pneumabranchus albinus, Nob.

Colour uniformly bright yellow, pupils black, irides narrow, and bright golden yellow, surrounded by a livid zone.
Hab.—Bengal.

Pneumabranchus cinereus, Nob.
Calc. Journ. Nat. Hist. iv. *t. f.*

Colour dark dusky grey above, blueish grey below. The anus situated a little before the posterior fourth part of the entire length. The membranous expansion representing the dorsal, begins to appear before the middle of the tail.
Hab.—Chusan and Ningpoo in China.

III. *Gen.*—Synbranchus, Bloch.

A single branchial aperture forming a longitudinal fissure under the throat, a thick head and blunt narrow muzzle.

SYNBRANCHUS MARMORATA, Bl. *Shaw Zool.* vol. iv. *t.* 4.	Muzzle round, jaws furnished with many ranges of small teeth. HAB.—Surinam.
SYNBRANCHUS IMMACUALTA, Bl.	Muzzle narrow and pointed, without spots on the body; it is smaller than the last and of a dusky brown colour. HAB.—Surinam.
SYNBRANCHUS CENDRE, Bon.	The dorsal commences about the middle of the body, the head small, muzzle pointed, upper jaw longer than the lower, colour grey. HAB.—Coast of Guinea.
SYNBRANCHUS LINEATA. *Unibranchapertura Lineata, Lacep.*	Muzzle pointed, many rows of hooked teeth in both jaws; a dark line extended from the head along the whole length of the back. HAB.—Cayenne.
SYNBRANCHUS LÆVIS. *Unibranchapertura Lævis, Lacep.*	Eyes small and situated near the end of the muzzle; the dorsal commences about the latter fourth of the entire length, the dorsal, anal and caudal adipose, and very difficult to distinguish. HAB.—Cayenne.

IV. *Gen.*—OPHISTERNON, Nob.

A single transverse opening under the throat, common to both branchiæ. These consist of four pectinated combs on each side. Two bands of teeth on the edges of the upper jaw, 5 *short cartilaginous branchial rays. Eyes small and placed on the muzzle, teeth disposed in bands on the sides of the jaws.*

OPHISTERNON BENGALENSIS, Nob. xi. 1.	The head is long, depressed and narrow, the eyes small and placed near the extremity of the muzzle which is slightly recurved; 2 broad bands of teeth on either side of the upper jaw, the outer band placed on the maxillaries, forms a crescent in front. HAB.—Bengal.

OPHISTERNON HEPATICUS, Nob. xi. 2. — Head short and thick, rounded at the crown; the outer band of teeth on the upper jaw terminates laterally in a single row, and forms an inverted crescent at the apex.
HAB.—Arracan.

V. *Gen.*—ALABES, Cuv.

A single branchial aperture under the throat; pectoral fins well marked, 3 branchial rays, the intestines as in Synbranchus.

A single small species only is known, and this inhabits the Indian Ocean.

ALABES CUVERIÆ. Nob. — A small concave disk between the pectoral fins, teeth pointed.
HAB.—Indian Ocean.

II. *Fam.*—PTYOBRANCHIDÆ, Nob.

Two distinct branchial apertures situated in front of small pectorals, leading to gills consisting of 4 pectinated combs supported by bony arches. Fins supported by rays.

VI. *Gen.*—PTYOBRANCHUS, Nob.

Head small, with a narrow conical round muzzle, and a long perfectly cylindrical body like a reed, terminating abruptly in a thick tail. Dorsal and anal narrow, rounded, and connected with the caudal by means of a narrow raphe.

PTYOBRANCHUS ARUNDINACEUS, Nob. x. 1. — Distance from the muzzle to the pectorals equel to 1-12th of the entire length, diameter of the body equal to about 1-50th of the length. The anus is situated at the latter 3d of the length, the tail is of equal depth with the body to the very end, within two or three diameters of which it becomes compressed, and terminates in a thick wedge. The anal fin commences at a distance behind the anus equal to its own length, the dorsal commences at the middle of the tail. The jaws are of equal size. Colour dark olive-green above, greenish-white below. The fin rays are P. 10 : D. 10 : A. 40.
HAB.—Bengal.

PTYOBRANCHUS GUTHRIANUS, Nob. x. 2.	The diameter equal to about 1-47th of entire length, body perfectly cylindric, but the tail is a little compressed, and terminates in an oval point; the anal fin commences at a distance behind the vent. The raphes connecting the caudal with the dorsal and anal fins are a little more developed than in the last, the fin rays are P. 11 : D. 36 : A. 44 : C. 64. Colour dark green above, of a lighter shade below. HAB.—Bengal.
PTYOBRACHUS LINEARIS, *Moringua linearis, Gray. Hard. Illust. Ind. Zool.* ii. 3.	The caudal, anal, and dorsal fins united and straight. N.B.—I suspect this species is fabricated from a drawing in the Buchanan collection Bot. Garden, Calcutta, in which the dorsal and anal are both represented by mistake winding in a spiral form round the end of the tail, which had been accidentally twisted.
PTYOBRANCHUS HARDWICKII, *Rataboura Hardwichii Gray.**	Dorsal fin contains 26 rays, the anal 32, and the caudal 36. N.B.—This supposed species was made by Mr. Gray to form a distinct genus from the last under an idea that the caudal is in the one distinct, and in the other united with the dorsal and anal. It is needless to remark that such distinctions could only have originated from bad drawings.
PTYOBRUNCHUS RAITBORUA, Nob. *Murœna raitaborua Buch Gang. Fishes, p.* 25. *Hard. Illust. Ind. Zool.* 11. *f.* 4.	The diameter of the body equal to about 1-31st of the entire length. The distance from the muzzle to the pectorals equal to 1-9th of the entire length, and to 1-3rd of the length of the tail. The anal fin commences about one diameter of the body behind the vent. Teeth short, strong and hooked, 10 forming a line on the vomer, and 15 an interrupted line on either side of the upper jaw, pectorals round, P. 9 : D. 39 : A. 44 : C. 60, or there abouts. Colour, purple above, below reddish white; tail dark. HAB.—Bengal.

* This is founded on a figure taken from Buchanan's MSS. Bot. Garden, Calcutta, marked in the Author's hand writing *Murœna raitaborua.* See As. Res. Beng. vol. p. xix. 221.

Ptyobranchus erythreus, Nob. ix.—3.	The anal fin commences near the anus, and contains 50 or more distinct rays, when it slopes off into a narrow raphe connecting it with the anal, which contains seventy or more distinct rays. Tail compressed and lanceolate. The fin rays are D. 40 : A. 56 : C. 70. Colour above red, minutely speckled with black dots, below reddish white. Length about 10 inches, diameter about ¼ inch. Hab.—Bengal.
Ptyobranchus multidentatus, Nob. ix.—4.	Tail thick and clumsy. The fin rays are D. 42 : A. 36 : C. 64. Hab.—Bengal.
Pneumabranchus parvidentatus, Nob. ix.—5.	Head small, tail slightly tapering and compressed, with the anal commencing near the anus; about 30 small hooked teeth forming a row on either side of the jaws, with only about 4 teeth, forming a row on the vomer near the apex of the jaw. P. 11 : D. 31 : A. 38 : C. 60, or thereabouts. Colour purple, and minutely dotted above the lateral line; white below. Length about 10 inches, diameter of the body ¼ inch.
Ptyobranchus gracilis, Nob. ix.—6.	The head is very small, muzzle acute and sharp, eyes close together, about 22 sharp hooked teeth on either side of the jaws and ten forming a row on the vomer. Length about 9 inches, diameter 1-5th inch. Colour purple above the lateral line, and white below.
Ptyobranchus Brevis, Nob.	About four inches in length. P. 11 : D. 40 : C. 54, probably the young of P. medius.

The following are the only species here omitted, the necessary works in which their descriptions appear, not being procurable in Calcutta. The first three are referred to by Cuvier as Congers; namely, *Muræna strongylodon, Schn. Mur. nigra, Risso, Anguilla Marbree,* Quoy and Gaym, Voy. de Frecin. t. 51, f. 2, and *M. Savanna,* Cuv. from Martinique. *Ophisurus longmusean,* Cuv. Quoy and Gaym. l. c.; *Oph. guttatus,* Cuv. a new species from Surinam. *M. Saga,* Risso, remarkable for elongated jaws and the extension of the tail into a point; it evidently belongs to the genus *Dalophis,* Raf. The other three are Murænidæ with a single row of sharp teeth on the edges of the jaws, viz. *M. Moringa,* Cuv. from the Antilles, Catesb. ii. xxi.; *M. punctata* Bl.; and *M. meleagris,* Sch. Lastly, two species referred by Cuvier to the genus *Sphagebranchus,* Bl., viz. *Leptocephalus spallanzani,* Risso, *Cæcula pterygea,* Vahl. Mem. d'Hist. Nat. de Copenh. iii. x. iii. v. 13. 1. 2.

Lastly, twelve species of Apodal fishes, known only by their remains in the tertiary strata of Europe, are figured in the *Ittiolithologia Veronese,* and two in M. Agassiz's work on Fossil Fishes. Being extinct, these species cannot be said, strictly speaking, to come within our present object, which is limited chiefly to the species of Bengal, and the position which they hold in the general distribution of the order. This I have endeavoured to exhibit in the following table, already referred to, p. 206.

It may be remarked however with regard to the solid parts of animals dispersed throughout the strata of the earth, that they prove a gradual cooling to have taken place in the temperature of the globe, by which alone we are enabled to account for the remains of tropical animals found in high northern latitudes. The history of Apodal fishes only tends to confirm the general fact of such a change. The accompanying table shows as already remarked, p. 206, that the number and variety of Apodal fishes increase as we approach the tropics. In Bengal the lowest latitude in which they have been examined, we have probably ten species of the genus *Anguilla,* which is more than double the amount of species now existing throughout the whole of Europe. Yet in a single locality of that temperate continent, nine fossil species of *Anguilla* have already been found. These are imbedded in the slaty rocks of *Monte Bolca*, together with a species of *Ophisurus*, a genus now nearly restricted to the tropics alone, and which is almost as little known in Europe in the present day, as the Crocodiles and Tapirs with whose bones its remains are mingled in Italy and France.

NOTE.

Should it be thought necessary to separate the Bengal species of the genus from *Anguilla*, Cuv. on account of their naked tessellated scales, I would propose the following name and characters for the new group.

Sub-genus.—*Terpolepis.*—Lower jaw broader, and longer than the upper. Dorsal and anal as in the genus *Anguilla*, body covered with minute naked oblong tessellated scales. Teeth conical, small, slightly hooked, and disposed in a broad band on either side of the jaws, as well as on the vomer. Anterior nostrils tubular.

ERRATA.

With respect to the genus Cossyphus, p. 403 *vol.* IV. *I find that name has been previously appropriated to another genus by M. Valenciennes, I therefore propose* Phagorus, *the Greek name of an unknown kind of fish, to be substituted for the genus in question, in place of the first mentioned name.*

Page 204, last line but one from bottom, for Pl. xii, read Pl. xiii.

Geographical distribution of Apodal Fishes.

Order.	Tribes.	Families.	Genera.	Asia. Bengal.	Asia. Arracan.	Asia. China.	Europe. Mediterranean.	Europe. G. Britain.	Europe. Other parts.	America. North.	America. South.	Africa. Nile.	Africa. Guinea.	Africa. Other parts.	Unknown Habitat.
APODES, Lin.	ANGUILLIDES, n.	ANGUILLIDÆ, n.	Anguilla, Cuv.	4	3	2		3	1						
			Conger, Cuv.				3		2					1	
			Murænesox, n.	4		1									
		OPHISURIDÆ, n.	Leptognathus, Sw.				1								
			Ophisurus, Lacep.	6			1								2
			Ophithorax, n.				1		1	1					
		MURAENIDÆ, n.	Dalophis, Raf.		1		1					2			
			Muræna, n.				1								2
			Strophidon, n.	3						2					
			Thærodontis, n.		2		1			1	1		1	2	1
			Gymnomuræna, Lacep.				2			1				3	
	OPHICARDIDES, n.	SYNBRANCHIDÆ, n.	Ophicardia, n.		1										
			Pneumabranchus, n.	3		1									
			Synbranchus, Bloch.										5		
			Ophisternon, n.	1	1										
			(?) Alabes, Cuv.		1										
		PTYOBRANCHIDÆ, n.	Ptyobranchus, n.	9											
			(?) Saccopharynx, Mitch.						1	1					
	ICHTHYCARDIDES, n.	(?) GYMNOTUS,	Gymnotus, Lin.								2				
			Carapus, Cuv.								6				
			Gymnarchus, Cuv.									1			
			Sternarchus, Cuv.								1				
			(?) Leptocephalus, Pen.					1							
		(?) OPHIDIUS,	Ophidium, Lin.				2			1	1				
			Fierasfer, Cuv.						4						
			Ammodytes,				2								

On Azolla and Salvinia. By W. Griffith, *Esq. F. L. S. Memb. Imp. Acad. Natur. Curios., Royal Ratisb. Botan. Soc., Asst. Surgeon, Madras Establishment.*

Having lately had an opportunity, one of the many which the H. C. Botanic Gardens afford, of examining Azolla and Salvinia, I now purpose giving my observations in detail. For I believe that there is no part of structural, and consequently systematic Botany, more enveloped in obscurity and mystification than these two genera, the examination of which appears to have been limited to their mature state.

It is necessary in the first place to observe that in Azolla and Salvinia the so-called, or supposed male and female organs are up to a certain and comparatively late period of their development indistinguishable, a circumstance of primary importance, of which I have been long aware.*

The first stage of the two organs (*ovula*) observed in Azolla has presented them enclosed in an involucrum of a very cucullate form, the point turned inwards so as to touch the axis. They are sessile cellular bodies of a concave or cup-shaped form, the cup (the young *tegument*) being occupied by a protruding cellular body (the *nucleus*); one is rather more advanced than the other. (*Pl.* 15. *f.* 1.)

The second stage presented them of a more oblong form, the protruding cellular body more surrounded by the cup, (*Pl.* 15. *f.* 2. 3.) by which in the third it is completely enclosed. (*Pl.* 15. *f.* 4.)

* The first opportunity I had of seeing Azolla was in 1837, during a journey across the Jheels of Eastern Bengal. I then became aware of the identity of the male and female organs up to so late a period as precluded their being intended to perform such opposite functions: of the other observations then made it is only necessary to notice the delineation of the granules within the organs in that stage when they often appear to form a column reaching from the foramen to the nucleus. The similarity of the two organs was mentioned to Mr. Solly, and by him brought to the notice of the Linnean Society.

The fourth stage presented them as still more oblong, with a tendency to an urceolar form. The once protruding nucleus is now completely concealed, the cup having become extended beyond its apex into a short mammilla having a narrow orifice (the *foramen*). Minute examination at this stage discloses a tendency, at least in appearance, in the aforesaid mammilla to be lobed, as though it had been produced, not by one, but by about four component parts. The same stage has generally presented moniliform filaments in apposition with the apex of one or both organs. (*Pl.* 15. *f.* 5.) These moniliform filaments are found within the involucrum from the earliest period examined, but were not observed to have any positive relations with the organs before this period. They now plainly pass into the organs, and have therein sooner or later appeared to be resolved into their component joints, which occupy the cavity existing between the once protruding body and the foramen. (*Pl.* 15. *f.* 7. 8. 10. 11.) And this is so constant, that even in cases where the moniliform filaments are not seen in application with the foramen, or passing through it, the space just particularised will be found filled with their component parts. (*Pl.* 15. *f.* 12. 13. 14. 15.)

Up to this time both the organs have presented a cellular surface of the usual colour; each cell of the surface containing a nucleus, likewise of the ordinary herbaceous colour.

The fifth stage presents the base of the nucleus surrounded by small cellular protuberances. (*Pl.* 15. *f.* 12. 13. 14.) The moniliform filaments are the same. The cells of the surface of each organ are more developed, and have begun to assume a rosy tint. The nuclei of these cells also are not only more distinctly defined, but are in most cases of a pink tint, in some deep pink.

Throughout these stages small cellular protuberances have been developing from the axis outside the base of either organ. These at the stage under consideration are simple, jointed, more or less capitate filaments, the head representing the protuberance as it existed originally. (*Pl.* 15. *f.* 10. 12. 15. 16.)

The sixth stage presents both organs of a decided pink tint, except the base or often the lower half, the cells of which do not contain a coloured fluid. The apex of both appears distinctly browned, and generally exhibits short moniliform filaments adhering to it. The space between the nucleus and the foramen, is occupied by the joints of the moniliform filaments. Thus far both organs present common appearances.

But at this stage remarkable dissimilarities begin to be exhibited, and what is equally remarkable these affect either both organs indifferently, or one only of each pair, in which case alone there can be said to be any thing definite in the position of the two. In this case in one organ the developments take place within the nucleus, in the other in the small cellular protuberances round its base. The former becomes the male of Botanists, the latter the female; or the former becomes the ovate organ presenting the so-called calyptra containing the large yellow sac, surmounted by the curious lobed body; the latter becomes the globular organ containing the numerous, smaller, pedicellate bodies. Of the first, the first change ascertained was the appearance of a grumous condensation in the original nucleus (*Pl.* 15. *f.* 12. 13. 14.); of the latter, the development of grumous matter in each of the small protuberances round the base of the nucleus, which are developed in a centrifugal order.

In the first which I now propose to follow, this condensation, for so it apparently is, increases until a tolerably well defined opaque grumous disc is seen in the nucleus: this disc subsequently appears under a certain focus transparent in the centre, opaque round the edges (*Pl.* 15. *f.* 15. *Pl.* 16. *f.* 3.); an appearance due, I believe, to the development of a membranous sac inside. In the meantime, the pink colour of the cells of the surface of the organ has increased, so has the browning of the apex, which still often presents traces of adhering moniliform filaments. Both organs also exhibit distinct vessels prolonged from the vessels of the axis into their bases. (*Pl.* 15. *f.* 12. 13. 14.)

The next stage presents nothing particular in the appearance of the organ, or the enclosed moniliform filaments. The nucleus however, presents about its centre, in lieu of the grumous disc transparent in the centre, a well defined small yellow sac, and between it and the apex of the nucleus, a grumous mass is seen presenting what appear to be several small points of condensation. (*Pl.* 16. *f.* 4. 5.) Somewhat later the organ having increased a little in size, the yellow sac is found to be as it were capped by the grumous mass, (*Pl.* 16. *f.* 6. 9.) which presents shortly after indications of division (lobes) on its surface. (*Pl.* 16. *f.* 7. 8.)

The space between the apex of the nucleus and the now very brown apex of the organ, still presents the dislocated joints, which now form a column of communication between the foramen and the nucleus (*Pl.* 16. *f.* 6.) ; parts of the moniliform filaments may often also be found adhering to the foramen itself.

The lobes mentioned as appearing in the capping grume continuing to be developed, encroach upwards on the nucleus (*Pl.* 16. *f.* 7.) ; and the yellow sac, which, as the lobes increase in consistency, appears more and more distinctly pendulous from their mass, becomes gradually covered with an incrustation. The joints of the moniliform bodies which previously could be easily squeezed out through the foramen disappear about this period. (*Pl.* 16. *f.* 7.)

When fully developed the organ presents scarcely if any change of form: most of the cells of the surface are gorged with pink fluid ; the apex is distinctly brown. The cavity of the organ is occupied by a complex body, consisting of two dissimilar parts; the upper, which forms rather more than the half, consisting of nine lobes (*Pl.* 16. *f.* 15. 16.) (the three uppermost of which are the largest,) mutually united by a remarkable tissue, which on pulling them from their places separates with them in the form of fibrous radicellar prolongations (*Pl.* 16. *f.* 20.) This part (the upper loculus of Brown) is up to a certain period perfectly homogeneous, and even when the nine lobes are evidently cellular, the axis or common attaching portion is grumous and homogeneous. It is by this tissue that the whole mass hangs from the apex of the capsule which separates with it in the shape of a conical calyptra, (*Pl.* 16. *f.* 13. 14.) presenting in the centre a brown mammilla (the original *foramen.*) The above mass is in apposition below with the upper surface of the yellow sac; the part of this (i. e. the vertex) so in apposition not being covered by the incrustation (*Pl.* 16. *f.* 17. 18.) The yellow sac is filled with oleaginous particles; it presents on the centre of its upper face a trilinear mark (*Pl.* 16. *f.* 17. 18.); it is separable from the incrustation, which presents an areolate cellular-looking surface (*Pl.* 16. *f.* 13. 15. 16. etc.); its membrane is thick, of a waxy texture, and without markings or any other indications of composition. (*Pl.* 16. *f.* 22.)

The changes in the other organ, appear only to affect the protuberances round the base of the nucleus, which body may be detected unchanged, as I have ascertained by measurements, in the mature organ. All the protuberances undergo the same changes, those next the base of the nucleus, (or those first developed, or the uppermost,) being the most precocious. A nearly mature capsule will present a complete series of the developments.

First they appear as small sessile protuberances with slight indications of cellularity and a central cavity (*Pl.* 17. *f.* 5.) In the second stage one or two cells will be found to have been developed under the original protuberance, which is now therefore more or less pedicellate. The cellularity of the head or terminal part is more evident, it is evidently hollow, and the cavity contains grumous matter (*Pl.* 17. *f.* 6. 7.) As it goes on enlarging the head assumes a spherical form, the pedicel becomes more developed, the grumous mass larger (*Pl.* 17. *f.* 8. 9. 10.)

Then in the cells of the heads, which are the young secondary capsules, amylaceous granules (for they are violetted by indigo) appear. And at this period, if the grumous mass be closely examined, very minute cells will be seen in it, each cell containing 3 or 4 nuclei (*Pl.* 17. *f.* 11. 12.) (or perhaps three or four cells each containing a nucleus) convex exteriorly, trifacial interiorly.*

The enlargement continuing, the next stage presents the formerly grumous mass as cellular, the membrane of the cells (*the parent cells*) not well developed, with grume along their contiguous faces. (*Pl.* 17. *f.* 13.) In each of these cells are 3 or 4 yellow nuclei presenting more or less of their original connection, or quite distinct. Examined separately each of these presents a convex surface and a trifacial one, the last being the surface of their former contiguity. The parent cells soon cease to be evident, and then the cavity of the s. capsule appears filled more or less with trifacial yellow cells (*Pl.* 17. *f.* 14.)

At a later period each head (or s. capsule) presents the appearance of being subdivided into several cellular-looking compartments, each of which encloses several of the yellow sacs (*Pl.* 17. *f.* 15.) The yellow sacs, when separated, present no particular change, appearing generally quite empty (*Pl.* 17. *f.* 16.)

Still later each s. capsule presents generally three or sometimes two subdivisions of increased size (*Pl.* 17. *f.* 17. 18.) And this is nearly the mature form, for the further changes

* Trifacial if three are developed as is most usual, quadrifacial, if four.

only regard the appearance of cellularity in the subdivisions, and the imbedding of the yellow sacs in the apparently cellular masses hence resulting.

When quite formed each secondary capsule presents a long simple stalk, a spherical head, formed of one layer of sinuous cells, containing green granules adhering to the walls of each cell (*Pl.* 17. *f.* 19.) Each contains two or three, sometimes four, cellular bodies, convex on the outer surface or that next the wall of the cavity, irregular on the inner surface, or that of mutual apposition. This surface presents prolongations having appearances of cellularity, but not of organic cellularity (*Pl.* 17. *f.* 20. 21.) The mass is solid and apparently cellular; within it may be seen the once free trifacial yellow sacs.

It will be hence seen that in Azolla the difformity of the mature organs is extreme, indeed but for the foramen, and the trilineal mark of the vertex of the yellow sac, the two could scarcely be considered as having anything in common.

The young state of the organ of the Salvinia is too like that of Azolla to need any detailed remark. But the nucleus presents from an extremely early period a papillar appearance, the first developments of the future secondary capsules taking place at an exceedingly early period (*Pl.* 18. *f.* 1. 2. 3. 4. 5.)

The first discrepancy remarked in the organs of this plant consists in the number of the papillæ (future secondary capsules) developed. This also occurs at a very early period, when the two subsequently difform organs are recognisable, the one by the smallness and great number of the papillæ, the other by their larger size and smaller number.

The second discrepancy arises from the greater development of a particular cell in the secondary capsules resulting from the development of the papillæ. Otherwise, at least up to the period of the enclosure of the trifacial cells (or spores) of the smaller sphærical secondary capsules, the developments are so much the same that they may be advantageously considered together.

In both, the first steps consist in the development of the cells of the superficies of the secondary capsules. (*Pl.* 18. *f.* 10. 11. 12. 13.) Shortly after, a cavity begins to appear in the secondary capsule, and this cavity then becomes filled with the usual formative grumous matter (*Pl.* 18. *f.* 17. 18. 20.) It is in this grume that all the subsequent changes of importance take place.

The first of these exhibits a variable number of irregular granular nuclei (or coagula or condensations) in the grume, which same coagula soon exhibit, (except in cases of abortion) traces of being surrounded by a membrane (*Pl.* 18. *f.* 21. 23. 24.)

A little later each secondary capsule will be found to present a central mass of grume apparently connected with the inner surface of the s. capsule by radiating grumous lines (*Pl.* 18. *f.* 22.) the interstices of which are very generally occupied at least partly by distinct cellular bodies with one surface trifacial. On slightly pressing the secondary capsules the grume escapes, and then presents, if attentively examined, a few nuclei or coagula as before said, and a considerable number of faintly defined cells, in most of which traces are to be seen of ternary or quaternary division, and as many nuclei; also a few small trifacial cells, as abovementioned.

The grumous mass of the secondary capsules resulting from the larger papillæ exhibits, however, in the centre a cell containing granules, completely surrounded by grume and apparently quite isolated (*Pl.* 19. *f.* 2.); with this exception and the difference in size, its contents may, I think, be considered as identical with those of the others. But this includes the curious difference of trifacial cells being developed both in the centre and the circumference.

Following the development of each from this period separately, it will be found that the grumous mass of the smaller secondary capsules gradually becomes smaller, while the number of the trifacial cells becomes visibly increased; until the whole or greater part of each secondary capsule is filled with them and with grume (*Pl.* 18. *f.* 27.); and latterly by trifacial cells alone. After this however, the cavity of these secondary capsules becomes again filled with grumous matter developed from the inner paries of each from several points, each including a variable number of the adjacent trifacial cells (*Pl.* 20. *f.* 1. 2.) These at length meet in the centre and form a solid mass, imbedded in which, without any appreciable order,* will be found all the trifacial cells of the capsule (*Pl.* 20. *f.* 11.)

In the perfect state these s. capsules are exceedingly numerous, attached by capillary simple pedicels to branches of a central receptacle (*Pl.* 20. *f.* 6.) They are of a brownish colour, the cells composing them are in one layer and are separable from each other (*Pl.* 20. *f.* 9.) Each contains a sub-globular whitish opaque body, with an unequal surface presenting prominent and depressed parts (*Pl.* 20. *f.* 10.) It can scarcely be considered as organically cellular, although its surface to a greater or less extent appears cellular under the microscope, for pressure destroys this appearance, and it then appears as uniform grume in which are imbedded the trifacial cells. These are of unequal size; some of them can be seen without using pressure; they are of unequal size, and of a yellowish brown tinge. Though previously empty they now contain grumous coagula cohering to the sides; the larger present in addition granules.

The trifacial cells often appear grouped. No oil escapes on pressure, or I should have attributed the superficial cellu-

* But I have remarked that while the trifacial cells are being imbedded the trifacial surface is turned to the periphery. Can this have any reference to germination ?

lar appearance (it is altogether like nascent cellular tissue, and its precursion by grume is like this too) to the same cause as the apparent cellularity of the incrustation. In some abortive trifacials may be seen.

The changes that take place in the larger capsules from the same period, chiefly affect the central sac, which, when detached, will be found to present a similar, but relatively smaller trifacial surface (*Pl.* 19. *f.* 5.); at this period this sac is about equal in size to the trifacial cells, visible in the circumference of the grume. But it never has presented to me their empty appearance (*Pl.* 19. *f.* 2. 3. 5.)

The next period presented this central sac a good deal enlarged, still apparently isolated; it is surrounded by a much thinner mass of grume, which from the frequent absence of the radiating* lines, often appears free of attachments. The space between this grume and the inner wall of the secondary capsule is more or less occupied by free trifacial cells (*Pl.* 19. *f.* 3. 4. 8.) The grume itself on escaping from the capsule will be found to present the trifacial cells, and larger cells, (*parent cells*) exhibiting indications of division (*Pl.* 19. *f.* 6.)

The central sac continues to increase: the grume surrounding it to diminish, until it is reduced to a thin coating. Generally about this period the sac has appeared to be attached to the apex of the cavity of the secondary capsule by means of grume; occasionally traces of radiating lines have been visible. The trilineal mark has mostly appeared to correspond with the attaching mass of grume.

The sac continuing to increase soon occupies the greater part of the cavity of the secondary capsule; it assumes a yellowish colour; generally it appears to be freely pendu-

* These lines are presumably unabsorbed or unaltered portions of the original continuous grume.

lous, but sometimes traces of radiating lines remain to a latish period.

About the same period I have pretty constantly observed a mammilliform process in the cavity of the sac, corresponding to the trifacial line (*Pl.* 19. *f.* 17.); it has a mucilaginous appearance and gradually passes off into a thin layer apparently applied over the whole surface of the cavity of the sac. About this period also, the outer surface of this sac will be found studded with granules, by the increasing deposit of which it becomes at length enclosed in an incrustation. This increases in thickness, presents subsequently three lobes at the apex, in the centre of which is an attaching? process of the sac (*Pl.* 20. *f.* 13. 14.) Its next and last change is to assume a cellular appearance and harder consistency. The cavity of the sac also generally presents appearances of cellularity, the cells seeming to be very irregular in size, and I believe having some connection, at least at first, with the mammilla above mentioned (*Pl.* 19. *f.* 21.) The contents of the sac, however though seemingly so cellular, are scarcely appreciable; grume only of excessive tenuity escaping under pressure. Soon after this, the yellow sac which has increased in yellowness and thickness, presents a viscid granular matter, not in my opinion organised.

The mature secondary capsule, which is attached to a free central receptacle by means of a short, stout, compound stalk (*Pl.* 20. *f.* 12.)* presents a cellular papillose surface of a brown colour, becoming hyaline in water; the component cells are separable; it contains a large, single, whitish body of a chalky embossed aspect, without any obvious attachment; this is of an oblong shape, and has a rugose or irregular surface (*Pl.* 20. *f.* 12.) The upper end, which is

* The assumption that the more numerous pedicelled capsules are derived from the development of every cell of the surface of the nucleus, while the fewer oblong ones are derived from the development of several cells of the same surface, will explain the difference of their stalks.

rather the smallest, presents three connivent valvular lobes. This white body is the incrustation, it is of a thick, apparently not organic, crustaceous substance. Its lower two-thirds are occupied by the yellow sac (*Pl.* 20. *f.* 12. 14. 19.) which is with difficulty separable entire; its upper surface, which on drying becomes concave, presents the trifacial line. This sac is filled with a viscid matter, innumerable granules, and irregular globules of oily fluid. A section in the dry state appears solid (*Pl.* 20. *f.* 20.) A few trifacial cells may still often be found between it and the wall of the secondary capsule.

The mature capsules of both kinds, which are almost similar in appearance, appear to become irregularly ruptured (*Pl.* 20. *f.* 5.); they are covered externally with brown rigid hairs, and present at the top a brown striated mark (the original *foramen;*) (*Pl.* 20. *f.* 17.) they consist of two layers, an outer, from which the hairs arise, composed of irregular angular cells of a brown colour, and an inner, thinner, colourless one, united to the outer only along certain lines: this is composed of oblong cells, in which a few greenish mobile granules exist.

Those containing the fewer oblong bodies are the most numerous, and more oblong, they are solitary, and always next the axis; therefore if only one capsule is developed it will be of this kind, if more than one, it will be the lowest one.

It will be hence seen that the differences of Salvinia from Azolla consist in the situation of the organs; in the absence of an indusium or involucrum; in the nucleus being in all developed into secondary capsules, in the early appearance of the papillæ indicating the future secondary capsules, their unequal size and number, (on which so much depends,) and their being all subsequently developed indiscriminately: in the greater degree of incrustation of the yellow sac, and its three-lobed upper end; and in the absence of the cellular lobes. The development of the smaller, more numerous, secondary capsules of the two may be said to be absolutely the same, the fact of their presenting in Salvinia simple pedicels, and a single mass being, at least so far as origin is concerned, of minor importance.

Many points of this communication are nearly untouched, but I have not lately been able to procure either of the two genera in fructification. I have not yet observed any thing in connection with germination; after three months immersion in water neither kind of organ has undergone any change.

There are some points of the above observations which seem to me to call for remark, before passing to the more general ones, which it is the aim of this to establish.

A curious discrepancy to reduce, appears to me presented by the body and its lobes surmounting the yellow sac in Azolla.

Analogy perhaps suggests its being of the nature of the masses enclosing the trifacial cells in the other kind of secondary capsules. For not to mention the similarity in appearance between the rather numerous condensed points, visible in the grume surmounting the sac in Azolla, with those, especially such as appear to be abortive, in the grumous nucleus of both kinds of secondary capsules in Salvinia, (which would perhaps justify the hypothesis of their being the rudiments of so many parent cells,) I have seen appearances in which they appeared to be surrounded by a membrane: and this has appeared to me certain that at least more such membranes have been observed than the subsequent number of lobes, even although I have seen more than one point of condensation enclosed in one membrane. So that their origin from confluence of several distinct parts, and the enclosure of one at least of the original points in the mass so resulting seems, though perhaps obscurely, to parallel the formation of the masses properly so called, with which in external appearance and hypothetical capabilities of forming new plants they have something in common.

On the remarkable difference of the yellow sac, etc. in Azolla being developed within the nucleus, to the exclusion of the growths round its base, while in Salvinia each corresponding sac is developed within a growth or protuberance from the surface of the nucleus, I have nothing to offer. Neither have I any thing to say in explanation of the pedicelled, mass-containing secondary capsules of Azolla being developments of the basilar protuberances, to the exclusion of the nucleus itself. It is a remarkable fact, however, that in Musci and the vaginulated Hepaticæ, the ovulum undergoes no change except in situation, for it forms the extreme tip or point of the mature seta. In Azolla something of the same kind occurs, but in a limited manner, an opposite direction and without change of situation; for the nucleus, the part first formed, may be found unchanged in the mature capsule. And we are not in want of instances in which that part of a phanerogamous ovulum, which is first formed and which is a direct extension of the surface from which it grows, remains equally unchanged during the development of the seed.

The first general remark I have to make regards the similarity of the organs in their younger stages to that form of the ovulum of phanerogamous plants, in which the original direction of development is preserved, and which are now generally known by the term antitropous, or more correctly atropous.* And though this simpler form of ovulum is not always peculiar to particular families and not

* Although the difference between the development of the vegetable carpel leaf and vegetable ovulum is in general sufficiently apparent, an exception has appeared to me to be presented by Naias, in which the future pistillum seems to be derived from an annular growth round a central body, which subsequently becomes the ovulum ! !

invariably even to particular genera among Angiospermous plants,* yet I believe it is characteristic of those plants called Gymnospermous, in which the ordinarily convolute carpel leaf is expanded or in which the ovulum is supposed to be a direct continuation of the axis.

The similarity contended for will scarcely be denied at least to Azolla, in which it is extended even to the relations of the vascular fascicles with the base of the nucleus. In both, as in all ovula, the nucleus is first formed, and is afterwards gradually enclosed by the growth of an integument, at one period a mere annulus round its base.†

I do not conceive the very early papillose state of the nucleus in Salvinia to weaken the similarity. For in the first place this indication of division is scarcely aboriginal, and I do not consider a nucleus with a similar surface unlikely to be found in a phænogamous ovulum, in connection with a plurality of embryo sacs, in which case the similarity will be mainly increased.

* Nepenthes.

† The other instances in which a similar structure might exist among the higher Acotyledones are Chara, such forms of Ferns as Deparia, some Cyatheæ and especially ? Hymenophyllum and Trichomanes.

In Chara, in which there is also a similar but more constant disposition of the two difform organs, the first objection presented is that the integument, within which the nucleus becomes included, is not a continuous development from round its base, but from as many points as there are subsequently spiral tubes. The growths of distinct cells from the apices of these form what has been considered by some the stigma. But I have not observed any thing like the usual subsequent developments; the original nucleus itself appearing to become the germinating body, that is the membrane enclosing the amylaceous granules. In this genus the degree in which both organs represent the axis of the plant itself, is carried perhaps to a greater extent than in any other.

So far as I have yet seen there is nothing in common between the supposed male of Chara, and the supposed males of these plants. But there is an analogy between the twisted filaments it contains and the assumed male organs of Azolla, and of many other of the higher Acotyledonous plants.

The structure of the germinating organs, and of the growing points of the stem and its branches appears to me to shew that Chara cannot be generically separated from Nitella, of which it is merely a more developed form.

If the comparison is drawn between the organs of Azolla and the ovula of certain Gymnospermous plants at a later particular period, we find the resemblance to be increased by the occupation of that part of the interior of the ovulum, (or body,) between the foramen and the apex of the nucleus, by a number of grains derived from without.* This circumstance in Gymnospermous plants is explainable by the external relations of the ovula being so much more direct than in Angiospermous plants. And the same may be said of Azolla (and Salvinia) if they are compared with pistilligerous Acotyledones.

I have here set aside the nature of the grains found in the ovulum of Azolla for the sake of exactness, but there are presumptive evidences that the analogy may be extended to the functions of the grains themselves.

The evidences in favour of fecundation are, I think, as strong as they are in Musci and Hepaticæ, in which I derive them from the breaking up of the tissue terminating and closing the style (subsequently to the application of a particular matter,) whereby the style becomes a canal opening exteriorly; from the browning observable in the orifice of this canal extending downwards until it reaches the cavity of the ovarium, and from the corresponding enlargement of the cell *(ovulum)* existing in that cavity.† In Salvinia the appearances as closely resemble the above as is compatible with the difference in the organs themselves. The supposed fecundating matter has appeared, at least after it has come in contact with the female organ, to be much the same.

In Azolla the evidence consists in the derivation of the grains from without, on the browning of the foramen after

* For instance Cycas; I have drawings illustrating this, made in 1835.

† Such are the appearances that have been presented to me by examination of Phascum and Funaria; by Mr. Valentine however neither the opening of the apex of the style or the browning is supposed to be in any way connected with fecundation.—Linn. Trans. xvii. p. 466-67.

the appearance of the grains within the ovulum, and on the subsequent new growths presumably excited into action thereby, and their direction, which proceeds from the point next the point of application of the supposed fecundating influence.*

I am not willing to omit an analogy with Phanerogamic fecundation derived from the apparent inaptitude of the means to the end. It has always appeared to me remarkable by what means a tube of such tenuity, of such flexibility, and with such an obtuse point as a pollen tube can not only get at the nucleus, but overcome the resistance presented by its solid tissue so far as to penetrate it to a certain, and often not inconsiderable a distance. Of this apparent insufficiency Azolla has a considerable share; yet the access of the grains to the inside of the ovulum appears certain.

Difficulties however are at present offered by both genera. In Salvinia there are three kinds of bodies, which might be

* Assuming fecundation to take place in Azolla and Salvinia, there will be, I think, three modifications at least of this phenomenon among the higher acotyledonous plants. In one the male influence is applied to the apex of the pistillum, in the second to the nucleus without the intervention of a pistillary apparatus. In the third the male influence is exerted on the frond itself, and is followed by the development of the young capsule from a point in the substance of the frond corresponding to and sometimes distant from the place to which the male influence has been applied.

This is founded on observations made on Anthoceros in 1836, from which it would appear that the place of exsertion of the future capsules is pointed out by a slight protuberance, over the apex of which a flake of matter like the male matter of Musci and Salvinia is spread, sending down to some distance within the frond a tube-like process, which causes the dislocation of the cells of the tissue with which it comes into contact.

The future capsule is stated in my notes not to be appreciably pre-existent, and its situation, which is exactly under the line of direction of the descending process, above mentioned, is only pointed out by a bulbiform condensation of the tissue of the frond. The young capsule during its development ascends along the same line, and pushes before it a corresponding cylindrical body of the tissue of the frond, the calyptra of authors.

I have never since had an opportunity of verifying these observations which, if correct, may I think prove of some importance.

assumed to be the male organs: one found on the stalks of the ovula, the second on the capsules, the third on the roots.

Of these the second kind (*Pl.* 16. *f.* 7.) appeared precisely like the moniliform filaments of Azolla, but was only observed once, and on a somewhat advanced capsule. The second kind was observed constantly and in plenty. They vary somewhat, some, the male organs of Hedwig, (*Theor. Gen. et fruct. Plant. Crypt. p.* 105, *t.* 8, *f.* 2, 3.) having rather long joints containing granules; others nearest the ovulum (*Pl.* 15. *f.* 7.) having shorter joints, each containing a nucleus immersed in a brownish fluid. Those on the roots, are also constant and in plenty: they resemble those on the stalk of the ovulum, figured by Hedwig. The granular contents are first developed in the terminal cell, and thence downwards; each joint becoming at length quite crammed with granules, some of which are often of a large size. They then lose more or less of their previously very active motion. These radicular filaments have the same reference to those containing granules found on the stalk of the ovulum, that the radicles themselves have to the brown hairs of the same part and the capsule.

But it is from the assumed action of those containing a nucleus and brown matter, that the appearance of the matter found adhering to the previously clean foramen, (and which looks like the fecundating matter of Musci and Hepaticæ) will be perhaps best explained.

I should not, however, omit remarking that in such submerged parts of a plant, as these of Salvinia, deceptions might arise from the adhesion of foreign matter to a greater degree than would be likely to occur in many Musci and Hepaticæ.

In Azolla the *chief* difficulty I think is presented by the absence of such a developed form of anther as might be expected to accompany so developed a form of pollen grain.*

* In order to reduce the usual acotyledonous form of anther to the type of the same organ among phanerogams, I have often speculated on the probability of each anther being a pollen grain. But they have an organic connection with the plants to

So much so, that each joint of the moniliform filaments, or each grain as found in the ovulum, is not distinguishable from the simplest forms of pollen grains, which I take to be those in which no outer integument is developed, as in Naias, Zanichellia, etc. and which are consequently simple membranous bags or sacs. The chief* discrepancy is that the grains of Azolla do not undergo any elongation in the performance of their supposed functions as appears to be universally the case in phænogamous plants, even in those in which the pollen grain is bodily received into the nucleus:† and contrariwise no growth, beyond mere extension, has been observed in phænogamous pollen exterior to the ovulum.‡

It is scarcely, however, to be expected that analogies, producable through every stage of any particular process in

which they belong, their structure is different, and they generally dehisce. These are all strong objections, particularly when it is considered that if these anthers be pollen grains they represent the inner membrane of ordinary pollen.

But the difference is not unadjustable in my opinion, if the anther of Mosses is compared with the very young phænogamous anther, at that period when the grume, from which the mass in which the parent cells are developed originates, is so fluid that pressure causes an escape of minute fovillar matter not unlike the contents of the anthers of Musci.

* I do not mention their organic connection with the plant, because that may be the consequence of their not being provided with a proper protecting organ. It is besides at the most only very partial, and it is not greater than that occurring in many forms of supposed anthers among these kinds of plants; *i. e.* where the anther consists of a cell terminating a stalk of a single row of cellules, to which type the male organs of Azolla and Chara are easily reducible. For any difficulty that might be objected to the attributing fecundating powers to each component cell (not exclusively to the terminal one) becomes lessened by the remarkable form of the male organs of Drepanophyllum and certain Neckeræ and Syrhopodon.

† e. g. Cycas.

‡ A remarkable circumstance was observed once or twice in some of the joints of the moniliform filaments, while attached to the axis. Some of them were a good deal enlarged, of a yellow green tint, with a nucleus towards either end, or with only one near the base when the enlarged joint happened to be the terminal one. Others near the terminal ones had become divided into two by a line across the middle, the two cells thus resulting being broader and more beadlike than before. In some others again close to either end was a small nucellus, which corresponded with the contiguous nucelli of the neighbouring joints: and near each nucleus was observed the shadowing out of a large cell.

plants very much differing in general organization, should be found; so I do not lay stress upon the possibility of the elongation, just referred to, being reduced to such an almost inappreciable amount as might perhaps occur in a Gymnospermous ovulum with exserted embryo sacs.

A difficulty may also be considered to be presented by the existence of the hairs round the base of the ovula. For these in their structure resemble what I suppose to be the male organs of Ferns, and also the anthers of certain Mosses and Hepaticæ; although the terminal cell presents less granular matter than usual.

In the respect of the supposed males, Azolla presents greater analogies with phanerogamous plants, than either Musci or Hepaticæ, in which nothing analogous to pollen grains has been, I believe, yet observed in the anther; which again can scarcely in all cases be considered a grain of pollen, the view suggested by the contents. Still even with the objections before mentioned the analogies are as tenable I think as those existing between the pistilla of Mosses and of phanerogamous plants; those organs in the former being originally closed, in the latter, theoretically at least, originally open.

General objections may be raised from the fact of moniliform filaments similar to those of Azolla having been found on the capsule of Salvinia, unconnected apparently with fecundation, and on the dissimilarity of the supposed fecundating process in the two genera.

These observations, although they appear to me to indicate the existence of sexes in Azolla and (Salvinia) as strongly as in Musci and Hepaticæ, (in which they are admitted by the best botanists), do not bear out in any way the ideas hitherto entertained by botanists regarding the sexual organs of the two genera in question. For independently of the organs being the same in structure up to a comparatively late period, they are both submitted to the action of the same agent determining their subsequent development; that development is continued contemporaneously; they separate contemporaneously, and without either having undergone any particular change. So that if they be male and female, the action of the one on the other does not take place while they are attached to the axis.

There appears to me absolutely nothing in the structure of the supposed male to suggest its performing the functions of that sex. I believe that in cases of the known male organs of vegetables the (active) contents are homogeneous, the functions ephemeral. Dr. Martius *(op. cit. p. 127)* is of opinion that the lobed bodies have nothing of the characters of anthers, and that the whole contents form the rudiment of a young plant, grounding this opinion on the similarity of the sac or vesicle with the nucula of Chara and Marsileaceæ. But it is remarkable that he considers the masses of the other secondary capsules, which are solid bodies, to have the closest analogy with pollen grains, and therefore he alludes to his having observed them adhering firmly to the calyptrate capsule.

An argument in favour of their being male organs is derivable from the development, which appears to be that of the pollen of phænogamous plants. But this holds good to a greater degree in the development of the contents of the supposed female, as well as in that of the acknowledged spores of some other Acotyledonous families, in which nevertheless the evidence in favour of sexes is acknowledged to be the most complete. The same argument, so extended as to include both kinds of bodies, may be advanced. In this case they will enter the hypothesis of Mr. Valentine,* which must, however, to be consistent with analogy suppose the absence of sexes in all Acotyledonous plants. This I think difficult to do, and while I fully agree in the remarkable similarity

* Linn. Trans. xvii. p. 480, 481; xviii. p. 502.

between pollen and spores, it is to be borne in mind, that whereas pollen is the result of a simple separation constituting a primary and independent process; in Musci, Hepaticæ, Salvinidæ, the spores, otherwise so similar to pollen, are the result of a secondary process, dependent on a primary one which appears to be remarkably analogous* to phanerogamic fecundation.

Among the peculiarities of the developments of the spores I may mention the comparative obscurity of the parent cells, which in all other similar plants examined by me have been obvious enough, especially in Isoetes and Marsilea, the spores being visible enough in the parent cells, within which their outer coat even becomes developed. In these plants however it is so obscure, and the separation takes place at such an early period, and apparently so rapidly, that for some time I was almost reduced to consider the trifacial cells, as parent cells, each containing 3 spores in a state of extreme contiguity. In no instance did I observe the parent cell of the central sac, (subsequently the yellow sac,) or its companions. And although I have examined many instances, yet in none did I find the usual relations continued, that might have been expected as long as the trifacial cells remained imbedded in grume. So much so, that for a second time I was almost reduced to look on them as parent cells.

* The identity of the spores of Acotyledonous and the pollen of Cotyledonous plants is perhaps strengthened by the curious resemblance of the fructification of Equisetum to the male apparatus of Cycadeæ; in which also the pistillary apparatus, in this view to be looked on as a sort of nidus, is of great simplicity.

Mr. Valentine's account was read before the Linn. Socy. in 1833, and appeared in 1837. M. Schleiden's was extracted in the Lond. Edin. Phil. Mag. from Weigmann's Archiv. für Zoologie, pt. iv. 1837. The similarity between the observations of the two is remarkable, and gives the hypothesis great importance. M. Schleiden has however an advantage in my opinion from considering the embryo to be a growth of the ends of the pollen-tubes, and from acknowledging the difficulties presented by Musci, Hepaticæ and Rhizocarpeæ.

The great development of a particular spore of a particular capsule, and the corresponding abortion of all the rest, is a second peculiarity. This, which has not been observed in Musci, Hepaticæ, or Filices, occurs in a marked degree in Marsilea* and Pilularia;† and there is also a tendency to it, though not confined to different capsules, in Isoetes and Psilotum. And this, to which the dissimilarity of the mature reproductive organs is mainly attributable, thus becomes so general, that it obviously relates to something important, and will probably be found to exist in particular portions of the families just mentioned as exceptions.

Mr. Valentine,‡ was so far as I know, the first who distinctly attributed this want of uniformity to abortion, an

* A second examination of Marsilea has not presented to me any thing corroborative of M. Fabre's statement. So far as the development of the two difform bodies *(capsules)* themselves is concerned, there is a manifest agreement with Pilularia, Salvinia, and Azolla. The germinating body is equally derived from the excessive development of a single spore of one capsule, and the abortion of the rest. The other capsules contain spores in a state of uniform development, forming the supposed pollen of some Botanists.

Marsilea evidently appears to connect Salvinidæ with Filices; its important differences from Salvinidæ consist in the capsules, which correspond to the secondary capsules of that family, being developed within the substance of a modified leaf, in their occuring mixed with each other, and in the spores of the pedicellate capsules not becoming imbedded in apparently cellular masses. I have not observed anything indicating fecundation.

† Mr. Valentine, (Linn. Trans. loc. cit.) appears to have no doubt of this in Pilularia. M. Endlicher* thinks it may be so in Salvinia, and makes it part of his generic character of Pilularia and Marsilea, (op. cit. p. 68,) at least so far as the term sporangia abortiva may be considered to indicate abortive spores.

But I think their great comparative number, the at least equal development of their capsules in Salvinia and Azolla, their appearance, and their subsequently containing granular matter, objections to this, though none of them can be considered conclusive. Still it is not to be denied, that if compared with the mature spores of Filices, Musci, Hepaticæ, in all which the spores have hitherto been found uniform, they exhibit an apparently imperfect state of development.

‡ Valent. Linn. Trans. xviii. p. 491, 497, t. 35, f. 34, 35, 36.

* Gen. Pl. p. 67, in annot. in Salvinia.

opinion which appears to be correct to some degree at least.

The anomaly observable in the numerous spherical pedicelled secondary capsules, through which the previously free spores become enclosed in cells, which subsequently partly or entirely coalescing form solid masses, in which the spores are then imbedded, is, I think, very remarkable.

The appearance, however, of these cells, which exist in both genera, and which seem to be developed from the inner surface of the secondary capsules, either corresponding to and enclosing several spores, or at least as in Salvinia occasionally arising opposite single ones, is not organic: it is that of the mammilla of the yellow sac. The young masses indeed are like it elastic, and it is evident that there is neither a common nor a partial membrane.

It is difficult to believe that these masses are abortive developments, particularly when the appearance of grume or molecules in the imbedded spores, and the obvious hypothetical capability of growth of the masses is considered. Direct observation on this head is required, and if it be found that they do produce young plants, and that the growths take place from more than one of the imbedded spores, an analogy may become presented to pluri-embryonate Gymnospermous plants.

I know of no parallel instances to the lobes surmounting the yellow sac in Azolla, and especially to the tissue, which on being pulled separates in the form of radicels. There are reasons, as I have stated, for supposing the lobes themselves to be modifications of the spores, and comparing the early number of nuclei or points of condensation with the mature number of the lobes, the opinion becomes suggested, that these receive their developments at the expense of others. However this may be, their analogy with the solid masses of the spherical pedicellate secondary capsules appears sufficiently obvious. They are not in any way to be referred to the incrustation, which does not, I think, become organised; and which moreover, appears somehow or other connected in every instance with the difformity of the organs.

In conclusion it appears to me sufficiently plain, that in the higher Acotyledonous plants, in which I include Filices, Lycopodineæ, Isoeteæ, Equiseteæ, Marsileaceæ, Salvinidæ, Musci, Hepaticæ, Characeæ, there are at least two modifications of the female organ representing the modifications of the same organ of Cotyledonous plants.

The term Pistillum has been applied to the female organ of Mosses by some first-rate Botanists, though not without violent opposition from some systematists. Since the examination of Balanophora, its application is, if possible, still more legitimate. In my opinion it is not to be doubted, that not only have Musci and Hepaticæ a pistillum, but that this contains an ovulum.*

The analogies presented by the plants which form the subject of this communication, to those Cotyledonous plants in which the ovulum is entirely naked, either, as is supposed to be the case in some, without a carpel leaf, or with that organ in an expanded not a convolute state, are I think equally striking.

It may be worthy also of remark, that in proportion as Acotyledonous plants become, so to speak, less pistilligerous, their vegetative organs appear to be more developed. This is evident if a Fern be compared with a Moss. And it seems to be so closely followed up, that Salvinia which has less, perhaps, of the atropous phænogamous ovulum than Azolla, has its organs of vegetation considerably more developed.

* See also Mr. Valentine, Linn. Trans. xvii, p. 466, 67, t. 23, f. 1, 2, 6; where it is stated, that the development of the capsule depends on the presence of the cell (or ovulum) in the pistillum.

Familia.—SALVINIDÆ, *Bartl.*

Pars Rhizospermarum. Roth. D. C. Rhizocarpearum, Batsch. Marsileacearum, Br.

Plantæ natantes, ramosæ. *Radices* plumosæ. *Folia* opposita,* pagina supera papillosa. *Organa mascula;* pili articulati pedicelli ovuligeri ? vel filamenta moniliformia partium novellarum. *Organa fæminea;* Ovula atropa, (submersa), solitaria vel per paria. *Capsulæ*† submersæ, apice micropyle notatæ, *aliæ*‡ (infima cujusque paris vel racemi) includentes saccum§ luteum, vel plures, (et tunc singuli in capsula secondaria reconditi,) materie granuloso-viscosa, oleaginosa farctum et incrustatione e maxima parte tectum. *Aliæ* (superiores cujusque paris vel racemi) continentes capsulas secondarias|| 00, globosas, pedicellos simplices terminantes, singulis includentibus *massam*¶ (vel massas 2-3) aspectuc ellulosam, in qua *sporæ* immersæ.

Sub-Familia.—Salvininæ.

Radices verticillato-fasciculatæ, nudæ. *Folia* opposita, integra, petiolata, pilis articulatis superne vestita, vernatione induplicata. *Organa mascula ?* pili** simpliciter articulati siti in pedicellum ovuli.

* The leaves are not quite opposite in Azolla: this combined with the obvious conduplicate vernation of these organs in Salvinia, inclined me to believe, that they were bilobed in Azolla; a conduplicative vernation would then explain their istuation. But their development is opposed to this, as also their opposition in Salvinia.

† Calyx. Schreber. Indusium. Willd. Mart. Fl. masculi et fæminei. R. Br. Receptacula. Sprengel. Organa propagatoria. Mart. Endlicher

‡ Flos. fæmineus. Schreb. Fl. Masc. R. Br. Meyen. Organ. masc. ? et fæminea. Mart. Endl. Indusium. Calyptra. Mart. Endlich.

§ Gongylus. Mart. Vesicula basilaris. Endl.

|| Fl. Masc. Antheræ. Schreb. Fl. Fæm. Meyen. R. Br. Capsulæ partiales, R. Br. Mart. Organ. fæm: masc. Sporangia. Mart. Endl. Indusia Mart. Meyen. Globuli. Endl.

¶ Semina Br. Grana. Endl. Granula Mart.

** These curious filaments have in some respects a centrifugal development: the cells of the base, or next the axis, being the least developed as regards number of granules. These, which are very irregular in size, are exceedingly mobile. The action appears to cease at last from want of room, for the cells become literally crammed with the granules.

Ovula terminalia, nuda, solitaria. *Nucleus* celluloso-papillosus. *Capsulæ*[1] aliquando solitariæ, sæpius in racemum terminalem dispositæ; *infima*[2] cujusque racemi, (vel terminalis si una tantum evolvitur) continens capsulas secondarias[3] 6-18 oblongas, insidentes in receptaculum centralem. *Saccus*[4] incrustatione apice triloba omnino inclusus. *Capsulæ aliæ superiores* capsulas secondarias[5] 00, globosas, in receptaculum centralem[6] ope pedicellorum capillaceorum[7] affixas recondentes. *Massa*[8] solitaria.

SALVINIA.

Mich. Nov. Gen. p. 107. *t.* 58. *Aublet. Pl. Guian. p.* 969. *t.* 367. *Linn. Gen. Pl. ed. Schreb. p.* 753. *No.* 1617. *Juss. Gen. Pl. p.* 16. *Lam. Enc. Meth. t.* 863. *Flore Francaise. DC. et Lam.* 2. *p.* 579. *Mart. Pl. Crypt. Bras. p.* 128. *t.* 76, 75. *II. Endl. Gen. Pl. p.* 67. *No.* 689.

CHAR: GEN:—Character Sub-familiæ.

Superficies *infera et immersa pilis brunneis subulatis vestita.* Radices *sessiles in cauli vel circa apicem rami ovuligeri.* Capsulæ *subrotundæ, irregulariter dehiscentes, parietibus bilamellosis, lamella interna exteriori secus lineas longitudinales paucas tantum adnata.* Crusta sacci *cretaceo-albida.*

HABITUS *Lemnaceo-Pistoideus.*

Characteres specierum forma foliorum, dispositione et numero papillarum, situ radicum, et numero et dispositione capsularum deducendi.

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1 Receptacula. Spr. Fructus. Mich. Fæm: flores. Germina, Aubl. Indusium. Mart.

2 Flos fæmineus. Schreb. Indusium. Mart.

3 Germina, semina. Schreb. Sporangia. Mart. Endl.

4 Gongylus. Mart. Spora. Endl.

5 Flores masculi. Indusium. Mart. Antheræ. Schreb. Sporangia. Mart. Fl. masc. ? Globuli. Endl.

6 Columella. Schreb.

7 Filamenta. Schreb.

8 Granulum. Mart. Materies mucilaginosa. Endl.

S. verticillata, foliis parallelogrammico-oblongis subpanduriformibus canaliculatis, pilis ternis vel quaternis papillas (conicas) superficiei terminantibus.

S. verticillata, *Roxb. Crypt. Pl. Cal. Jour. Nat. Hist.* IV. *p.* 469.

HAB.—Stagnant waters. Bengal.

DESCR.—Floating, sparingly branched. *Stem, stalks* and *undersurface* of leaves thickly covered with stout subulate brown hairs, the terminal cell of which is suddenly attenuated. *Leaves* parallelogrammic-oblong, constricted about the centre so as to be subpanduriform, channelled down the middle. *Hairs* in threes or fours arising from conical papillæ of the surface: terminal cells brownish, withered-looking.

Roots terminating, short, descending stalks, generally about 12, disposed in two series around the lower reproductive organ, which occupies the centre. Mixed with the radicles, especially in the young parts, are articulated colourless filaments, the component parts of which contain unequal granules.

Male organs? articulated hairs on the stalks of the ovula; each joint containing a nucleus and a brownish fluid.

Ovula nearly sessile concealed by the roots, and partly covered with hairs. *Tegument* open at the top.

Mature reproductive organs solitary, or in racemes of 3-5, about the size of a pea, covered with brown rigid hairs. The upper ones of each raceme, (or lowest as regards general situation,) contain innumerable sphærical bodies, of a brownish colour, and reticulated cellular surface, terminating capillary simple filaments. These again contain a solid whitish opaque body.

The other, which occupies the lowest part of the raceme, and which is the first and often the only one developed, is more oblong, containing 6-18 larger, oblong-ovate bodies on short stout compound stalks: colour brown, surface also reticulated. Each contains a large, embossed, opaque, ovate, free body, of a chalky aspect: it is three-lobed at the apex, and contains below this a cavity lined by a yellowish membrane, filled with granular and viscid matter and oily globules.

S. cucullata, foliis subreniformibus in cucullum conduplicatis, pilis solitariis e superficie ipsa exorientibus.

S. cucullata. *Roxb. Crypt. Pl. Cal. Jour. Nat. Hist.* IV. *p.* 470.

HAB.—Stagnant waters. Bengal, Tenasserim Coast.

DESCR.—Much branched. Under-surface covered with brown hairs, longer and with a less suddenly attenuated terminal cell. *Joints* of the stem short, so that the leaves are all close together. *Roots* springing directly from the stem, about 15. *Leaves* on short stalks, subreniform in outline, so folded together that the margins of the base are in contact. *Hairs* of the surface solitary, springing immediately from the surface; terminal cells with the same curious withered appearance. *Fructification* not observed.

OBS.—This species I take to be comparatively less developed than the preceding, founding my supposition chiefly on the fact, that the leaves partly represent the immature state of the same organs of S. verticillata.

SUB-FAMILIA.—AZOLLINÆ.

Radices solitariæ, basi vaginatæ, apice calyptratæ.* *Folia* imbricantia, inferum immersum membranaceum. *Organa mascula;* filamenta moniliformia in partibus novellis caulis et ramorum. *Ovula* per paria cauli affixa, in *involucro* e folii

* The calyptra of the roots of Azolla has probably been considered to be the torn-up end of the sheath surrounding the base of each root, which can scarcely have escaped observation. But it is quite a distinct organ; the sheath at the base is perforated at its apex by the young root, while the calyptra appears to be a separation of its cutis, due to the development of a radicle from each cell of the subjacent tissue.

In this respect it has another curious analogy with Lemna, of the sheath and calyptra of which I was aware in 1836, long before I saw M. Schleiden's paper on Lemnaceæ.

contigui lobo membranceo derivato abscondita. *Capsulæ*[1] involucro inclusæ, subsessiles; paris difformis *inferior*,[2] oblonga, demum circumscissa continens *Saccu*[3] (luteu) e maxima parte incrustatione inclusum, vertice coronatum *corpore*[4] centro cavo, apice explanato cum capsulæ apice cohærente, divulso radiculoso fibroso, superficie diviso in *lobos* 3 vel 9 [5], quorum 3 superiores (majores), 6 inferiores; corpus totum in membranam nuclearem (capsulam secondariam) inclusum. *Capsulæ* alterius [6] capsulæ secondariæ massas[7] 2—3 faciebus contiguis radiculigeras continent.

Azolla.

Lam. Enc. Meth. 1. *p.* 343. *t.* 863. *R. Br. Prod. Fl. Nov. Holl. edn. p.* 2. 22. *App. Flinders. Terra Austr.* 2. *p.* 611. *t.* 10. *Mart. Pl. Crypt. Bras. p.* 123. *t.* 74, 75. *I. Meyen. Nov. Act.* 18. *p.* 523. *t.* 38. *Endl. Gen. Pl. p.* 67. *No.* 688.

Salvinia, *Juss. Gen. Pl. p.* 16.

Rhizosperma. *Meyen. op. cit. loc. cit.*

Char. Gen.—Character Sub-familiæ.

If the foregoing supposition be correct, those species of Azolla alone, that have radicles either plumose throughout, or to a greater or less distance from the apex, will present *this* calyptra. M. Meyen does not notice any such calyptra in his account, and I do not understand what Martius means by a calyptriform spongiole—still less by the phrase " spongiola conica vestita," op. cit. p. 124. Figs. 2, 3. of his work, would appear to represent a calyptra of some sort.

1 Organa propagatoria Mart. Endl. Meyen.

2 Fl. Masc. Meyen. Endl.? R. Br. Calyptra. Mart. Endl. Indusium. Meyen.

3 Dimidium inferius. Loculus inferior. R. Br. Vesicula. Mart. V. basilaris. Endl. Vesicula sphærica Meyen.

4 Dimidium superius. Loculus superior. R. Br. Axis tricruris. Mart. Columella tricruris. Endl. Axis triangularis. Meyen.

5 Antheræ. R. Br. Meyen. Corpuscula. R. Br. Mart. Corp. antheriformia. Endl.

6 Involucrum interius. R. Br. Indusium. Mart. Indusium exterius. Meyen Capsulæ. Capsulæ partiales R. Br. Sporangia. Mart. Endl. Sporangia. Indusium interius. Seed-holder. Meyen.

7 Semina R. Br. Grana. Mart. Endl. Granula Meyen.

* Americanæ. *Radices* simplices. *Lobi corporis* (capsulæ calyptratim dehiscentis) 3, pyriformes. *Massæ* (capsulæ secondariæ pedicellatæ) 6-9, globosæ, subcompressæ, margine pilis† glochidiatis instructæ.

** Asiaticæ. (Rhizosperma. *Meyen. op. cit. p.* 523.) *Radices* partim vel omnino plumosæ. *Lobi corporis* (capsulæ calyptratim dehiscentis) 9, angulati, (3 superiores majores, 6 inferiores.) *Massæ* (capsulæ secondariæ pedicellatæ) 2-3, extus convexæ, intus concavæ et processubus radicelliformibus 3-4 instructæ.

Superficies *infera immersa glabra.* Ovula *basi processibus paraphysiformibus stipata.* Capsulæ *rubro plus minus tincta, parietibus simplicibus;* inferior (paris difformis) *oblongo-ovata,* superior *subglobosa, superficie rugosa.* Sacci lutei *tegumentum nigro-sanguineum.*

Habitus *Jungermanniæ.*

Affinitates incertæ. Analogiæ cum Gymnospermis phanerogamicis et Lemnaceis.

A. pinnata, circumscriptione triangulari-pinnata, foliis superioribus papulosis, radicibus longitudinaliter plumosis.‡

A. pinnata, *R. Br. Prod. p.* 23.

Salvinia imbricata, *Roxb. Crypt. Pl. Cal. Jour. Nat. Hist.* IV. *p.* 470.

A minute floating plant with the habit of Jungermannia. *Stem* so branched, that the general outline of the whole plant becomes triangular. *Roots* solitary, arising from the stem at the origin of

† The situation and structure of these hairs require I think further examination. As regards the first it appears to me, that whether scattered over the whole surface, or only along the margins, they would be visible while contained in the secondary capsule, yet neither Martius nor Meyen represent them as being so. And as regards the second, the hairs of Azolla pinnata do not appear to me organically cellular.

‡ Char. ex. immort. Prodr.

each branch, plumose throughout their whole length, tipped by a *calyptra,* and surrounded at the base by a short *sheath,* which may be mistaken for one of the circumcised capsules.

Leaves opposite, so close together as to become imbricated, especially the lower membranous ones, entire, obliquely ascending, thick, fleshy, outer surface covered with stout whitish papillæ of a single somewhat conical cell, the oldest ones rather the smallest, upper ones more or less trapeziform. *Under* ones quite membranous, hyaline, larger, nearly reniform, with a tendency, especially in the young ones, to have the points incurved; these are composed of a single layer of cellular tissue.

The growing points especially, present a number of minute confervoid filaments, the assumed *male organs,* which at certain periods may be seen passing into the foramen, the ovula becoming resolved into their component cells within the cavity of that body.

Organs of reproduction in pairs, attached to the stem and branches, one above the other, concealed in a membranous involucrum. *Ovula* atropous, oblong-ovate, with a conspicuous foramen and nucleus, around the base of which are cellular protuberances.

Capsules of each pair either difform—in which case the lowest one is oblong-ovate, the upper globose—or both of either kind, generally perhaps the globose, presenting at the apex the brown remains of the *foramen,** and still enclosed in the *involucrum.* Upper half generally tinged with red.

The oblong-ovate capsule opens by circumcision; with the apex separate the contents, which consist of a large yellow sac contained in a fine membrane, the remains of the nucleus (or the secondary capsule.) The sac is filled with oleaginous granular fluid, and surmounted by a mass of fibrous-tissue, by which it adheres slightly to the calyptra; on the surface of the fibrous tissue are 9 cellular lobes (the three upper the largest), which when pulled away, separate with some of the fibrous tissue, and so appear provided with radicles.

* See also Martius, t. 74, f. 10, and Meyen f. 23, for the apex of the round capsule containing the pedicelled secondaries.

M. Meyen indeed says, his figure is a representation of the base of this organ, his common indusium; but this is probably a mistake. For the mere punctum in the centre is too small an indication of a rather large hilum, and the disposition of the cells and whole appearance is that of the apex.

The globose capsule has a rugose surface from the pressure of the secondary capsules within; these are many in number, spherical, attached by long capilliform pedicels to a central much branched receptacle; each contains two or three cellular *masses*, presenting on their contiguous faces two or three radiciform prolongations. In their substance may be seen imbedded numerous yellow grains, the *spores*.

The genus Azolla was founded by M. Lamark,* on specimens without fructification brought from Magellan by M. Commerson. M. Jussieu,† as I have stated, considered it a congener of Salvinia.

Willdenow‡ who quotes Lamark, describes the fructification as "capsula unilocularis radicalis globosa polysperma ?"

It was first accurately defined by Mr. Brown in his Prod. Fl. Nov. Holl. ed. 2, p. 22, and subsequently in the Appendix to Flinders' Voyage to Terra Australis, vol. 2, p. 611, t. 10, in which it is worthily illustrated by that great observer, Ferdinand Bauer. M. Meyen observes of these illustrations, that they are so wonderfully complete, that repeated examinations since have made scarcely the least addition to what is therein represented. To this I may add, that M. Bauer has even delineated the trilineal mark on the yellow sac, which in itself is quite sufficient to shew the real origin and nature of that body.

It was again described and figured by Martius,§ from American specimens.

It has been observed in an original manner by M. Meyen,|| with whose paper I am acquainted through a translation by my friend Mr. Macpherson, Civil Surgeon, Howrah; and also by M. Rafinesque, but I have no access to his account.

* Enc. Meth. 2, p. 343, t. 863, and Suppt. 5, p. 567.

† Gen. Pl. 5, p. 17.

‡ Sp. Pl. 5, p. 541.

§ Pl. Crypt. Bras. p. 123, t. 74, 75, f. 1.

|| Nov. Act. Acad. 18, p. 507, t. 38.

The character framed by Mr. Brown, leaves as usual, little or nothing to be desired. He considers the capsule containing the yellow sac, etc., to be the male: the other capsule, *i. e.* that containing the pedicelled sphærical secondary capsules, the female. Of the two cited characters, if I may presume to judge, I prefer that of the Prodromus. That of the Appendix to Flinders presents some modifications, the most important of which appears to be the substitution of "Involucrum interius" for "Capsula communis," which latter term is, I think, very happy. Another regards the substitution of "corpuscula" for "Antheræ ?" unaccompanied however by any increased doubt of their being the male organs. For this alteration may perhaps be taken as indicating, that though sexes may be present, yet the male must not necessarily be an antheriform body, which some writers would seem to have insisted on.*

By Martius the pedicellate sphærical secondary capsules are called "sporangia," their contents "grana," and the capsules themselves "indusia,"† these he considers doubtfully the females. The others which he considers with equal doubt to be the males, he describes to consist of a "calyptra," subsequently circumcised, containing a "vesicula," on which is placed a three-legged axis bearing semi-immersed "corpuscula," and adhering to the apex of the calyptra. The "grana" or contents of the sphærical secondary capsules are stated to be furnished with hairs,‡ but this appears only to apply to the American species.

The principal aim of M. Meyen's account is to establish a generic difference between the American and Asiatic species, but the genus Rhizosperma, intended to contain the

* Lindl. Introd. Nat. Ord. p. 407, extr. Mem. Wern. Soc.

† His synonym "involucrum, R. Br." should have been "involucrum interius;" it has no application to the character in the Prodromus.

‡ See t. 75, f. 14, 18, 19.

Asiatic species, has not been adopted. The principal points to be noticed in regard to the fructification are his considering (with Mr. Brown,) the calyptrate capsule to be the male organ, and the globular capsule containing the pedicelled secondary capsules to be the female; his not having been able to ascertain the presence of the yellow sacs, each containing four bodies, figured by Martius in the contained masses, (his seeds); and his stating that the root-like prolongations are confined to their flattened edges, and not, as represented by Martius, scattered over the whole surface. M. Meyen's inner calyptra of the male is the nucleary membrane? M. Meyen mentions the original nucleus of the capsules containing the pedicellate secondaries, as a pestle-shaped body, terminating the column to which they (his partial indusia,) are attached.

The later descriptions of Sprengel and Endlicher are compilations.

Sprengel* calls the capsules receptacles, and states them to be axillary! Some of these are described as transversely bilocular, the upper-cell containing triangular bodies attached to a common axis, the under-cell containing a mucous latex or subsequently a powdery mass. The others which are said to be covered by a double membrane! contain pedicelled globules, each divided into three triangular corpuscles furnished with radicles.

The best part of this curious character appears to be taken from the character in Flinders's Appendix, and as regards the contents of the pedicelled secondary capsules, from figure 17 of M. Bauer.

It is, I think, instructive to observe, that with the exception of the term receptacula, this character presents no analogy with those of the other genera with which it is classed: even the similarity of the pedicelled spherical

* Gen. Pl. 2, p. 716, No. 3604.

secondary capsules with those of Salvinia, the genus immediately preceding it, is not noticed.

M. Endlicher's* character is obviously derived from that of Martius; one difference being his applying the term columella, (the columnula of the organum calyptratum of Martius,) to the three-legged axis of this botanist; another his stating the lobes attached to it to be antheriform.†

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* Gen. Pl. p. 67, No. 688.

† In Mr. Hervey's Genera of S. African Plants, I find a character of this genus taken from Kaulfuss, but it would be impossible to identify the genus without the synonymy.

The terms used in most of the characters, except those of Mr. Brown, are in several instances unintelligible, as generally is the case when a name is made to pass for an explanation, or when the application of a name is founded on mistaken ideas of the nature or analogies of certain parts. In the late work on Genera by M. Endlicher, I find the terms indusium, calyptra, and columella, all in use. And in a note, other general analogies are so extended as to refer one of the organs to the type of a "flos monadelphus ovario infero."

Now of the terms above cited, there appears to me only one, (calyptra,) capable of legitimate application, but only as far as regards mechanical function. The difference otherwise is very great; for in Azolla the calyptra is nothing more than what is presented by every dehiscentia circumscissa of a fruit, and is limited to one only of the capsules; while in Mosses and all calyptrate Hepaticæ, it is the pistillum displaced from its base at a remarkably early period. A more real analogy of this part in Azolla is to be found, perhaps, in the seed of Lemnaceæ during germination.

The term indusium is applied to the capsule itself, whereas, correctly speaking, it is only applicable to a covering of capsules of a partial or general nature derived from the surface of the foliaceous body or frond, on which the capsules are situated. This term indusium, which should be distinguished from involucrum, is at most only applicable to Azolla.

A columella is the remains of an originally continuous, solid, cellular tissue, unaffected during the development of the spores; it is a continuation either of a partial or a special axis. It may, I believe, be justly considered analogous to the connectivum of a bilocular anther, or the cellular tissue between the cavities of a plurilocular anther. In Azolla it does not appear to be even solid.

It may be seen also, that the same character gives an indusium to one, a calyptra to the other body, while the application of the term calyptra ceases to be even mechanically correct from being applied to the whole capsule.

The genus Salvinia is said to have been first established by Micheli.* He considered the papilliform hairs on the surface of the leaves to be apetalous flowers; a curious idea, since the hairs themselves, which he calls filaments, are expressly stated to be without anthers, "scilicet filamento apice destituto." The spiral nature attributed to them is due to a mistaken view of their articulations.

Linnæus† referred it to Marsilea; the generic description of which is derived as regards his male-flowers from Salvinia, and as regards his female-flower, from Marsilea itself. But his views of the parts of the male-flower do not quite coincide with those of Micheli, as he describes with greater consistency, but not accuracy, the filaments as anthers, and the papilla from which they arise as filament (or receptacle).

Aublet's‡ description of the filaments is much the same as that of Micheli, but he expresses doubt of their being the male organs. The capsules are described by him as germina. He appears to have only noticed the smaller indefinite secondary capsules,§ which he describes as seeds. The species is represented as having emerged erect fructification, and the capsules as being bivalved.

Jussieu|| in adopting Salvinia of Micheli refers to it Marsilea of Linnæus and Azolla of Lamark. His character is derived almost entirely from Micheli. The flowers are stated to be monoicous; the view taken of the males is much the same as that of Micheli, but the specification of the analogous parts is avoided. It is suggested that the males will rather be found to have some connection with the capsule than the leaves.

In Schreber's¶ character, (probably owing to Guettard whose account I have not been able to consult,) a considerable step is made in advance, the difformity of the organs be-

* Nov. Gen. p. 107, t. 58.

† Genera Plantarum, ed. 6 Holmiæ, 1764, p. 560, No. 1182.

‡ Hist. des Pl. de la Guiane, p. 969, t. 367.

§ See Pl. 367, f. 5, 6. || Gen. Pl. p. 16. ¶ Gen. Pl. ed. 8, p. 969, No. 1617.

ing recognised. The capsules constitute his calyx; those containing the indefinite mass-containing secondary capsules being his male flowers. Their pedicels are the filaments; the capsules themselves his anthers. The other capsules are the females; their secondary capsules are his germina, and the analogy is carried so far as to suppose, though with some doubt, the existence of a stigma. The germina become the seeds, though the pericarpium is stated to be present!

It is stated in a note, that the above males and females are distinguishable even in the dried plants by the size of the grains they contain. The male-flowers are described as glomeruled round a central solitary female.

Willdenow* after quoting Schreber, describes the capsules as composed of imbricated connate indusia. The difformity of their contents is passed over entirely. The capsules are described for seeds!

Lamark† appears to have entertained still another view, for in his generic character, (o. c. p. 484,) the stamina are stated to be situated on the capsules, which are said to be in pairs. In his description of S. natans no mention is made of any difformity in the contents of the capsules, nor is it to be gathered from his remarks on any of the other species in the Supplement, that he was aware of it. The figures C. D., however, of the Illustrations obviously represent the two forms of the mature organs.

In the Flore Française of Lamark and Decandolle,‡ the same views are entertained as in the Encyclopédie.

In the Dictionaire des Sciences Naturelles,§ the same opinions are adhered to, and it is to be gathered from it, that the hairs on the capsules are the stamina of Lamark.

Sprengel,|| describes the capsules as receptacles, the secondary capsules as sporangia. He is also silent regarding the important point of their dissimilarity.

* Sp. Pl. 5, pt. 2, p. 536, No. 1985. † Enc. Meth. Illustr. Pl. 863.
‡ 2, p. 579. § 47, p. 149. || Gen. Pl. p. 716, No. 3603.

Martius* calls the capsules indusia, the indefinite mass-containing secondary capsules he doubtfully considers sporangia; the others he calls sporangia, their contents a germinating gongylus. (This gongylus Martius states to be the seed of Schreber, which I have rather considered to be the secondary capsule. This appears to me indicated by the statement of the pericarpium being absent.) The part to which the secondary capsules are attached he calls columnula. He notices the articulated granule-containing filaments found among the radicles, which he describes as spongioliform.

Endlicher's† character is much the same as that of Martius, but without as much reservation regarding the nature of the organs. The contents of the larger sac-containing secondary capsules, which he considers the females, is stated to be a solid spore; of the others, (doubtful males,) a mucilaginous matter. In a note he inclines to regard these as abortive sporangia.

These are all the accounts which I have been able to consult. It appears to me singular, that the dissimilarity of the organs so specially noticed by Schreber, should have been overlooked by subsequent authors, prior to the appearance of Martius's beautiful work. It is, moreover, adverted to by Mr. Brown,‡ who also notices the analogy between the seeds of Guettard and Schreber, (the sac-containing secondary capsules,) and the supposed male organs of Azolla. This analogy is reversed by Martius and Endlicher.

The germination of these sac-containing secondary capsules has been observed by M. Vaucher§ and from Endlicher's|| remarks it would appear to have been also observed by

* Pl. Crypt. Bras. p. 128, t. 76, 75. f. 2.

† Gen. Pl. p. 67, No. 689.

‡ Prodr. Fl. Nov. Holl. ed. 2. p. 23 in. obs.

§ Ann. Mus. Hist Nat. 18, p. 404, t. 21, No. 1.

|| Gen. Pl. loc. cit.

others. M. Vaucher, seems to have been unaware of the existence of any other organs: although the indefinite mass-containing secondary capsules appear to be represented by the right hand figure of f. 3. The circumstance that fixes the germination to have been observed in these particular secondary capsules, (otherwise it would be an open question,) is the explanation of fig. 5, and this figure itself. For the teeth there mentioned and depicted only exist in these particular secondary capsules. But there is nothing to fix the exact nature of the three teeth, which may either be those of the incrustation, as is most probable, or the interlinear spaces of the vertex of the yellow sac.

The accompanying table will shew the opinions regarding the locus naturalis of the family composed of these two genera. I consider the association of these plants in a tribe with Isoeteæ and Lycopodineæ to be untenable.* The classification of Reichenbach is remarkable.

1804,	Lamark.	Naiades.	
1810, 1814,	Brown.	Marsileaceæ, (Rhizospermæ, Roth, D. C.*) (ord. nat.)	Pilularia, Marsilea, Salvinia, Azolla.
1828,	Reichenbach.	Musci. Gongylobrya. (Formatio.)	Riccieæ, Salviniaceæ.
1830,	Bartling.	Rhizocarpæ. Batsch. (class.)	Salviniaceæ, Marsileaceæ, Isoeteæ.
1831,	Sprengel.	Rhizospermæ, D. C.	Marsilea, Pilularia, Salvinia, Azolla, Isoetes.
1836,	Lindley.	Lycopodales. (alliance.)	Lycopodineæ (including Isoetes,) Marsileaceæ, Salviniaceæ.
1836,	Endlicher.	Hydropterides (class.)	Salviniaceæ, Marsileaceæ.

* De Candolle does not include Isoeteæ in his Rhizospermeæ. See Fl. Franc. 2, p. 577-579.

Aublet places Salvinia in the Linnean Cryptogamia Algæ.

EXPLANATION OF THE PLATES.

AZOLLA PINNATA.

Pl. xv.

(Male Organs and Development and fecundation of the Female Organs,) (Ovula.)

Fig. 1. Pair of organs (ovula,) with the involucrum somewhat reflexed.

2. Another pair rather more advanced; involucrum removed.

3. One of these magnified, about 400 times.

4. Ovulum considerably more advanced, 250 times.

5. A pair of the same more advanced: under slight pressure.

6. Fully developed ovulum, in this instance no filaments were found connected with it, but grume is represented projecting from the foramen.

7. Fellow ovulum, burst accidentally; about 300 times. The filaments passing out through the rupture were noted to be apparently continuous with some of those projecting from the foramen.

8. Another ovulum, the filaments are seen plainly passing into the cavity, which was partly filled with their disconnected joints, 300 times.

9. 9. Confervoid filaments; undergoing certain changes while attached to the axis, 550 times.

10. Pair of fully developed ovula.

11. Right hand one of the same pair, the space inside is filled with the disjointed component parts of the protruding filaments.

12. Pair of rather more developed ovula, the left hand one burst accidentally; both seen under pressure. The protuberances round the base of the nucleus distinctly seen, also the paraphysiform bodies, the vascular supplies of the ovula, and in the right hand one the disposition of the component cells of the previously continuous filaments. Both shew the first change that occurs in the nucleus, and both would have been calyptrate capsules; 200 times.

13. Another a little more advanced, burst and under pressure.

16. Fellow of the same, the grains, (disconnected joints of the filaments,) have all passed out by pressure, and the space between the nucleus and the foramen is consequently empty. In both the early development of the future yellow sac is attempted to be shewn.

17. Part of a confervoid filament found about the base of this pair, 550 times.

18. 19. Grains contained in the same: in fig. 19 these appear as if inclined to coalesce; 550 times.

14. Another more advanced.

13. Fellow of the same, as usual a little more advanced: in this the yellow sac was sufficiently distinct, and the condensed points, the first step in the development of the lobes, had also made their appearance; 200 times.

Pl. xvi.

(Development and mature state of the sac-containing capsule.)

Fig. 1. Young capsule, filaments still protruding from the foramen; this belongs to the second kind of formation: it is a fellow of No. 4.

2. Another of about the same period, with some paraphysiform bodies round its base.

3. A pair rather more advanced: the membrane of the (yellow) sac is now being developed; to the right hand one confervoid filaments are seen adhering.

4. Fellow of No. 1, represents the development of the yellow sac, and the appearance of the condensed points within the nucleus above the (yellow) sac.

5. Another similar one, more advanced.

6. Do. do. still more advanced: this is intended to represent that step of the development when the (yellow) sac is crowned with a cap of grume, presenting numerous condensed points, or nuclei.

7. Another still more advanced, under slight pressure: the grains (disconnected joints of the filaments) have almost disappeared, a membrane is developed round the condensed points, (or nuclei:) the (yellow) sac is collapsed accidentally.

8. Represents the (yellow) sac and its crowning mass detached, parts displaced: (yellow) sac collapsed. In-

tended to shew that there are more membranes developed in the crowning grume than there are subsequent lobes, there being in this, on one surface, no less than 7.

9. (Yellow) sac and capping grume with its condensed points, at a stage intermediate between fig. 6 and 7.
10. (Yellow) sac alone.
11. The same, burst on the trilineal-marked surface.
12. Lower persistent parts of a pair of calyptrate capsules.
13. Contents of one of the same, as they separate with the calyptra.
14. Calyptra detached.
15. Contents without the calyptra, to which they adhere by the cup-shaped mass of radicello-fibrous tissue at the apex : nucleary membrane (or secondary capsule) removed.
16. Contents without the calyptra, and without the nucleary membrane : lobes somewhat displaced.

17. 18. (Yellow) sac, and its incrustation removed, shewing the trilineal mark on its vertex.

19. Part of the incrustation.
20. One of the lobes, pulled off.
21. One of the radicular fibres, 550 times.
22. (Yellow) sac.
23. The same burst, and emptied of most of its contents.

Pl. xvii.

(Development of the other kind of capsules and their contents, part copied from Mr. Bauer's drawing.)

Fig. 1. Young capsule.

2. Nucleus and basilar protuberances detached.
3. The same magnified, about 300 times.
4. Nucleus and basilar protuberances of another more developed young capsule.
5. One of the lowest or least developed protuberances, (very young secondary capsule.)
6. Another more advanced.
7. Ditto still more advanced.
8. Ditto ditto.

9. 10. Ditto ditto in connection with curious, jointed, often very irregular bodies, the history of which was not traced.

11. Young secondary capsule more advanced: burst by pressure. Young trifacial cells shewn in the escaped grume.

12. One of these trifacial cells, about 500 times.

13. Portion of the contents of one of these secondary capsules, shewing the parent cells, and enclosed (trifacial cells) or spores: only observed once; 300 times.

14. Young secondary capsule, for the most part filled with grume and (yellow) trifacial cells.

15. Ditto more advanced: the primary masses are being developed.

16. Trifacial cells (spores) detached from the same.

17. 18. Fully developed secondary capsule: containing 3 masses in which the spores are imbedded.

19. Secondary capsules, surface view.

20. Masses of the same.

21. A mass detached.

From Fd. Bauer.
- 22. Portion of a plant, (natural size.)
- 23. The same magnified.
- 24. Contents of the calyptrate capsule, calyptra removed.
- 25. Longitudinal section of body crowning the (yellow) sac, (upper loculus of Brown.)
- 26. One of the other kind of secondary capsules, cut across.
- 27. One of the masses of the same under two aspects.

SALVINIA VERTICILLATA.

Pl. xviii.

(Development of the Organs, (Ovula,) and of the indefinite mass-containing secondary capsules and their contents, trifacial cells (or spores.)

Fig. 1. Apex of a reproductive-organ-bearing axis with one somewhat developed ovulum, and one in a much earlier state, *i. e.* before the appearance even of the tegument. Both, from their situation, would have contained the spherical mass-containing secondary capsules.

2. A young organ (ovulum) under pressure, it is the small one of No. 4.

3. Another rather more advanced.

4. An organ (ovulum) in its perfect state, with a much younger one (No. 2) at its base. The supposed fecundating matter shewn in application to the foramen.

5. 6. An organ much less advanced: 5 is a longitudinal section.

7. Another in its perfect state: the jointed obtuse filaments are what I take to be the male organs. The supposed fecundating matter shewn in contact with the foramen. It was also noted to have appeared to fill the space in the organ between the nucleus and the foramen.

8. Young capsule under pressure to shew the nucleus, now a mass of young secondary capsules.

9. Nucleus (or mass of young secondary capsules) of the same.

10. 11. 12. 13. 14. Represent the first developments of these secondary capsules.

15. 16. 17. 18. Continuation of the developments, ending in the presence of a larger cavity filled with grume in the secondary capsule.

19. Long section of a capsule more advanced.

20. One of its secondary capsules at that stage, when the cavity is occupied by uniform grume.

21. Another intended to exhibit the next step, *i. e.* the appearance of points of condensation (or nuclei.)

22. Another more advanced: the parts of the circumference of the grume between the radiating lines have a tendency, (shewn by iodine,) to the production of membrane (parent-cells?)

23. Represents a young secondary, with its cavity only partly filled with grume, in which two condensed points (nuclei) are visible.

24. Another about the same period, a considerable number of membranous sacs (parent cells?) visible in the grume.

25. Another about the same period.

26. Ditto more advanced, the membranes, (parent cells?) more developed.

27. Another still more advanced; at this stage the cavity is filled partly or entirely with grume, in which are imbedded a number of distinct trifacial cells, the young spores.

Pl. xix.

(The development of the sac-containing secondary capsules.)

Fig. 1. Capsule.

2. One of its secondary capsules, the cell in the centre of the grume is the young (subsequently yellow) sac; those between the central grume, and the inner surface of the capsule are young trificials, (abortive spores.)
3. Another secondary of the same capsule rather more advanced.
4. Another, still more advanced.
5. The central cell, young (subsequently yellow,) sac detached; trilineally marked surface.
6. Portion of the grumous contents of No. 4, shewing parent cells developing, and fully formed, and two young spores.
7. Confervoid filaments attached to the outside of the capsule of No. 4; about 500 times.
8. A young secondary still more advanced, but with the central cell abortive, appearing in its original state of a grumous condensation or nucleus.
9. 10. 11. Parent cells squeezed out of the grume of the same secondary capsule.
12. Another secondary capsule still more developed: central cell (subsequently yellow) sac much more developed; the surrounding grume much diminished.
13. 14. Part of the more fluid grumous contents of the same: 14. represents what appears to be trifacials just separating: this was only observed once.
15. Central sac of No. 12.
16. Another secondary capsule rather more advanced, the central sac now commences to assume a yellowish tint.
17. Another more advanced, shews the mammilla in the vertex of the central (yellowish) sac, appearing to pass off into a thin grumous lining of the cavity of the sac.
18. Sac of the same; trilineally marked face.
19. Another more advanced: perhaps represents the development of the three lobes subsequently crowning the (yellow) sac. *Analogy with Azoolla?*

20. Vertex of the (yellow) sac of the same.
21. Another surface of the same, intended to represent the cellular appearance.

Pl. xx.

(Salvinia verticillata and cucullata, the completion of the development of the spherical mass-containing secondaries, and the perfect state of the (yellow) sac-containing secondary capsules of the first species.)

Fig. 1. 2. Spherical mass-containing secondaries at the time when the trifacials become contained in grumous projections from the inner surface of the secondary capsules, which projections subsequently coalesce into a mass.

3. Salvinia verticillata, (natural size.)
4. Capsule containing the indefinite, simply pedicellate, spherical, mass-containing secondaries.
5. The same opened naturally.
6. Some of the secondary capsules and part of the receptacle.
7. Superficial view of one of the secondaries.
8. Another view of the same; centre in focus.
9. Portion of the secondary capsule, shewing the separation of the component cells.
10. A mass.
11. The same under pressure, to shew the imbedded trifacial cells or spores.
12. A nearly mature sac-containing secondary capsule.
13. Contents of the same.
14. Another view, shews the central attaching (?) process between the lobes of the vertex.
15. Same, (vertex in view,) lobes somewhat displaced to shew the trilineal mark.
16. Mature capsule.
17. Same, long section.
18. Contents of the same.
19. Contents of one of its secondaries.
20. Cross section of the same.
21. Salvinia cucullata, natural size.

All the figures, (with a few exceptions mentioned,) more or less magnified: reduced for the most part from (measured) sketches made under ¼, 1-16th objectives of an achromatic microscope, by Ross.

Description of four species of Fishes from the Rivers at the foot of the Boutan Mountains. By J. M'CLELLAND.

Several species from the Boutan mountains have been described in the notice of Mr. Griffith's collections, made during the Embassy of Captain Pemberton, &c. in the second volume of this Journal, p. 586.

Mr. A. Campbell, Superintendent of Darjeeling, favoured me with two species from Darjeeling, noticed in the second volume, p. 148.

Mr. D. C. Russell, of the Bengal Civil Service, favoured me with a species from the same quarter, which has been noticed p. 427, vol. 1.

It remains upon the present occasion to describe three species subsequently received from Mr. A. Campbell, and which would have been noticed earlier, but that I have been waiting in hopes of receiving a regularly selected collection from that quarter, such as might afford materials for a paper on the subject of suitable interest and importance.

Before going further, it is necessary in the first instance to offer a few remarks on Mr. Russell's specimens, of the Ground Fish of Boutan, or, as it has been called, inaccurately I suspect, the *bura Chang*. This species belongs to the same well known genus, with a small fish known in some parts of Bengal under the native name *Lata*, in other places called *Chang*. The Boutan ground fish is so much like the *Chang*, that ordinary observers would only distinguish it as considerably larger; hence I conceive the term *bura Chang* to be only a corruption of *bura* (large) *Chang*. In my former remarks on the subject, the species was considered to be the same as *Ophicephalus barca*, Buch. I now consider it to be a distinct species, which may be named and described as follows :—

OPHICEPHALUS AMPHIBEUS, (J. M.) *vol.* i. *Pl.* xi. *f.* 3.
Bura Chang.

In addition to the general characters of the genus, the fins are dark, and the sides marked with twenty-four alternately dark and whitish transverse bars. The length is equal to eight diameters of the body taken at the pectoral fins. The ventral fins are small and soft, the dorsal and anal broad, the former commencing on the back just above the pectorals. The fin rays are

P. 14: D. 48: V. 5: A. 34: C. 13.

When alive, the dark sombre colours are relieved by minute dots of vermillion and smalt blue, dispersed indiscriminately over the upper parts of the body and sides, more particularly about the head.

This species is very nearly allied to *Ophicephalus nigricans,* Cuv. et Val. from which it differs in containing two rays less in the dorsal fin.

When noticing this subject on a former occasion, vol. i. p. 427, the circumstance of Buchanan Hamilton having twenty years ago announced the fact of certain species of this genus inhabiting holes in the perpendicular banks of the Bramaputra, near Goalpara, was pointed out. The holes he says, were those frequented by certain birds, and consequently raised high above the water. Other species of this genus, (says the same author,) are found on the grass after heavy showers of rain, and that too at a distance from water, so as to be reckoned amongst those fishes which the natives of India, together with many Europeans, believe to fall from heaven with rain.—*See Gangetic Fishes, pp.* 67-8.

As to the species here described, Mr. Russell observes, that it is found in the vicinity of the Chail river, one of the tributaries of the Teesta at the foot of the Boutan mountains; sometimes it is met with as much as two miles from the bank of the river, where it penetrates into holes in the ground. From these it probably emerges when the ground is inundated during heavy rain, like the species of this genus so frequently found on the surface of the earth, as if they had fallen from the clouds.

The natives of Boutan know so well the ground in which to find these fish, that they dig them out from their holes in the following manner: a stick is passed into the suspected hole, and the earth raised sometimes to a depth of nineteen feet. When water makes its appearance the operations are suspended, and a little cow-dung is dropped into the well, this attracts the fish from their hiding place into the well, when they are easily secured. They are said to be usually found in pairs, each fish weighing about 4 lbs., and sometimes as much as two feet in length.

Such is the account given of the habits of this species by Mr. Russell, and I have already adverted to the statements of Buchanan Hamilton on the same subject, together with the popular opinion of the people of the country and of Europeans, forming together a body of evidence not to be questioned.

Dr. A. Campbell, Superintendent of Darjeeling, in a paper, (in the xi. vol. Jour. As. Soc. p. 963,) which I only refer to for the inadvertence with which it is written, without consulting the opinions of others, seems to regard the foregoing account of the habits of the *bura Chang*, as if it were calculated to excite, (to use his own words,) either " an *unenquiring* and implicit credence, or *wonder*, without any lasting impression of the matter narrated, or *sceptical disbelief*."

In a recent visit to Boutan, Dr. Campbell states, that he learnt on enquiry, that the *bura Chang* or, as he names it the *bura Chang*, is not found on the right bank of the Teesta.*

* This, if not depending on some local cause, which ought to have been stated, would be far more incredible than any thing else that has been advanced upon the subject.

It inhabits jheels and slow running streams near the hills, living principally in the banks, into which it penetrates from one foot to six. The '*tubes*' leading from the water into the banks, are generally a few inches *below* the surface of the water,* and are consequently filled with water, and terminate in a basin where the fish remains. The usual mode of catching them is by introducing the hand into these recesses under the water, two fish are generally found together, and they lie coiled up horizontally like a wheel. It is not believed that they bore their own holes, but that they occupy the abandoned locations of land crabs. When in the water-pools or streams, they always remain close to the margin, and constantly move out and into their holes. "*They never leave the water, nor can they move on grass more than any other fish.*"

Under an impression, perhaps, that no fish are formed to live out of water, Dr. Campbell may have thought it necessary to obtain the foregoing information, in order to reconcile with his own views, what appeared to him to be an exception to a general law of nature. But there are eight genera of the same family of fishes to which the *bura Chang* belongs, all specially formed for an amphibious mode of life. They constitute what Cuvier calls, the family of *Labrynthiform Pharangeals,* from the circumstance of their pharangeal bones being formed into a kind of honeycomb, for the retention of a supply of water to enable them to live in dry places.

The following is the account of the family in question, as given by the Baron Cuvier in the *Histoire Naturelles des Poissons:*—

"The family of which we are about to afford a history, is remarkable for a peculiar structure, which consists of a division into leaflets of a portion of the pharangeal bones.

* This we should suppose would depend on the season and state of the river, as hill streams rise and fall so continually, that they never can be said to have any fixed level.

This division produces a number of little cells more or less complicated, and calculated to retain a certain quantity of water; they are a good deal like the cells in the stomach of the camel. This apparatus is formed under the arches of the operculum, and being pressed closely against the body when the fish is removed from the water, a sufficient quantity of that fluid is thus retained free from evaporation, and in contact with the gills, to protect them from drought. Hence the fishes of this family, whose habits we have any account of, all seem to be capable of quitting the rivers and tanks in which they ordinarily reside, and frequently make excursions to great distances by jumping along the grassy surface of dry land."

Hence we see, that Mr. Russell's account of the *bura Chang*, is only in accordance with the known habits of the family to which it belongs, and however extraordinary it may seem, does not require to be bolstered up by any such explanations as those of Dr. Campbell. Nature herself is the best monitor in such cases. Mr. Pearson incommunicating Mr. Russell's account of the *bura Chang* to the Asiatic Society, considered it to be of such a novel* nature, as to deserve on that account the peculiar attention of that learned body. Now as to the novelty, which the Society took for granted!

"What is most astonishing," says Baron Cuvier, "and what some naturalists of the present day ought to be ashamed of, these habits were known to the ancients."

Theophrastus in his Treatise on Fishes which live without water says, that there exist in India certain fishes which leave the rivers for a time, and return to them again; that they resemble those which the Greeks call *μύξινος*, that is to say, mullets. "There may be some doubt," says Baron Cuvier, "as to whether this refers to our *Anabas*, or rather perhaps

* Journ. As. Soc. Beng. 1839, vol. viii, p. 551, and Cal. Jour. Nat. Hist. vol. i, p. 427.

to *Ophicephalus*, which both have the head broad and obtuse, and covered with scales as the mullets." In another place, Cuvier remarks, when speaking of *Ophicephalus*, that "Theophrastus, as we have already stated, was acquainted with these singular fishes; for it is evident to those who are acquainted with the passage of this philosopher which we have cited, that there are in India certain fishes resembling mullets, which spend a portion of their time in the earth." Again in another work, (the last edition of the Règne Animal, vol. ii,) the same illustrious author remarks in a note, that the fishes alluded to by Theophrastus, most incontestibly belong to the genus Ophicephalus.

Thus it would appear, that what was communicated to, and received by the Asiatic Society in 1839 as new, and four years after questioned as improbable in the publications of the same Society, was well known to the ancients, and so far from being improbable, is as I have here proved by a reference to one of the greatest modern philosophers, to be perfectly consistent with the order of nature.

The history of this species may be useful, as tending to remind us, how liable we are to retrograde in these things.

Two undescribed species of Barbel, and a non-described genus of Chætodon.

The large-scaled barbels of India are conveniently divided into such as have a smooth, and such as have a denticulated spine to the dorsal fin. Six large-scaled species of this genus having the dorsal spine smooth, are described, vol. xix, As. Res. Of these, five are remarkable for the great length of the head. The sixth, an Assam species, there called *Bokhar*, although having the head short, has only 27 scales along the lateral line. A seventh is mentioned on the authority of Buchanan in the work alluded to, where it is stated in a note, that I had not myself met with it. Since then, in a collection from China, I met with a species with short head and smooth dorsal spine, which I believed to be Buchan's *Cyprinus putitora;* the scales of this were still larger than those of the *Bokhar*, being only 25 in number on the lateral line.

The following species differs from both, in having 32 scales on that line.

2. BARBUS SPINULOSUS. (J. M.) *Pl.* xxi. *f.* 3.

Descr.—The length of the head is equal to a fourth part of the length of the body. The eyes are placed anterior to the middle of the head, the back is little arched, and the dorsal commences mid-way between the end of the nose and commencement of the tail fin. The three first rays of the dorsal are closely united, the third spinous ray is straight, and more slender than usual in this genus. It is shorter than the succeeding soft ray. The muzzle is short and smooth; there are 32 scales along the lateral line, the fin rays are,

$$P.\ 16 : D.\ \frac{3}{9} : V.\ 9 : A.\ \frac{3}{7} : C.\ \frac{\frac{6}{19}}{7}.$$

Colour olive green above, white below, the fins are all pale.

Length of the spceimen 7 inches.

Habit.—Rivers at the foot of Sikkim Mountains on the northern frontier of Bengal.

3. BARBUS CLAVATUS. (J. M.) *Pl.* xxi. *f.* 2.

Cyprinus chagunio, Buch. The large spined Barbel.

In the As. Res. vol. xix, the characters of this species are given on the authority of Buchanan. Not having met with it, I conceived from that author's description, that it might be a variety of the spotted Barbel, B. spilopholus.

The collection now before us, affords however, a very distinct species, which I believe to be the Cyprinus chagunio, Buch.

Descr.—The depth of the body is equal to $\frac{1}{4}$ of the length, mouth slightly cleft, muzzle short and covered with small thorny tubercles; the eyes are large and placed midway between the muzzle and operculum. The back ascends from the nape to the dorsal, leaving a narrow ridge in front of that fin; the third dorsal spine is large, and equal in length to the depth of the body, and serrated behind. The fin rays are

$$\text{P. } 16: \text{ D. } \tfrac{3}{8}: \text{ V. } 10: \text{ A. } \tfrac{3}{5}: \text{ C. } \overset{8}{\underset{7}{19}}$$

There are 42 scales along the lateral line, and 11½ in an oblique row from the base of the ventrals to the dorsal, colour blue above, lower parts white; the fins are pale bluish white. Length 7 inches.

HABIT.—Rivers at the foot of the Sikkim Mountains on the northern frontier of Bengal.

Tribe, *Squammipennes*, Cuv.—Fam. *Chœtodon*, Cuv.

CTENOPS, *N. Gen.* Nob.

GEN. CHAR.—Head acute, dorsal small, placed far back on the latter third of the back, anal long, the lower margin of the preoperculum denticulated, anterior suborbitar bone forming the side of the rostrum, is large and denticulated below.

OBS.—The intestines are about the length of the body, and present two large cæcal appendages.

The teeth are placed in partial tufts, or two incomplete rows on the margins of the intermaxillaries, which are very protractile. No teeth on the vomer or palatines.

There is but one species known.

CTENOPS NOBILIS, (J. M.) *Pl.* xxi. *f.* 1.

DESCR.—The back is obliquely raised almost in a straight line, from the head to the dorsal, which is placed near the tail. Head depressed, rostrum elongated, the operculum smooth-edged behind, with a soft projecting scaly point directed backward, the ventrals are preceded by a sharp spine. The fin rays are

$$\text{P. } 12: \text{ D. } \tfrac{6}{6}: \text{ V. } \tfrac{1}{5}: \text{ A. } \tfrac{4}{27}: \text{ C. } 16.$$

Colour mottled grey, with some bright silvery spots.

Habit.—The rivers at the Sikkim passes on the northern frontier of Bengal.

We are indebted to the kindness of Mr. Campbell Superintendent of Darjeeling, for the three last specimens. They were received two years since, and a description of them only withheld in hopes of receiving further accessions from the same quarter.

The late Dr. J. G. Malcolmson. F. R. S., G. S.

Since the appearance of the last number of this Journal, the death of J. G. Malcolmson, Esq. of Bombay, has been announced in the public prints. Mr. M. belonged formerly to the Madras Medical Service, which like the Medical Service generally in India, rarely affords scope for men of enterprising character and talent. Mr. Malcolmson after having distinguished himself as a medical officer by the publication of an Essay on Berri Beri, and several geological and other papers, became Secretary to the Medical Board of Madras.

He vacated this office, and availed himself of furlough to Europe, where he further distinguished himself by the discovery of fossil fishes in the old red sandstone of his native country in the north of Scotland, as well as by several communications to the Geological and other Societies of which he was elected member. He also formed upon that occasion an extensive connection with the principal scientific men of London and Paris, with whom he continued afterwards to correspond till the period of his death. He resigned the Honorable Company's Service, we believe, before he was entitled to any pension, and joined the mercantile house of Forbes and Co. of Bombay. Amidst the cares of mercantile pursuits, he still kept up his scientific correspondence, and found time to devote a portion of his energies to scientific occupations. He became Secretary to the Bombay branch of the Royal Asiatic Society, and was one of the chief supporters and original projecters of a valuable Quarterly Journal published by that Institution at Bombay. Mr. Malcolmson possessed a high degree of public spirit and enterprize, directed by a sound judgment. He was always foremost in undertaking works of utility, aiding them no less by his example and intelligence, than by his own private resources and means. In all this, he ever appeared to hold himself in the back ground, and rather seemed to advocate and promote the objects and views of others, than his own. No man however, had a better sense of what was due to himself, as he occasionally proved on his natural generosity of character being misunderstood. He was one of the ablest and best friends of this journal, and shortly before his death we had a communication from him on the subject of Isinglass, on the introduction of which to the English market from Bombay, he was bestowing much attention.

This, however, is only one of the numerous objects of public interest that will suffer by his loss. Mr. Malcolmson died, we believe, in the prime of life, from a fever contracted it is said, during an excursion for some scientific object, the particulars of which we have not heard.

Apparent objections to the Glacial Theory. By Capt. Thos. Hutton. *Bengal Army.*

The figure of the earth, and the traces which its strata present of a former elevated temperature, have long since given rise to the opinion, that our planet has gradually and insensibly cooled down from a state of intense heat; and certainly without deeming it necessary to admit, that the material elements of the earth were once in a *nebular* condition; it is still abundantly evident from the facts of Geology, that the animals whose remains are found imbedded in the earlier strata, must have lived in a climate perhaps even warmer than those of tropical countries in the present day. Those very fossils, indeed, from the earliest to the most recent period may be said to form a kind of *thermometric register*, which proves indubitably, that the climates of the earth have, from some cause, decreased in temperature until the present order of things commenced, since which no sensible diminution would appear to have taken place. There is nothing observable amidst the appearances and phenomena of the strata, to warrant the idea that such decrease of temperature has been fitful and uncertain ; diminishing at one period; increasing at another ; and then again resuming a ratio of gradual decrease; but on the contrary, every fact with which we are acquainted, tends forcibly to prove, that such decrease, although periodical, and occurring at widely distant periods of time, has yet been constant, and dependant mainly upon the physical distribution of land and water. The strata of the earth in all parts of the world, from the earliest to the most recent periods, furnish incontestible evidence of violent disruption; the transition; the secondary and the tertiary formations have each in turn been subject to some revolution or convulsion, which has destroyed the organised beings of those periods, and has been succeeded by a decrease of temperature, and a corresponding change in the species of the animal and vegetable tribes, a fact well proved by the gradual passage in a fossil state of the exuviæ of beings adapted only for existence in the warmest climates, to those which could survive only in more modern times.

Yet doctrines have recently sprung up, apparently in direct opposition to these revealed facts of geology, which are endeavouring to prove, that glaciers formerly existed in countries which at the present day are totally free from them, and whose temperature is moreover altogether opposed to their formation. The proofs of the former occurrence of glaciers in Edinburgh and other parts of Great Britain, as well as on the continent of Europe, are said to be furnished by accummulations of transported matter across the mouths of glens and valleys, and by deep grooves and polished surfaces on rocks, to which it is asserted nothing but the weighty friction of enormous glaciers charged with debris, could have given rise.

Now it must be evident, since glaciers do not at present occur in our island, that if they ever had existence there, it must have been at a period when the temperature was far colder than it has ever been during the historical era of man; yet this would be to set at nought the evidence furnished by organic remains, for these all prove, that up to the opening or commencement of the present era, all prior conditions of temperature were *invariably higher* than now, and such a result too, the theory of refrigeration must absolutely demand. Lyell it is true, has endeavoured to explain, that by some cause during the cooling process, the temperature may have become such as to give rise to glaciers, and then again returned to a higher state and destroyed them; but this is like building up a structure with one hand, for the sole pleasure of destroying it with the other. Lyell seems to have taught himself to believe in the truth of this hyphothesis, from the occurrence in a fossil state of certain species of shells, still living in temperate climates, but surely this fact instead of proving that the former condition was colder, merely shows that some of the present living forms were capable of existing during the tertiary period likewise, and we know that even in the secondary series, there are some species which occur in more than one member of the system, without proving that the earlier deposit was made during a colder period.

Nor if we agree with this author, that changes in physical geography have always affected the temperatur of climates, could *the former temperature* ever have been colder than in our days? for we are taught by him, " that *since the commencement of the tertiary period,* the dry land in the northern hemisphere *has been continually on the increase,* both because it is now greatly in excess beyond the average proportion which land generally bears to water on the globe, and because a comparison of the secondary and tertiary strata affords indications of a passage from the condition of an ocean interspersed with islands, to that of a large continent."—*Lyell's Prin. Geol. p.* 215.

Now, that increase of land in northern latitudes must necessarily operate *in reducing the temperature,* and rendering climates colder, is perhaps one of the surest propositions of the author's theory, and as he shows us from the appearances of the present northern continents, that land *has been continually on the increase in the northern hemisphere ever since the commencement of the tertiary period,* so he proves to us also most conclusively, that the cold of our climates has been, from the commencement of the same period, *continually on the increase likewise.*

It has been urged, that the particular degree of cold which the glacial theory requires, occurred between the conclusion of the tertiary, and the commencement of the modern eras; but even in this case we fail most signally to prove the truth of the doctrine, for if land in northern latitudes has been continually on the increase till the termination of the tertiary epoch, so likewise has the cold; and if no lands have arisen from the waters since that time, *the maximum* decrease of temperature took place at that period. In order therefore to raise the temperature again and dissolve the glaciers, the northern lands should have *decreased* at the commencement of the modern era; yet this so far from being true, is actually disproved by the fact, that land is still rising in the north, and has continued to do so, we are informed, *since the commencement of the tertiary period.* The climates of the earth are therefore colder now than they have been at any former period, and this the phenomena of the strata confirm, and the theory of refrigeration demands; for it must be evident, that if the theory of internal heat be true, such a result as this must be inevitable, for in by-gone ages when the central heat was greater, and the crust of the external earth less thick and solid, the surface temperature must have been kept higher by the radiating heat; whereas in our time it is proved, the the surface is scarcely affected by the internal temperature of the planet.

" All the observations collected and discussed by the most learned physiologists of our days, inform us, that the increase of temperature in the strata lying immediately beneath the surface, is about a degree in thirty metres, at a medium. In a globe of iron, a similar increase would only give a quarter of a centesimal degree, for the actual elevation of the temperature of the surface. As a consequence of the influence of the central fire, this elevation is very trifling, and almost imperceptible; that, however, which the earth experiences is much less still. In fact, the strata of the mineral shell are not composed of iron, but of substances which offer much less facility for the transmission of heat. Now, the heating of the ground is (for the same level of temperature in the direction of the depth) directly proportioned to this facility; whence it follows that if, as is very likely, the substances of which the upper envelope of the earth is composed, conduct eight times less heat than iron, the excess of heat communicated by the internal fire will only be the 32d part of a centesimal degree, a quantity quite insignificant. When we examine attentively and according to known principles, all the observations relative to the figure of the earth, we cannot doubt that this planet received at its origin, a very elevated temperature. On the other hand, thermometrical observations shew us, that the present distribution of heat in the terrestrial envelope is, that which would have occurred, if the globe had been first very hot and then progressively cooled, till it reached the state in which we now find it."—*Calcutta Journal Nat. Hist. No.* 12, *p.* 604.

Thus, if there be any truth in the doctrines of geologists, we derive conclusive evidence from the fossil exuviæ of extinct animals, from the former distribution of land and water, and from the past and present condition of the interior of the planet, that the climates of the present day are far colder than they have ever before been, and consequently, that if glaciers cannot now form in our island, so neither could they have done so at any previous epoch; from all which it will necessarily result, that if the Glacial Theory is to be maintained, the previous work and research of years, and the inferences drawn from the phenomena apparent in the strata of the earth, must be abandoned as erroneous.

Again, it has been urged by high geological authority, that while the accumulations of debris at the mouths of glens and valleys are attributable to the former occurrence of glaciers in those situations, the detached erratic blocks so numerously scattered over the countries of the north, between the fortieth parallels of latitude and the pole, are due to the agency of icebergs, which carried those huge masses "when the lands over which they lie scattered were submerged beneath the sea."—*Lyell's Elem. Geol. p.* 136.

This author goes on to state, that the fact of those blocks occurring in both hemispheres as far as the fortieth parallels, raises a presumption, that the greater warmth of parts of Asia, Africa and America nearer the line, has been proved unfavorable to the transport of such blocks. On the other hand, they abound in the colder regions of North America from Canada Northwards, as well as in Northern Europe, and when we travel Southwards, and cross the line in South America, we fall in with them again in Chili and Patagonia, between latitude 41° S. and Cape Horn."—*Ibid, p.* 137.

Many serious objections appear to rise up against this hypothesis even out of the very arguments used to establish it, for although it is undoubtedly true that icebergs in the present day possess the power of diffusing large blocks over northern tracts, yet such, with reference to the period of deposition, are geologically distinct from those other blocks and detritus more properly termed *erratics;* and again such modern blocks become *more numerous towards the lower limit of icebergs than in the preceding part of their course.*

Now it ought naturally to follow, that if icebergs were the agents which scattered the true erratics and detritus, the occurrence of such phenomena should be more frequent as we approach the southern limit to which icebergs are supposed to have travelled, than when we journey northwards ; for as the icefloes engendered in the north, sailed down towards the south, the higher temperature towards which they were floating would have caused them to deposit the detritus with which they were charged over those tracts within the influence of tropical heat, and consequently a far greater accumulation of blocks and detritus would be found in *those warm southern regions over which the icebergs had melted,* than in those cold climates of the north which had given them birth. We should therefore look for such transported matter in abundance as we neared the warmer regions, and in a decreasing ratio as we travelled north to the countries from whence the icebergs and boulders started. But is such the fact? assuredly not,—for precisely the very reverse is well known to be the case, and Lyell himself, the propounder of the theory, tells us, that " these erratics are far more numerous in northern countries, although some are met with as far south as the Swiss Jura;" *(Lyell's Elem. Geol. p.* 136,*)* and it is precisely the gradual diminution of these blocks both in size and frequency as we proceed southwards, which has hitherto influenced all observers in declaring the course of the last diluvial currents to have been from north to south. In this respect, therefore, the order of deposition apparent in *recent* and *ancient* erratics is reversed, and the inferences deduced cannot be relied on, for while modern deposits of transported matter increase as we travel from the north towards the limits to which icebergs can attain, the ancient detritus is found on the contrary to decrease ; thus in this instance it is evident, that the causes now in operation did not produce the effects under consideration.

But according to Lyell's reasoning, the present northern continents were submerged beneath the sea at the time when these blocks were scattered over them. Whence then did the icebergs obtain the detritus with which they were charged? or where were the icebergs themselves produced? where was then situated the land which furnished the erratics? The North was then all Ocean, could equatorial lands have furnished icebergs?

Had the ancient erratic blocks been deposited by icebergs at a time when the present northern lands were submerged, the arrangement now apparent in their distribution would indicate, that such icebergs must have come from a direction opposite to that pursued in the present day. It may therefore perhaps be said, that the time when our northern lands were beneath the sea, the then existing drylands occupied the regions near the equator, especially since many facts arising from the character and appearances of the imbedded fossils, would tend to show that former conditions of temperature were far higher than now. Since, however, the northern latitudes must always have enjoyed a colder climate than the equator, it is evident that had icebergs by any possibility been engendered in the latter regions, they could not have been dissolved in the colder temperature of the former, and therefore they would have accumulated into a mass without depositing the erratics enclosed in them. But such a distribution of land is easily seen to be totally adverse to the formation of icebergs, and Lyell himself assures us, that if we consider a mere approximation to such a state of things, it would be sufficient to cause a general elevation of temperature, and if there were no arctic lands to chill the atmosphere and freeze the sea, and if the loftiest chains were near the line, it seems reasonable to imagine, that the highest mountains might be clothed with a rich vegetation to their summits, and that nearly all signs of frost would disappear from the earth. If during the long night of a polar winter, the snows should whiten the summits of some arctic islands, they would be dissolved as rapidly by the returning sun, as are the snows of Etna by the blasts of the sirocco."—*Lyell's Prin. Geol. p.* 191.

Now there seems every reason to believe from the phenomena which strata disclose in all parts of the world, that the temperature of climates during the period immediately preceding the present distribution of land and sea, was such as is here conjecturally described, for we perceive that animals analogous to those now only existing within tropical countries, once lived in the immediate vicinity of the arctic regions. The occurrence of these tropical forms, while it indubitably proves, that during the period alluded to, there were some lands uncovered in the northern hemisphere, likewise establishes the fact, that the climates of the regions in which those animals lived were warmer than at present, and therefore, that if they were adapted to tropical constitutions, they must have been quite unfitted for the production of icebergs.

The occurrence of large boulders on the summits and slopes of lofty mountains, between which and the true site from whence the blocks have been torn, deep valleys at present intervene, have presented difficulties which it is said can only be removed by supposing that icebergs were instrumental to their deposition at a time when the localities in which they rest, were beneath the waves; but independent of the decisive argument above given, it may very reasonably be doubted, whether a huge mass of rock suddenly liberated from a floating iceberg, would ever have found a resting place either on the summit or slopes of a submerged chain of mountains, inasmuch as such a falling body, however much its velocity might have been moderated by the medium through which it was descending, could never have been so gently and quietly deposited as to enable it to rest at once in a state of equilibrium, but on the contrary, the weight of the mass and the impetus acquired in the descent, would undoubtedly have caused it to roll down into the troughs or submerged valleys, unless it happened accidentally to alight in some hollow, or under some other peculiar circumstance which prevented its farther descent. So far, however, from this appearing to be the case, the boulders are often found upon the very summit of hills without the least additional support. It may perhaps be urged, that at the time when the blocks were deposited, they sunk down amidst the softer sediments with which the submerged land was covered, and so found an immediate support and resting place; but that subsequently when the land was upraised, those softer materials were washed away or drained off by the retiring waters; this, however, can only be admitted by supposing that such upheavements have been very slow and gradual in their progress, for a sudden and violent uprise would not only have caused the finer detritus to drain off with the waters, but would likewise have set in motion the larger boulders, and caused them to roll from the uprising ridges down into the valleys below. The violent disruption apparent among the strata of uplifted rocks, and the vertical position many of these strata have attained, afford sufficient evidence of a rapid uprise from the waters, and therefore renders it highly improbable that such boulders were deposited before the upheavement took place, and these facts coupled with the proofs above cited, of former elevated temperature in which icebergs could not have existed, clearly demonstrate that these latter were not the agents by which boulders have been dispersed over the countries of the north. In many instances, as in the Alps, the ranges on which boulders rest, are not more than fifty miles distant from the sites whence they have been torn, and it seems scarcely reasonable to suppose, that at the time when the climate of the central chain of the Alps, (which was then a rocky island,) was cold enough to give origin to icebergs, the temperature at only fifty miles distant was warm enough to melt them again, for as Lyell hypothetically observes, at the time, when the northern hemisphere was an ocean studded with islands, the equatorial regions abounded in land, and the temperature caused by such a distribution was not only totally opposed to the formation of icebergs, but even to the occurrence of any severe cold.

But if then it be thus shown that diluvial matter, and erratic blocks are not due to the agency of glaciers or of icebergs, what other agent can we employ to distribute them according to their present arrangement? What, but the mighty, and overwhelming rush of retiring waters, thrown back tumultuously in furious waves towards *the south*, as the mountainous regions of the northern hemisphere successively burst upwards from beneath the sea? What other agent save diluvial currents such as these, could have borne off the masses of shattered rocks urged onwards by the double impulse afforded by uprising hills and retiring waters, and strewed the land with detritus decreasing in quantity and in size as we travel towards the southern tracts, where the mighty debacle was at length reduced to tranquillity and equilibrium in the depths of the Southern Ocean?

The glacier theory proposed by M. Agassiz, and now supported by Buckland and Lyell, asserts, that the accumulations of debris called "*moraines*," which occur across the mouths of glens and valleys in the Highlands of Scotland, could only have been there deposited by melting glaciers, for their position is such, that had water been the agent, which brought down the detritus from the hills, it must inevitably have swept off the fragments before it, instead of heaping them up as barriers across the glens. This reasoning, however, does not appear to be absolutely correct, for the waters which must have accumulated these moraines, were not the rivers and streams of modern times, nor were they the transient out-bursts of lakes from the higher lands; had they been such, it is no doubt true, that they would have swept away the accumulations of debris from the mouth of every glen through which they descended. But the height at which many of the moraines occur on the sides of the glens, at once proves, that if they were deposited by water, it must have been by water possessing far greater force and volume than any that occurs at present. Now if we allow that the land was once submerged, and the strata horizontal, of which no reasonable doubt can be entertained, it will follow, that when volcanic movements within broke up the strata and upheaved them, the friction of the uprising masses against each other would, in numerous instances, have caused precisely the very grooves, striæ, and polished surfaces which rocks often exhibit, while the shattered and disrupted surface would have yielded abundantly the debris and boulders of which the supposed moraines are composed, and these hurled together in confusion by the mighty debacle formed by the suddenly uprising land, would have been accumulated in masses of great extent across the openings of the glens and valleys through which the recoiling, and ever and anon returning swell, tumultuously descended. These forming barriers to the quiet streams which at a later period occupied the glens, would have dammed up the waters until their gradually increasing force at length burst over or through the obstacle, and thus modified the form and appearance of the moraines. It may perhaps be objected, that the friction of uprising masses of rock is not of itself sufficient to account for the grooves and striæ which are often visible. That such friction, however, is capable of producing some of these phenomena, we have proof in the instance of the " ninety fathom dibe," in the coal-field of Newcastle. This name has been given to it, because the beds are ninety fathoms lower on the northern than they are on the southern side. The fissure has been filled by a body of sand, which is now in the state of sandstone, and is called the dibe, which is sometimes very narrow, but in other places more than twenty yards wide. The walls of the fissure *are scored by grooves, such as would have been produced if the broken ends of the rock, had been rubbed along the plane of the fault*."—*Lyell's Elem. Geol. p.* 120.

Still it may be urged, that such friction could not have acted on horizontal surfaces, nor on external surfaces generally, which exhibit no signs of violent fracture; in these cases, another agent is evidently necessary, and if we admit, that at the time when our lands first emerged from the ocean, the strata were in a soft and semi-consolidated state, we shall perceive that the striæ and grooves may have been furrowed upon them by the passage over the surface, of the vast rocky masses which hurled down from the uprising hills, were borne along by the retiring waters, to the lower lands.

Thus we shall derive assistance from two distinct agents, both of which may have been instrumental, under different circumstances, to the production of the phenomena now attributed to glaciers.

The partial stratification which some of the supposed moraines exhibit, as in the district where the rivers Esk, Proson, and Carity unite, not only offers difficulties which the glacier theory cannot explain or surmount, but is precisely the very effect to which water alone could give rise.

" The lower part of the barrier at Glenairn, thirty feet in depth, laid open in the river cliff, consists of unstratified mud full of boulders; and the upper part from fifty to one hundred feet thick, of gravel and sand is inferred by Mr. Lyell from analogy, to be stratified. If this barrier be supposed to be a large terminal moraine accumulated by a retreating glacier, Mr. Lyell states, its origin is easy to be understood, and that the water produced by the melting of the ice may have overflowed the mound and furrowed out the softer materials composing the upper part into ridges and hillocks; *but,* he adds, *it is difficult to comprehend how a capping of such materials on the summit of a terminal moraine could have acquired a stratified structure.* At Cortachie, four miles below the barrier of Glenairn, the Esk enters the lower country of old red sandstone; and a mile and a half farther down it, is joined by the Proson; and a mile yet lower, by the Carity. In the district where these streams unite, there is a great amount of unstratified detritus full of Grampian boulders, and covered for the most part with *stratified gravel and sand, in some places from thirty to forty feet thick.*"—*Edin. New Phil. Jour. No.* 59, *p.* 201.

Now the very circumstance of boulders occurring in the lower part of these accumulations, while the upper portion is composed of strata of gravel and sand, at once points out the action of water rather than of glaciers; for had the latter been the agent, we shall at once perceive, that as the ice melted, the detritus would have been indiscriminately deposited in a shapeless heap without reference to any law of specific gravity, such as the arrangement in the above described moraines betokens. Lyell here seems to overlook a fact recorded in his Principles of Geology; "the moraine of the glacier, observes Charpentier, *is entirely devoid of stratification,* for there has been no sorting of the materials as in the case of sand, mud, and pebbles, when deposited by running waters. The ice transports indifferently into the same spots, the heaviest blocks and the finest particles, *mingling all together, and leaving them in one confused and promiscuous heap* wherever it melts."—*Lyell's Prin. Geol. p.* 377.

If this doctrine be correct, and it is clear from the manner in which Lyell quotes it, that he believes it to be so, it is very evident that the accumulations near Glenairn cannot be the production of glaciers, and he indeed while describing them, seems to be reminded of the impossibility, although the desire of establishing a novel and somewhat marvellous theory has urged him to persevere, even in the face of facts which militate against it.

On the other hand, this arrangement is in every respect that which would have resulted from the action of retiring waters, for if a sudden upheavement of our present continents or portions of those continents had taken place, the swell occasioned in the ocean by such uprise would have forced back the diluvial wave, bearing with it the fragments of various rocks which had been shattered by the movement, and these would have been dropped sooner or later according to their weight, over those tracts traversed by the retiring waters. But it is not to be supposed, as Bakewell judiciously observes, that such a swell could suddenly subside; it would return over the land repeatedly at a lower and lower level each time, until its force being expended and the equilibrium once more restored, it would have deposited those lighter materials which had become sorted by the movement of the water, above the heavier boulders and detritus.—*See Bakewell's Introd. Geol. passim.*

Thus the heavy blocks forming the lower portion of the Glenairn moraine, and those scattered over the lower land at Cortachie, would appear to be precisely in the position, supposing water to have been instrumental to their deposition, which their greater specific gravity would demand; while the lighter gravels and sands which form so thick a stratum above them, are likewise the produce of the same waters as their force and powers of suspension diminished. Nor is it at all necessary to suppose, that all our lands were at once uncovered by this outburst, for when once the mountains had been upheaved by the volcanic action within the earth, the subsequent movements may have been more gradual and similar to what is still taking place; the mounds or accumulations of debris would therefore have remained uninjured beneath the waters, until the uprise of more land in various quarters had caused the ocean to retire, and left the diluvium to the action of rivers and streams as the drainage of the land proceeded, while its own retirement would have denuded the strata to which it had previously given rise. Lyell supposes, that the detritus at Glenairn is the production of a glacier whose dissolution caused a body of water to accumulate, until it "overflowed the mound and furrowed out the softer materials composing the upper part into ridges and hillocks."

This is obviously incorrect, or he not only shows us elsewhere, that the distribution of land and sea previous to the historical era was such as to banish nearly all signs of frost from the earth, but that the rise of land in the north has continued ever since the commencement of the tertiary period which preceded it, down to the present time, and therefore that the climates of the earth are now colder than they have ever before been; from which it must follow, that as no glacier now exists at Glenairn, so it never could have existed there at all.

Supposing, however, for the sake of argument, that such had once been the fact, we shall still perceive that no furrowing of the mound could have taken place from the melting of the ice, much less could it have given rise to stratification; for had the melting of the glaciers been as sudden as M. Agassiz supposes their accumulation to have been, vast deluges would have been produced, which instead of heaping up debris at the mouths of glens, would have swept it all off before the impetuous torrents, *(See Hitchcock's Geol. passim)*; while on the other hand, had the thaw proceeded as gradually as it does in the present day, where glaciers occur, the waters would have escaped before the mound of detritus was completed, for it is to the escape of the ice in the form of water that the moraines are due, and until such escape is effected, no moraine is deposited. As the ice melts, the water escapes, and the detritus falls down into a confused and promiscuous heap without stratification; the Glenairn moraine therefore must owe its origin to some other cause.

There is yet another circumstance which seems to me, to militate against the opinion, that detritus and erratic blocks are due either to the agency of glaciers or of icebergs. I allude to the rounded and water-worn appearance which almost invariably characterises this group of deposits. It is well known, that in the present day, the detritus with which icebergs are occasionally loaded, is torn by the action of frost from the shores where the ice is formed, and afterwards floated away to be deposited in situations far distant from their natural sites. Such fragments are either torn from the solid rock by the expansion of water which has found a passage into fissures; or masses already detached are uplifted from the shores and bottom of shallow waters. In the former case, the fragments would exhibit their edges or angles for the most part uninjured, while in the latter instance, the detritus uplifted will, in all probability, consist of rounded water-worn fragments, which have either been subject to friction in the situations from whence they are lifted, or by the action of the river currents which have brought them down from the land. At the time when the present lands were submerged therefore, there could have been no rivers to furnish detritus, for allowing that some land existed in the northern hemisphere, yet such would have consisted only of rocky islands such as the summits of the present mountains might produce, and consequently would have been unable to furnish rivers of any moment; the detritus therefore which is now scattered over the continents of the north, should consist chiefly of the angular fragments which the frost had detached from rocks *in situ,* and not of rounded or water-worn pebbles and boulders. Lyell endeavours to shew, that the rounding of erratics is to be attributed to the action of frost, and not to the attrition of moving waters, and he cites the granite used in the buildings of Quebec to show the correctness of his views. This, however, is founding a general rule upon one nearly solitary exception, for while the Quebec granite requires to be coated over with oil and paint, in order to preserve it from exfoliation, we do not hear of the same necessity existing elsewhere in regard to all granites ; and this is proved from what Lyell himself tells us regarding the icebergs which were seen " in Sir George Eyre's Sound in the latitude of Paris, which were seen in 1834 carrying *angular pieces of granite,* and stranding them in fiords, where the shores were composed of clay slate."—*Lyell's Prin. Geol. p.* 379.

While therefore the rounding of erratics composed of the Quebec granite may be attributed to the agency of frosts, the same rule will not apply to all, nor yet to the generality of blocks; and thus the instance quoted, forms but an exception, and is of little value in determining the cause which has rounded almost all boulders and detritus, of whatever rock composed.* M. Lariviere relates, that " being at Memel on the Baltic in 1821, when the ice of the river Niemen broke up, he saw a mass of ice thirty feet long which had descended the stream, and had been thrown ashore. In the middle

* It is proper to add, that my friend Lieut. R. B. Smith informs me, that in the primary districts of Southern India, the granite blocks are subject to similar exfoliation from the effects of atmospheric agents, and have all the appearance of having been subjected to aqueous attrition.

of it was a *triangular piece of granite*, about a yard in diameter, resembling in composition the red granite of Finland." "In a late voyage of discovery made in the antarctic regions in 1839, a dark coloured *angular mass of rock* was seen imbedded in an iceberg, drifting along in mid-ocean in lat. 61° S."—*Prin. Geol. p.* 370-379.

These instances are sufficient to show, that modern icebergs are instrumental to the deposition of angular boulders, and that although they also carry large quantities of rounded pebbles and blocks, yet the probability is in favour of these latter having been uplifted from districts previously strewed over with the water-worn detritus of a former epoch; while therefore the true ancient erratics are rounded, the modern iceberg deposits, if composed of fragments recently torn from rocks *in situ* are angular or possessing their sharp edges; it still remains then to account for the rounding of ancient erratics.

It has often been objected, that the transient passage of a body of waters over the land could not have imparted to transported matter, the rounded and often polished surface which its pebbles and boulders exhibit; but there are conditions attending the deposition of ancient erratics, to which due weight does not appear to have been accorded. The sharp and rugged outline almost invariably apparent among members of the primary class, and the curious step-like structure of the trappean rocks, to all of which an igneous origin is now pretty generally assigned, have long since attracted the attention of observers; and controversies have occasionally arisen as to whether molten or fused matter could have assumed the acute and steeple-shaped form of granitic peaks; or whether it ought not rather to have arranged itself over the surface after the manner of modern lavas. The fact, that at the time when primary and plutonic rocks were upheaved, the strata of the earth were horizontal beds beneath the deep enveloping waters of the sea, seems to have been entirely lost sight of, or disregarded in these controversies. If, however, we admit this fact, it must be evident, that when the igneous rocks first burst through the upper strata of the earth, and came in contact with the cold waters of the superincumbent ocean, a sudden cooling and contraction of the heated mass must naturally have ensued, which would have caused the surface to exfoliate and split into fragments of various magnitude, and these fragments yielding to the force of the waters which were thus suddenly displaced, would have been hurried off by the retreating waves to the lower levels. This reasoning seems in some measure to derive support from the facts observable, whenever in modern times an outburst of volcanic matter takes place from beneath the sea; numerous instances are on record of islands suddenly appearing above the waters, but these have almost invariably disappeared again after a short time, from their summits having been swept off in fragments caused by the sudden refrigeration and splitting of the surface, as the heated matter came in contact with the superincumbent ocean. The ruggedness of primary ranges is therefore easily accounted for by the sudden cooling of the surface when in a state of intense heat, and by the immediate denudation attendant on the passage of the tumultuous body of waters displaced by the movement. The step-like appearance of trappean rocks would, in like manner be caused by the sudden refrigeration of surface inducing the rock to split into cuboidal masses, and the denudation of this fractured surface would therefore give the step-like appearance alluded to. This may perhaps be admitted as a satisfactory explanation of the phenomena apparent in these formations, and coupled with the subsequent tumultuous action of the waters on the newly detached fragments may enable us to arrive at some explanation of the reason, why ancient detritus is almost invariably rounded and worn. Had the action of the displaced waters been no greater than that exercised by the transient passage of a flood over the lower lands, doubtless the effects attributable to it would have been insufficient to account for the polishing and rounding of erratics, but we must not be blind to the fact, that a sudden and violent outburst of large tracts of land, or of mountain ranges from beneath the sea, would have given rise to waves which would not only have acted with an intensity of force of which we can perhaps form no just conception, but likewise that their action on the land would have been of long continuance. " The vibration of the sea produced by the great Lisbon earthquake of 1755, threw a wave sixty feet high on the coast of Cadiz, and one eighteen feet in height on the island of Madeira. The area agitated by this earthquake comprised a large portion of the northern hemisphere, yet no very great amount of dislocating effects was observed, at least nothing like the production of a line of elevated land. We may hence form some idea of the effects which would be produced if a line of mountains one hundred miles long, and not above two or three thousand feet high, were suddenly thrust up beneath the waters of the sea. The vibrations produced in the superincumbent fluid would be proportionally great, and the waves rushing over shallows and lowlands, comparatively enormous. We may therefore fairly infer, that greater intensities of force would produce greater waves, while the motion caused in the water over the dislocations, supposing such to be formed, would tend to remove the fragments produced."—*De la Beche's Theor. Geol. pp.* 202-203.

" At Tabahuana, during the earthquake of February 1835, when the sea was observed to retire, so that vessels at anchor in seven fathoms water were aground, and all the rocks and shoals in the bay were visible, an enormous wave was seen forcing its way between the western passage, which separates Quiriquina Island from the main land. This immense wave passed rapidly along the western side of the Bay of Concepçion, sweeping the steep shore of every thing moveable within thirty feet, vertically from the high water mark. It broke over, dashed along, and whirled about the shipping, as if they had been light boats; it overflowed the greater part of the town, and then rushed back with such a torrent, that almost every thing moveable, which the earthquake had not buried, was carried out to sea. In a few minutes, a second wave returned more powerful than the first. After another awful suspense of a few minutes, a third enormous swell was observed approaching, larger than either of the former waves. The island of Juan Fernandez suffered much. Great waves swept the shores of the island, after the sea had retired, so much that old anchors were seen at the bottom of the anchorage."—*Bakewell's Introd. Geol. p.* 43.

" During this earthquake a permanent elevation of the ground of about *nine feet* took place, and the sea rose to the height of from thirty to forty feet, sweeping over a great extent of land, and tearing away the various obstacles opposed to its progress. If we suppose mountains several thousand feet high were elevated by similar causes, the swell of the sea must have been inconceivably overwhelming. Sir James Hall supposes, that the upheaving of a large island, like Sumatra, might take place so suddenly, as to drive the ocean with great impetuosity over the summits of the highest mountains, and strip off the glaciers, and transport them into distant countries. Ice being specifically lighter than water, the glaciers would carry away with them the blocks of stone that had fallen from the impending rocks, and had become incased in ice. This theory of Sir James Hall's would, I conceive, offer a better explanation than any other, for the occurrence of groups of fragments of particular rocks, unmixed with fragments of other rocks. Each glacier, loaded with stones from the rocks above it, may be regarded as a ship freighted with specimens of its native mountains, which it deposits, by thawing in the place where it ultimately rests. Nor would a wave or swell of the sea that had covered the highest mountains, suddenly subside; it would sweep repeatedly over the whole surface of the globe at a lower and lower level each time; breaking down opposing obstacles, opening new passages for the water, and scooping out valleys and cols in the softer beds and strata."—*Bakewell's Introd. Geol. p.* 588.

If then the elevation of land by modern earthquakes to no greater height than nine feet, can produce such violent agitation in the waters of the sea, what might we not expect from that volcanic force which has been instrumental in times past to the upheavement of whole ranges of lofty mountains? It will be evident, that the fragments of rock torn by the united action of sudden cooling, and retiring waters from the uprising mass, would not only have been hurried to the lower lands, and scattered far and wide, but that they would have been rolled backwards and forwards over those plains by the repeated flux and reflux of the debacle, until their edges were completely rounded off, when the final retreat of the waters as equilibrium was restored, would have left the detritus scattered in a decreasing ratio from north to south, precisely as it exists on the continents of the northern hemisphere.

That mountains have been as suddenly upraised as this theory would require, there can be no reason to doubt, from the fact, that the strata are not only often lifted up to a vertical position, but are actually traversed by dibes and beds of igneous rocks, whose former state of fusion is a proof that they must have been rapidly forced upwards; and besides which, it sometimes happens, that fragments of a low-seated rock, have been carried upwards and imbedded in a superior stratum, and it seems quite impossible, that such phenomena could have been produced by a gentle and gradual uprise.

Water, therefore, would appear to have been the agent by which detritus has been accumulated, and its fragments rounded, and the very arrangement of these fragments in a decreasing ratio as to size and quantity as we proceed farther from the parent rock, affords evidence which is at variance with glacial action. "M. Elie de Beaumont has shewn, that in the valley of the Durance, the blocks decrease in volume and become less angular as they recede from the mountains behind Gap, until the transported matter diminished to the pebbles constituting the wide extent of country known as the Crau. Similar facts are also observable down other valleys. Perhaps in the *loess* of the Rhine, we may trace the remains of still finer detritus, which has accumulated to the depth of 200 or 300 feet above the valley, and bears evident marks of sudden transport. The supposition is rendered more probable by the abundance of Alpine pebbles discovered resting on various rocks, where the *loess* ceases in the higher parts of the valley of the Rhine, and which have apparently been accumulated by a sudden rush of water down the valley. The other great accumulation of erratic blocks seems due to some more general cause, since not only are the blocks scattered in great abundance over Northern Europe, in a manner to shew their northern origin, but those which occur in the northern parts of America, apparently in equal abundance, also point to a similar origin. We hence infer, that some cause, situated in the polar regions, has so acted as to produce this dispersion of solid matter over a certain portion of the earth's surface. *We know of no agent capable of causing the effect required, but moving water.* —*De la Beche's Theor. Geol. p.* 389.

With regard to Dr. Buckland's statement, that a glacier once descended from Shap Fells, and crossed the valley of the Eden, it appears to me that the desire to establish the theory, has in great measure led him to overlook the fact, that the physical conformation of the valley altogether militates against his views, and proves them to be erroneous. "It is impossible," says this eminent geologist "to explain satisfactorily the dispersion of the well-known Shap granite boulders, in the valleys which lead down from the Fell northwards, southwards, and easterly, by a great diluvial current, and still more so, their transport from the valley of the Eden over the lofty summits of Stainmore Forest into the valley of the Tees. The glacier theory, he states, offers on the contrary a solution of the difficulties. A glacier descending to the north from Shap Fell, would convey the blocks to the village of Shap, and distribute them throughout the intervening space; another glacier ranging to the south would deposit the boulders on the hills and in the valleys descending by Highborrow Bridge to Kendal; whilst a third glacier proceeding eastwards betwixt Crosby, Ravensworth and Orton, would traverse transversely the upper part of the valley of the Eden near Brough, and accumulate piles of ice against the opposite escarpment, until they overtopped its lowest depressions in Stainmore Forest, and disgorged their moraines into the valleys of the Greta and the Tees."—*Edin. New Phil. Jour. No.* 59, *p* 205.

It may not perhaps be very difficult to show, by the aid of Greenough's beautiful geological map, that it is more probable that water was the agent which produced the above described effects, than glaciers, which latter I trust I have shewn, could not have existed in our island without a far colder climate than the facts of geology authorise us to believe has ever occurred. The difficulty which Dr. Buckland cannot remove, seems to consist almost entirely in the various directions which the boulders have pursued from a given point, namely, Shap Fells. Now as it is not contended that the valleys leading down from the Fell have been scooped out by the action of glaciers, we are left at liberty to conclude, that they had origin before the supposed glaciers which slid through them. The elevation of the Fells, and the existence of valleys leading in various directions from them, prove, that an upheavement has taken place which not only gave rise to the heights, but likewise produced the troughs or valleys between the uprising masses. If at the period of this movement the land was submerged, what other agent would be required to scatter the blocks than the retiring waves as they rushed impetuously down the channels which the valleys formed, and what more natural than that the first violent down rush of the retreating waters should have heaped up detritus "against the opposite escarpment," until it overtopped the depression in Stainmore Forest, and discharged itself over the then rising barrier, into the valleys of the Greta and the Tees? Taking the Fells as the point or chief point of upheavement, it is evident that the divergence of valleys from it as a centre, is natural and necessary, for such is the arrangement in every quarter of the globe where mountains and hills occur; there being always some points of upheavement from which valleys descend and diverge in various directions; so that if the elevated land happens to be detached or isolated, it will necessarily constitute a focus or central point from which valleys and glens will radiate around it. Now such appears to be the arrangement in the locality under consideration, the Fell being the focus from which valleys descend to the north, south and east.

The retiring waters would therefore naturally rush down these valleys, and scatter the erratics and detritus precisely in the direction and order in which they now occur. A wave descending to the north from Shap Fells would convey the blocks to the village of Shap, and distribute them throughout the intervening space; another wave ranging to the south, would deposit the boulders on the then uprising hills and in the valleys descending by Highborrow Bridge to Kendal; whilst a third great wave proceeding eastwards betwixt Crosby, Ravensworth and Orton would traverse transversely the upper part of the valley of the Eden, near Brough, and accumulate piles of detritus against the opposite uprising escarpment, and rushing over the hills of Stainmore Forest, would disgorge itself into the valleys of the Greta and the Tees, which form the drainage of the country. A glance at the accompanying map Plate xxii. will moreover point out, that water is the only agent which could so have acted, for a glacier crossing the valley and encountering the escarpment opposed to its onward passage, would only have accumulated ice along that base *until the lateral pressure caused by the streams in the higher parts of the valley would* *have forced it down towards the embouchure of Eden,* instead of over the ridge. Had the ice melted within the boundary, the water would naturally have followed the drainage of the valley, and have escaped by the Eden, and the detritus would have remained altogether on the outside of the escarpment in a confused heap. On the other hand, a mighty recoil of waters before an uprising mass of land would at once have rushed straight over the escarpment, carrying with it, as above quoted, the fragments of the shattered rocks, and leaving accumulations of the same against the escarpment which was then rising up to intercept the passage. Again, when we consider that the Shap granite boulders are found lying chiefly along the true drainage of the country, it becomes still more probable that water was the agent by which they were dispersed. The northerly course of the boulders by the village of Shap is corroborative of this opinion, for from the very base of the Fells on that side arise numerous minor streams which, lower down, after passing the villages of Shap and Rosgill, unite to form the river Lowther; while still lower this river is joined by the Eamont, and then both turning easterly, are emptied into the river Eden. On the south in the direction of the boulders, the country is drained by the rivers Mint and Ken, which after uniting, pass by Kendal, and are discharged into Morecambe Bay, as is likewise the river Lune, one of whose tributaries appears on Greenough's map to take its rise from Shap Fells. Again on the east, the drainage of the country is effected by many small streams proceeding from a southerly direction, and forming the river Eden whose course is northerly till it joins the Solway Firth. A glacier therefore which descended from the Fells and crossed the valley of the Eden transversely between Crosby, Ravensworth and Orton, must have intercepted the course of all the streams in the upper part of the valley, and caused an accumulation of water, or more probably of ice, which would effectually have stopped the farther uphill progress of glaciers; or rather, at the time when the climate was cold enough to form glaciers on such an inconsiderable elevation as the Fells, it is more probable that every stream descending from the heights of Stainmore Forest must have been frozen likewise, and thus an accumulation of ice would have taken place along the upper portion of the valley of the Eden, which would have formed an enormous glacier, whose course, from the conformation of the country, must necessarily have been along the line of the present river, and would therefore not only have intercepted any glacier from the Fells, but would have turned it down the valley likewise. No accumulation of boulders from Shap Fells could ever therefore have reached the escarpments of Stainmore Forest, much less could a glacier have carried them into the valleys of the Greta and the Tees, and had glaciers ever existed in the neighbourhood of the Fells, the transported matter from that locality should now be lying at the embouchure of the Eden, instead of against and beyond the escarpments of Stainmore Forest.

The only other agent then, that we can produce possessing sufficient power to carry the granite blocks into the valleys of the Greta and the Tees, is evidently water, whose rapid and overwhelming rush to the lower levels as the granite of the Fells was suddenly upheaved, would have carried the disrupted fragments across the valley and the uprising hills, and left them in their present situations as its power of transport decreased and its equilibrium was again established.

It becomes probable, therefore, that neither the agency of icebergs nor of glaciers could have produced the effects apparent upon the surface of the earth, but that such are precisely the phenomena which would have resulted from the action of water, for the boulders and debris so plentifully scattered over the countries of the northern hemisphere shew, that while the debacles caused by the sudden rise of portions of the land were thrown back on all sides towards the south, the blocks and fragments of the shattered surface were deposited according to their own specific gravity, and the decreasing power of the retreating waves to carry them.

Thus erratics would naturally be more numerous in the northern lands, and occur in a decreasing ratio as we travelled southwards, until they ceased altogether, and it is precisely their occurrence in this order which has hitherto led to the inference, that the diluvial currents which deposited them must have passed from north to south.

I do not, however, mean to assert, that glaciers have had no share in the distribution of blocks over those countries where they still exist, because it seems to be well proved, that such glaciers have formerly descended to far greater distances over the lower lands than they do now, and undoubtedly the deposition of many of the blocks observed at considerable distances from the limit of the present Alpine glaciers, is due to the agency of ice. What I would insist upon is, that the numerous boulders termed erratic blocks which lie scattered abroad over the countries of the north, and even in our own Island, *where no glaciers exist*, are not due to the agency of glaciers, but to that of the powerful rush of retreating waters, as the lands of the northern Hemisphere arose from out the ocean, with which they were formerly covered.

Mussooree, 4th March, 1844.

On a method of treating Mineral Sulphurets, especially those of Copper, for the manufacture of Sulphuric Acid, and the extraction of their Metallic Base. By Lieut. THOMAS LATTER, *67th Regiment Bengal Native Infantry. Plate* xxiii.

The following method of treating mineral sulphurets, especially those of copper, having been for some time employed with great success in France, and on account of its simplicity and cheapness, being peculiarly adapted for use among the natives of India, I take an early opportunity of publishing it through the medium of your Journal.

It may be necessary to premise, that this method employed in Lyons for the treatment of sulphurets of copper, was for the primary purpose of manufacturing sulphuric acid, after which, the remaining metallic slag was treated for the copper that it might contain, and ores which were found to yield not more than $1\frac{1}{2}$ per cent. of metal, were thus treated with profit.

The ores are placed in furnaces of a peculiar shape, having a round head, with a narrow neck, fig. 1, front-view ;

fig. 2, side view; *a*, is a little feeding door at the top of the head, just large enough for the purpose of admitting a shovel with fresh supplies of ore; *b*, *b*, *b*, are doors, three on each side, for the purpose of raking out the burnt ore and slag; *c* is the neck about 4 or 5 inches wide—the ore is broken into pieces about $\frac{1}{2}$ or $\frac{1}{4}$ the size of the first, just large enough not to drop through the neck until diminished by burning. For the first time of charging, the furnace is filled from top to bottom with the ore mixed with one-third its quantity of coal or charcoal, and when once well-set a burning, it only requires being regularly fed with *ore*, taking care never to allow the fire to get lower than the neck part; it may thus be kept burning without any fresh supply of fuel whatever for any number of years, the heat and flame of the burning ore being sufficient to set alight the fresh supplies; the height of these furnaces is about $4\frac{1}{2}$ feet high, the head part about $1\frac{1}{2}$ foot, the neck between 4 and 5 inches broad. The length of the furnace is 6 feet, and the size of the three side-doors in proportion.

Eight of these furnaces are placed round a domed reservoir or alembic, to which they are connected by as many pipes; *d*, at the end *opposite* the feeding door *a*, fig. 3, shows a bird's eye view of the 8 furnaces, *e*, *e*, *e*, *e*, *e*, *e*, *e*, *e*, arranged round the domed reservoir, *f*; to which they are connected by the 8 connecting tubes *d*, *d*, *d*, *d*, *d*, *d*, *d*, *d*. Fig. 4 presents the view of 2 furnaces with the domed reservoir, the others being removed for the purpose of showing the action more clearly; *e*, *e*, are the two furnaces; *f*, the domed reservoir; *d*, *d*, the connecting tubes; *g*, an aperture admitting a stream of vapor of water for the purpose of uniting with the sulphurous vapors arising from the combustion of the sulphur in the mineral which enters the domed reservoir *f*, through the pipe *d*, from the head of the furnace *e*; on uniting with the vapor of the water it becomes liquid sulphureous acid, whence it passes through the pipe *h*, (fig. 4,) towards the leaden chamber *l*; but on its way it passes over a quantity of saltpetre placed in the recess *i*, absorbs oxygen therefrom, becomes sulphuric acid, is condensed in the leaden chamber *l*, and afterwards evaporated to the proper strength; *k* is an aperture for the purpose of supplying saltpetre to the receptacle *i*. Thus far for the manufacture of sulphuric acid. I was informed, that when the furnaces were supplied with fresh ore every three hours, and the well-burnt ore extracted every 24 hours, the calculation was, that every three hours you charge these furnaces with 120lbs. of metal, and every 24 hours extract 800lbs. of roasted ore.

This roasted ore is then placed on a platform of masonry, *m*, fig. 5, and is kept continually soaked with water acidulated with sulphuric acid. This platform should have a tilt down towards one corner, so as to permit the water to percolate, and to pass charged with the sulphates through one angle into the reservoir *n*. In proportion to the heat of the weather will be the rapidity with which the diluted sulphuric acid will take up the soluble matter in the ore—a mixture of alumina, peroxide of iron, and silica, &c. will remain behind, and the water will pass overcharged with the sulphates as of copper, iron, arsenic, &c. according to the composition of the mineral. When arrived in the reservoir *n*, it is pumped up into another reservoir *o*, from whence it is allowed to descend unto the baths *p*, *p*, *p*; in these baths are placed pieces of iron, and as the water charged with acidulated sulphate of copper passes over this iron, the coppper will be precipitated; these baths empty into one another by the assistance of syphons *q*, *q*, *q*, so arranged, that they may play of themselves. Fig. 6 is a bird's eye view of fig. 5, shewing the arrangement of the baths, the same letters correspond to those in fig. 5. These baths may be as numerous as necessary, the water with the sulphate of copper being kept continually running over these successive deposits of iron, precipitates all its copper, and passes off in a state of sulphate of iron ; of course the first bath will be the one that will first present a deposition of chemically pure metallic copper in a state of powder, when such is the case, it should be cleaned out, and fresh iron put in. When the next bath is in the same state, the same thing should be done to it, and so one with the rest.

The ore in the platform need not be thoroughly cleaned away more than once in two or three months. It is necessary to remark, that at the bottom of the domed reservoir, there is always a small quantity of water to permit of the absorption of any arsenical or other vapor.

Note.—The simple plan here proposed of working the sulphurets of copper, would, we conceive, be applicable in a most particular manner to the Kemaon copper mines. These mines are now a very trifling source of revenue, but might be rendered, by the introduction of this method of treating the ore, of very great national importance. Sulphuric Acid, one of the products, is an article which we only require to obtain in India at a cheap rate, in order to give rise to numerous chemical manufactures of which it is the basis, as, for instance, the whole of the manufactured medicines.—J. M.

THE

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OF

NATURAL HISTORY.

The Palms of British East India. *By* W. Griffith, *Esq. F. L. S. Memb. Imp. Acad. Natur. Curios., Royal Ratisb. Botan. Soc., Corr. Memb. Hortic. Socy. of London, Asst. Surgeon, Madras Establishment.*

[Continued from page 103.]

Sub-familia.—CORYPHINÆ. *Mart. Palm. p.* 231.

Flores hermaphroditi, rarius polygami, rarius dioici. *Ovaria* 3, discreta aut partim cohærentia. *Fructus* drupaceus vel baccatus, monospermus, ovario unico plerumque tantum maturato. *Albumen* corneum, æquabile vel centro-cavum, vel processu tegumentorum intrante excavatum vel exaratum. *Embryo* sæpius dorsalis, rarissime subbasilaris.

Palmæ *perennantes vel monocarpicæ, frutescentes vel arboreæ.* Folia *sæpissime flabelliformia, raro pinnata.* Inflorescentia *axillaris, raro terminalis.* Spathæ *plures incompletæ, vaginantes, rarius una completa*; *secondariæ plerumque deficientes.*

Sect. I.—Folia Flabelliformia.

Corypha.—*Monocarpicæ,* arboreæ, terminifloræ. Folia palmatim partita, flabelliformia. *Spathæ secondariæ et tertiariae tot quot rami spadicis.* Flores hermaphroditi, glomerulati. Corolla tripetala. Bacca sub-exsucca. ***Albumen centro-cavum vel solidum. Embryo verticalis.***

Livistona.—Perennes, arboreæ, axillifloræ. Folia palmatim partita, flabelliformia. Flores hermaphroditi, glomerulati. Corolla tripartita. Drupa. ***Albumen processu intrante excavatum.*** Embryo dorsalis.

Licuala.—Perennes, frutescentes, axilliforæ. ***Folia pinnatim flabelliformia.*** Flores hermaphroditi, solitarii, binati vel ternati? tribracteati. Corolla tripartita. ***Filamenta in annulum faucinum sæpissime coalita.*** Drupa, etc. præcedentis.

Chamærops.—Perennes, frutescentes vel arboreæ, axillifloræ. Folia palmatim-partita, flabelliformia. ***Flores polygami.*** Corolla tripetala. Bacca. ***Semen longitudinaliter sulcatum.*** Embryo dorsalis.

Sect. II.—Folia Pinnata.

Phœnix.

Sub-family.—CORYPHINÆ.

Flowers hermaphrodite, seldom polygamous, rarely diœcious. Ovaria three, distinct or partly cohering. Fruit a berry or a drupe, generally solitary, one ovarium only being matured, 1 seeded. Albumen horny, equal, solid or hollow in the centre, or excavated on the surface, or subruminate. Embryo dorsal.

Leaves fan-shaped.

Palmately divided. ..	Large trees flowering only once. Inflorescence terminal; secondary and tertiary spathes many. Flowers hermaphrodite, several together. Corolla three petalled. Stamens hypogynous. Berry almost juiceless. Albumen hollow in the middle or solid. Embryo near the apex.	Corypha.
	Perennial trees. Inflorescence axillary. Flowers hermaphrodite, several together. Corolla tripartite. Stamens perigynous. Fruit a drupe. Albumen with a cavity communicating exteriorly and filled with the integuments. Embryo about the middle of the dorsal face. ..	Livistona.
	Perennial. Inflorescence axillary. Flowers polygamous, several together. Corolla tripartite. Stamens hypogynous. Fruit a berry. Seed with a longitudinal furrow.	Chamærops.

Pinnately divided. ..	Perennial. Inflorescence axillary. Flowers hermaphrodite, solitary, or two or three together. Corolla tripartite. Stamens perigynous : filaments at the faux combined into an annulus. Fruit as in Livistona.	LICUALA.
LEAVES PINNATE.	....	PHÆNIX.

SECT. I.

Folia flabelliformia. *Flores* hermaphroditi, rarius polygami. *Spathæ* plures incompletæ. *Corolla* valvata. *Stamina* 6, sæpius perigyna. *Styli* connati. *Drupa* rarius *bacca*. *Semen* superficie læviusculum, vel (in Chamæropide) verticaliter sulcatum. *Albumen* centro-cavum, vel processu intrante excavatum, vel (in Chamæropide) exaratum, interdum sub-ruminatum.

Palmæ *frutescentes vel arboreæ, perennantes vel monocarpicæ, in umbrosis humidisque vigentes.* Folia *palmatim vel* (in Licuala) *pinnatim flabelliformia, interdum maxima, plicata, laciniis ut plurimum bifidis :* petioli *inermes vel sæpius secus margines aculeati.* Spadices *perennantium axillares, monocarpicarum terminales, maximae.* Spathæ *plures, incompletae, vaginantes.* Flores *sessiles, solitarii vel sæpe glomerulati, sæpe obscure* 1-*bracteati.* Stamina *in tripetalis libera, hypogyna, in reliquis perigyna, filamentis sæpe in annulum faucinum coalitis.* Antheræ *versatiles.* Ovarium *sæpius vertice exsculptum.* Baccæ drupæve *olivaceæ, rubræ vel cyaneæ.*

Incolæ Americæ tropicæ, Australiæ, et Asiæ præsertim ultragangeticæ et archipelagicæ. Species una Mediterranea, altera Affghanensis. Limes borealis specierum indicarum 30-31 grad. alt. supra mare 1,000—1,500 pedum.

USUS.—Foliorum pinnis exsiccatis inscribere solent indigenæ.

CORYPHA.

Linn. (*Mus. Cliff.* 11.) *Gen. Pl. ed.* 6*ta. p.* 572. *No.* 1221. *ed. Schreber. p.* 774. *No.* 1690. *Syst. Pl. ed. Schult.* 7. *p.* lxxviii. *No.* 1493. *Juss. Gen. p.* 39. (partim.) *Gærtn.*

Fruct. et. Sem. 1. *p.* 18. *t.* 7. (semine inverso.) *Lam. Enc. Meth. t.* 899. (e Rheede et Gærtner.) *R. Br. Pr. Fl. Nov. Holl. ed. 2da. p.* 123. *Roxb. Fl. Ind.* 2. *p.* 174. *Icones.* 7. *t.* 37. *Suppt.* 3. *t.* 80. *Mart. Progr. p.* 10. (partim.) *Palmæ.* 231. *Endl. Gen. p.* 252. *No.* 1753.

Codda-Pana. *Rheed. Hort. Mal.* 3. *p.* 1. *t.* 1-12.

Taliera. *Mart. Progr. p.* 10. *Syst. Pl. ed. Schult.* 7. *p.* lxxviii. *No.* 1492.

Gembanga. *Blume. in Bot. Zeit.* (1825.) 2. *p.* 580. *et* 678. (e Martio.)

Char. Gen.—*Flores* hermaphroditi. *Calyx* tridentatus. *Corolla* tripetala. *Stamina* 6, hypogyna, filamentis basi distinctis. *Ovaria* 3, cohærentia. *Styli* connati. *Fructus* (unicus sæpius maturescens) baccatus, monospermus. *Albumen* corneum, centro-cavum (unius solidum.) *Embryo* versus apicem albuminis.

Habitus.—Palmæ *asiaticæ arboreæ, proceræ, monocarpicæ.* Truncus *annulatus vel spiraliter sulcatus.* Corona *maxima, ampla.* Petiolorum *margines aculeati.* Rete *O.* Lamina *palmatim multipartita, laciniis apice bilobis.* Inflorescentia *terminalis, amplissima.* Spathæ *primariæ et secondariæ plurimæ.* Flores *glomerulati, breve pedicellati, flavescentes.* Fructus *olivacei seu flavescentes.*

Affinitas proxima cum Livistona (confer R. Br. Prod. p. 123, adnot.) Discrimina majora constant in vita monocarpica, inflorescentia terminali et spathis secondariis.

50. (1) C. *elata*, trunco spiraliter sulcato, petiolis spiraliter dispositis exauriculatis, lamina (petiolo breviore) plana, laciniis 85-90 profundis lineari-ensiformibus obtuse bilobis posticis cum petiolo angulum acutum efformantibus, glomerulis florum distantibus, petalis lanceolatis, fructibus sclopeti globuli magnitudine, embryone versus apicem albuminis solidi.

C. elata, *Roxb. Fl. Ind.* 2, *p.* 176. *Icones Suppt* 3. *t.* 80. *Mart. Palm. p.* 233.

Hab.—Bengal, flowering in March and April: the seeds require about 12 months to ripen. *Bujoor* or *Bujur-batool*, Beng. (*Roxb.*) Cultivated in the Botanic and some other Gardens about Calcutta. I have not seen it in flower or fruit.

Descr.—" *Trunk* straight, but often varying in thickness. I have two trees, which were pretty well ascertained to be about thirty years old when in flower; one was seventy feet to the base of the inflorescence, the other about sixty; circumference near the root eight feet, and about the middle of the trees five and a half or six: their whole length strongly marked with rough, dark coloured, spiral ridges, and furrows, which plainly point out the spiral arrangement of the leaves. The ligneous fibres, as in the order, are on the outside, forming a tube for the soft spongy substance within, of dark chocolate colour, tough and hard, but by no means equal, in either quantity or quality, to the very serviceable wood of *Borassus flabelliformis*.

Leaves round the top of the trunk, immediately under the base of the inflorescence, numerous, palmate pinnatifid, plaited, from eight to ten feet each way; *segments* generally from forty to fifty pair, united about half their length, ensiform, apices rather obtuse and bifid, texture hard, smooth on both sides. When the tree begins to blossom, the leaves wither and soon fall off, leaving the fructiferous part naked. *Petioles (stipes)* from six to twelve feet long, concave above, with the thin, hard, black margins thereof cut into numerous, very short, curved spines. *Spathes* numerous, there being one at each joint of the various ramifications of the spadix, all smooth and when recent, of a pale yellowish green. *Inflorescence*, (spadix) terminal; it may be called an immense, more than supra-decompound, round panicle; in this species it is of a much smaller span than the leaves, and only about one-fourth or one-fifth part of the whole height of the tree; the various and innumerable ramifications are always alternate, smooth and of a pale yellow colour.

Flowers small, sessile, collected in little bundles over the ultimate divisions of the panicle, pale yellow, small, rather offensive. *Calyx* small, 3-toothed. *Petals* three, oblong, reflexed, shorter than the stamina. *Filaments* six, broad at the base, and there united, toward the apex slender and incurved. *Anthers* ovate. *Germ* superior, round-ovate, 3-lobed, 3-celled, with one *ovulum* in each, attached to the bottom of its cell. *Style* short, 3-grooved. *Stigma* 3-lobed. *Berry* globular, the size of a musket ball, olive-coloured, smooth when fresh, but it soon becomes dry and wrinkled, 1-celled; the two abortive lobes of the germ are always to be found at the base. *Seed* solitary, subglobular. *Integuments* apparently two, but they are firmly united, and of a friable texture; the *exterior* one pale yellowish brown, and veined; the *interior* one brown, and adhering firmly to the perisperm. *Perisperm* conform to the seed, of a hard, horny texture, and a pale gray colour. *Embryo* simple, short, cylindric, lodged near the apex of the perisperm." *(Roxb. o. c. l. c.)*

To this I have to add that the petioles are much more slender than in the other species, their sides marked with oblique furrows, corresponding with the teeth, which are very large. They separate a little above the base: this afterwards becomes longitudinally split, and long afterwards falls off. The lamina describes nearly a complete circle; length 5-6 feet, breadth 15 feet; the posterior pinnæ do not meet, much less overlap. Laciniæ about 85, linear-ensiform, much narrower than in the others: the central are about 3 feet long, the lateral and intermediate about $3\frac{1}{2}$ feet; the posticous ones towards the base present denticulate margins.

This Palm will be at once recognised by its black spirally marked trunk. From the other species of Corypha it is abundantly distinct by its long, obviously spirally placed, exauriculate petioles, and by the smaller, dark green, flat lamina with narrow, linear-ensiform segments. The fruit is also smaller.

According to Roxburgh's drawing, the inflorescence of this is so dense that no part of the spadix or spathes is visible, and the outline is irregularly pyramidal, some of the branches being much larger than others.

52. (2) C. *Talliera*, trunco obsolete annulato, petiolis biauriculatis, lamina (petiolum excedente) glaucescente a medio supra conduplicata, laciniis 80-90 ensiformibus bilobis posticis incumbentibus, glomerulis florum approximatis, petalis oblongis æstivatione imbricatis, fructibus pomi minoris magnitudine rugosis, embryone in apice albuminis centro cavi.

C. Talliera, *Roxb. Cor. Pl.* 3. *p.* 51. *t.* 255-256. (auct. Mart.) *Icones* 7. *t.* 37. *Fl. Ind.* 2. *p.* 174. *Mart. Palmæ. p.* 231. Taliera benghalensis. *Spreng. Syst.* 2. *p.* 18. Taliera Tali. *Mart. Syst. veg. ed. Schult.* 7. *p.* 1306.

Hab.—Bengal, scarce in the vicinity of Calcutta. Flowers at the beginning of the hot season, seeds ripen 9 or 10 months afterwards. *Tara*, *Tallier*, *Tareet*, Beng. (Roxb.) Cultivated in the Botanic Gardens. I have not seen the flowers or fruit.

Descr.—" *Trunk* perfectly straight, about thirty feet high, and as near as the eye can judge equally thick throughout, of a dark brown colour, and somewhat rough with the marks left by the impression of the fallen leaves. *Leaves* palmate-pinnatifid, plaited, subrotund. *Leaflets* or divisions of the frond united rather more than half way, numerous, generally about eighty, (or forty pairs,) linear-lanceolate, pointed until broken by the wind, or otherwise, polished on both sides, with a strong somewhat four-sided rib running their whole length ; generally about six feet long, greatest breadth about four inches. The thread which forms part of the *Linnæan specific character* of *Corypha umbraculifera*, is sometimes present, sometimes wanting, at best such perishable marks deserve no notice. *Petioles* from five to ten feet long, remarkably strong, upper side deeply channelled, the sharp margins armed with numerous, short, strong, dark-coloured polished, compressed spines. *Spathes* just as numerous as the primary and secondary ramifications in the spadix, all smooth, and obtuse. *Spadix* supra-decompound, issuing in the month of February from the apex of the tree, and centre of the leaves, forming an immense, diffuse, ovate panicle, of about twenty or more feet in height, so that the height of the whole tree, from the ground to the top of the spadix is now about fifty feet. Primary branches alternate, round, spreading nearly horizontally with their apices ascending. Secondary ramifications alternate, bifarious, compressed, drooping, recurved, soon dividing into numerous, variously curved, smaller, subcylindric, branchlets covered with innumerable, small white, odorous, subsessile flowers. *Calyx ; perianth* inferior, minute, obscurely 3-toothed. *Petals* three, oblong, concave, fleshy, smooth, expanding, many times larger than the perianth. No nectary. *Filaments* six, nearly of the length of the petals, at the base broad, and in some measure united. *Anthers* ovate. *Germ* 3-lobed, 3-celled with the embryo of a distinct seed in each, attached to the bottom of its cell. *Style* shorter than the stamina. *Stigma* simple. *Berries* from one to three conjoined, though one is the most common, and then the rudiments of the other two are present, they are singly quite round, about the size of a crab-apple, when ripe, wrinkled, and of a dark olive, or greenish yellow colour. The pulp is but in small proportion, and yellow when the fruit is ripe. *Seed* solitary, round, attached to the base of the berry, of a white colour, and horny substance, with a small vacuum in the centre. *Embryo* lodged in the apex, which circumstance alone, is sufficient to distinguish it from *Gœrtner's Corypha umbraculifera.*

The leaves of this tree are employed by the natives to write on with their pointed steel bodkins, and also to tie the rafters of their houses, for they are said to be strong and durable. I do not find that the wood is applied to any useful purpose." *(Roxb. o. c. l. c.)*

This species is so closely allied to C. umbraculifera, as to be difficult to distinguish when out of flower. The Garden specimens are distinguishable by the lamina of the leaf of this species being conduplicate from the middle upwards, and by the posticous segments overlapping, so that the whole becomes peltate.

The leaves are very like those of Borassus flabelliformis, but much larger. The petioles are bi-auriculate and without an obvious spiral arrangement, they separate at the top of the dilated part, and subsequently fall off leaving a smooth trunk. The lamina is 5-6 ft. long, 15 ft. broad, glaucescent; the segments 90-95, deeper and broader than in C. umbraculifera, the central being 3-3½ feet long.

Roxburgh's drawing represents the inflorescence as conical pyramidal, longer than the crown of leaves, open so that the spathes and branches are seen distinctly, and these last as regularly diminishing upwards.*

53. (3) C. *umbraculifera,* trunco annulato, petiolis exauriculatis, lamina (petiolum subæquante) a medio supra conduplicata, laciniis 90-100 parum profundis ensiformibus bilobis posticis cum petiolo angulum acutum exhibentibus, glomerulis florum approximatis, fructibus pomi minoris magnitudine et forma, embryone in apice albuminis centro cavi.

C. umbraculifera, *Linn. Spec. Pl. ed. 2da. p.* 1657. *Fl. Zeyl. p.* 187. (excl. syn. Rumphii.) *Gærtn. Fruct. et. Sem.* 1. *p.* 18. *t.* 7. sem. inverso (excl. syn. Rumphii.) *Willd. Sp. Pl.* 2. *p.* 201. *Spreng. Syst. Veg.* 2. *p.* 138. *Lam. Enc. Meth.* 899. (e Rheede et Gærtner.) *Syst. Veg. ed. Schultes.* 7. *p.*

* I subjoin descriptions of flowers and fruit from Garden specimens with the name C. umbraculifera, but which I believe to belong here.

Flower-bearing branches often dichotomous above the mouths of their spathes, about 2 inches long. *Flowers* several together, on short stout subannulate stalks, among the bases of which small scales may be found. *Calyx* short, cup-shaped, with three very rounded teeth. *Corolla* 3-times longer than the calyx, petals oblong, concave, very spreading in bud, imbricate! *Stamina* 6; *filaments* stout subulate, about as long as the petals, those opposite the petals being twice as broad; *anthers* oblong-ovate. *Ovarium* globose turbinate, 3-lobed, each lobe with 3 depressed areolæ on its vertex. *Style* about as long, stout, subulate, 3-furrowed. *Stigma* subsimple. *Ovula* solitary, erect, anatropous.

Fruit globose, substance excepting the cutis rather thick, homogeneous, fleshy, cellular. *Seed* erect, oblong roundish; tegument externally cellular, coriaceous, internally blackish, subosseous, adhering firmly to the very dense, hollow in the centre, horny *albumen.* *Embryo* situated rather obliquely in the apex of the albumen, the cavity containing it communicating with the central cavity of the albumen.

1308. *Roxb. Fl. Ind. 2. p.* 177. *Mart. Palm. p.* 232. Codda Pana. *Rheede. Hort. Mal. 3 t.* 1-12.

Hab.—Ceylon, Malabar Coast. *Tala* or *Talagas.* Cinghalese. *Condapari.* Tamul. (*Roxb.*) *Codda-Pana.* Malabar. (*Rheede.*) *Tallipot Palm.* I have not seen it in flower or fruit.

Descr.—Habit very much like that of C. Talliera. *Leaves* larger than those of C. Talliera; in native places immense. *Petioles* stout, 7-feet long, channelled, margins with horny, irregular, often paired teeth. *Lamina* describing nearly a complete circle, 6 feet long, 13 feet broad, from the middle upwards conduplicate, but not so much so as in C. Talliera; laciniæ 95-100, ensiform, obtusely bifid, the central ones $1\frac{1}{4}$ foot long, the intermediate ones $1\frac{3}{4}$, the posticous not meeting or overlapping, but forming acute angles with the petiole. *Inflorescence* much the same as in C. Talliera.

I have specimens of part of the inflorescence, from trees round some of the pagodas at Mergui, most probably belonging to this species. I subjoin a description.

Descr.—*Flower-bearing branches* 18-20 inches long, lower divisions bi-trichotomous, the rest simple; these are about a foot long, subulate, covered with warty protuberances (the situations of the flowers.)

Flowers several together on short subannular stalks, at the base of which small scales exist. *Calyx* cup-shaped, small, with three very short teeth. *Petals* broader, spreading, 3-4 times longer than the calyx: subvalvate in æstivation, upper edges quite so. *Stamina* 6; *filaments* rather shorter than the petals, about equal, stout, subulate; *anthers* oblong, ovate in bud, much larger than those of C. Talliera. *Ovarium* conical from a round base, three-lobed, attenuated into a stout subulate three-furrowed *style*, which is rather longer than the ovarium. *Stigma* simple. *Ovula* solitary, erect.

I have no means of ascertaining to what species these specimens really belong, not having access to a complete copy of

Martius' Palms, where the necessarily minute examination can only be expected; but probability is in favour of their belonging to C. umbraculifera. If this is the case, the æstivation of the corolla, and shape of the ovarium will assist the specific distinction.

LICUALA.

Rumph. Hb. Amb. 1. *p.* 44. *t.* 9. *Thunb. Nov. gen. p.* 70. *Linn. Gen. Pl. ed. Schreb.* 2. *p.* 774. *ed. Spreng. p.* 149. *No.* 1300. *Jussieu. Gen. Pl. p.* 39. *Gærtner. Sem. et. Fruct.* 2. *p.* 268. *t.* 139. *Syst. Veg. ed. Sch.* 7. *p.* 77. *No.* 1490. *Roxb. Fl. Ind.* 2. *p.* 179. *Icones. Suppt.* 3. *t.* 79. *Mart. Progr. p.* 9. *No.* IV. *Palmæ. p.* 234. *t.* 134, 135, 162. *Endl. Gen. Pl. p.* 252. *No.* 1755.

Char. Gen.—*Flores* hermaphroditi. *Perianthium* utrumque tripartitum. *Stamina* 6, filamentis (a corolla liberifactis) in annumul sæpissime coalitis. *Drupa* (unica maturescens) monosperma. *Albumen* cavitate ventrali. *Embryo* dorsalis.

Habitus.—Palmæ *Asiae orientalis et archipelagicae incolae, frutescentes, interdum subacaules.* Caulis *ut plurimum annulatus, interdum basibus petiolorum persistentibus induratis exasperatus.* Folia *pinnato-flabelliformia*; petioli *sæpissime secus margines aculeis corneis conicis saepius aduncis armati;* pinnæ *cuneiformes, apice plus minus truncatae, lobatae, lobis bifidis.* Spadix (*initio siliquaeformis*) *spicatim vel paniculatim ramosus.* Spathæ *tubulosae, ore obliquo bilobo.* Flores *solitarii, bini vel terni, saepe extus pubescentes.* Ovarium *vertice exsculptum.* Carpidia *apicibus cohaerentia.* Drupæ *miniatae vel rubrae.*

54. (1) L. *spinosa,* trunco 8-12-pedali annulato vel aspero, petiolis per totam longitudinem armatis, lamina orbiculari-reniformi, pinnis sub 18, lateralibus oblique præmorsis 3-4-lobis obtuse bipartitis, terminali 10-11-lobo, intermediis 3-5-lobis

lobis obtuse bifidis, spadice foliorum circiter longitudine, ramis 3-7 spicigeris, spicis subulatis pubescentibus, floribus bi-ternatis extus pubescentibus, calyce ovato ad medium rotundate tripartito, bacca obovato-oblonga.

Licuala spinosa, *Willd. 2. p.* 201. (excl. syn. Rumph.) *Roxb. Fl. Ind. 2. p.* 181.? (excl. syn. Rumph. et Lam.) *Syst. Veg. ed. Sch. 2. p.* 1301. *Mart. Palm. p. 235. t.* 135. I. II.

HAB.—Common in wet places, particularly in hedges, Malacca. Malayan name, *Plass.* Cultivated in the H. C. Botanic Garden, where it flowers in the cold and ripens its fruit in the hot season.

DESCR.—A stout Palm, 10-12 feet high, forming dense tufts. *Trunk* 2-4 inches in diameter, 8-10 feet high, marked with the scars of the fallen petioles. *Leaves* 6-7 feet long. *Petiole* about 4-4½ feet long, obtusely trigonal, margins armed throughout with stout conical somewhat curved aculei. *Lamina* in outline orbicularly reniform, about 4 feet across the broad diameter; pinnæ about 18, narrow cuneate; central ones about 2 feet long; terminal one 10-11 plicate, truncate, with as many lobes as plaits, the lateral ones the deepest, all obtusely bifid; the intermediate more or less truncate, 3-5 lobed, lobes larger and deeper, but otherwise similar to those of the terminal one, the lateral with oblique 3-lobed ends. *Ligula* very narrow, 1-1½ inch long, scarious.

Spadix a little longer than the leaves, branches 7-10, adnate to the axis as high as the points of the spathes. *Spathes* green, sprinkled with brownish scurf, with scarious lacerated ends, occasionally obliquely lacerated. *Spikes* to the lower branches several, stout, subulate, downy, spreading, generally secund.

Flowers sessile, in two's or three's, small, nearly ovate. *Calyx* subovate, divided to the middle into three rounded teeth. *Corolla* a little longer than the calyx, divided below the middle into three broad lanceolate, acuminate segments. *Annulus* rather high, nearly entire. *Filaments* (free,) short, setaceous. *Anthers* oblong-ovate. *Ovarium* depressed, turbinate, sculptured at the apex. *Style* filiform, rather longer than the ovary.

Fruit as though stalked by the cylindrical tube of the calyx, surrounded at the base by the perianth, oblong, red, one-seeded. *Seed* ovate, intrant process curved towards the middle of the dorsum. *Albumen* horny, on a transverse section horse-shoe-shaped. *Embryo* about central.

This species appears to vary a good deal; it is not improbable that two species lurk under this name. Some of my Malacca specimens have the trunk armed with the hardened bases of the petioles, slenderer spadices and considerably smaller fruit.

It approaches in the leaves to L. peltata, especially in the division of the ends of the pinnæ, but it is otherwise obviously distinct; it is the only species I know that forms tufts. Its nearest affinity is with L. paludosa.

Rumph's figure* (Hb. Amb. 1. t. 9.) quoted for this appears to me to be a distinct species, particularly as regards the spathes and the erect simple spikes.

55. (2) L. *paludosa*, (n. sp.) trunco sub-lævi 8-12-pedali, petiolis apice inermibus, lamina flabelliformi, pinnis 7-9, lateralibus apice obliquis profunde et acute 3-4 lobis, lobis bipartitis, reliquis truncatis lobis 4-5, (vel terminali 7-8) latis brevibus bifidis, spadice foliorum circiter longitudine, ramis spicas plures nutantes secundas gerentibus, floribus glabris solitariis turbinatis, calyce cyathiformi integriusculo corolla sub-duplo breviore, ovario depresso-turbinato.

Hab.—Low sandy wet places along the sea-coast, about Tanjong Cling, Koondoor, and Pulo Bissar, Malacca; associated with Pandanus, Eugenia, Diospyros, Helospora, etc. In flower February, 1842.

Descr.—*Trunk* 8-12 feet high, about 1½ inch in diameter, unarmed and almost without marks of annuli, except towards the apex

* See Mart. Palm. p. 236. adnot. where the name L. Rumphii is proposed for this species.

where they are incomplete. *Crown* moderate. *Rete* of rather stout, rich brown fibres. *Ligula* linear, one inch long, gradually attenuate towards the apex. *Petiole* $1\frac{1}{4}$-$1\frac{1}{2}$ foot long, subtrigonal, armed along the margins, except towards the apex, with small, black, horny, conical, curved teeth. *Lamina* flabelliform, rather smaller than that of L. spinosa; *pinnæ* 8-10, cuneate, lateral ones oblique at the apex, deeply and acutely 3-4 lobed, lobes bilobed (except the side ones,) the others more or less truncate with 4, (or as in the terminal 5-8,) broad, short, bifid lobes.

Spadix about the same length as the leaves, rather curved. *Spathes* tubular, green, with membranous or scarious lacerated mouths. *Branches* of the spadix bearing 5-7 spikes, which are 4-6 inches long, curved, secund, generally nodding, slightly puberulous, often appearing as if they arose separately from within the mouth of the spathe.

Flowers solitary, sessile, of a turbinate form, smaller than usual. *Calyx* cup-shaped, half the length of the corolla, nearly entire, irregularly split at the expansion of the flower. *Corolla* (in bud) urceolate, about one-third longer than the calyx, divided to the middle into three, cordate ovate segments. *Annulus* of the *stamina* white, nearly entire, projecting considerably above the faux of the corolla. *Filaments* (free) short, setiform. *Anthers* versatile, oblong, pale brown. *Ovarium* depressed, turbinate, with a horny sculptured vertex; carpels adhering by the style. *Ovula* solitary, erect, anatropous. *Style* subulate, rather shorter than the ovarium. *Stigma* simple. *Fruit* not seen.

This species approaches to L. spinosa, but is abundantly distinct by its smooth stem, which does not look much like the stem of a palm, and by the short smooth turbinate flowers.

The tracts of country in which it is found, form one of the peculiar marks of the Straits' Flora, and are highly contrasted with the muddy littoral tracts, which are covered as usual with Mangrove jungle.

56. (3) L. *peltata*, trunco robusto 3-4 pedali, petiolis per totam longitudinem armatis, lamina orbiculari-peltata, pinnis

18-20, lateralibus apice obliquis profunde et acute 3-5 lobis, lobis bipartitis, reliquis truncatis plurilobatis, lobis obtuse bifidis, spadice foliorum circiter longitudine, spicis simplicibus pendulis secundis pubescentibus, floribus solitariis (maximis) extus pubescentibus, annulo staminum nullo, ovario depresso turbinato stylo triplo breviore, bacca obovata, processu intrante sursum latissima obliqua, embryone infra medium seminis.

Licuala peltata. *Roxb. Fl. Ind. 2. p.* 179. *Icones. Suppt. 3. t.* 79. *Hamilton Comm. Herb. Amb. in Mem. Wern. Soc. 5. p.* 313. *Mart. Palm. p. 234. t.* 162.

HAB.—Woody mountainous country to the eastward of and near Chittagong, *Roxburgh;* Mountains beyond the Ganges; Rungpore, *Buchanan;* Assam, *Major Jenkins;* Himalayan range, below Darjeeling, *Seharunpore Collectors.* Cultivated in H. C. Bot. Gardens, flowering in the cold season, fruiting in the hot season. *Kurup, Kurkuti.* Bengally. *Chattah Pat.* Assamese.

DESCR.*—A low Palm, with a stout stem 3-4 feet high, marked below with the scars of the fallen leaves, above rough from the persistent bases of the petioles. *Leaves* 8-10 feet long. *Rete* copious. *Petiole* 6-7 feet long, triangular, armed throughout along the margins, especially towards the base, with stout, horny, black, very sharp, conical, rather curved thorns. *Ligula* cordate, when young the margin is very elevated and tomentose. *Lamina* peltate; *pinnæ* about 18-20, describing nearly a circle of about 6 feet in diameter, about 3 feet 3 inches long, outermost ones cuneate-oblong, 3-5 plaited, 3-5 lobed, lobes acutely bilobed, with oblique ends; intermediate and terminal much broader, 7-8 inches across, truncate, with several plaits and as many less deep, broader, rather obtuse, bifid lobes.

* From plants in the Botanic Gardens. Entire specimens since received from Major Jenkins have the stem 3½-4 feet high, rough from the persistent, distant bases of the petioles; the leaves 12-14 feet in length; the petioles 8-9 feet and armed throughout. The spadices equal the leaves.

Spadix erect, rather longer than the leaves, stout, simply branched, sprinkled in the upper parts with brown scurf. *Spathes* tubular, green, lower ones a foot or nearly two feet long, bilobed at the apex, at length variously split, similarly scurfy. *Spikes* 3-5, solitary, nodding-pendulous, secund, centrifugally developed, a foot (or more) long, pubescent, adnate to the axis to about the middle of the spathe.

Flowers numerous, on short stalks, solitary, very large, 7 lines long, of a greenish white-colour, covered externally with the same pubescence as the spike, opening centrifugally. *Calyx* with a funnel-shaped or obconical tube, shortly 3-toothed. *Corolla* twice as long as the calyx, divided to the calyx into three broadly lanceolate, coriaceous, reflexed segments. *Filaments* united among each other and to the corolla as far as the base of its segments, thence free, long, stout, plano-subulate, keeled along the back. *Anthers* linear, sagittate, exserted, attached near the middle; otherwise the cells are nearly distinct.

Ovarium turbinate, short, with a sculptured depressed apex; carpels cohering by their apices. *Ovula* solitary, erect, anatropous. *Style* filiform, slender, three times longer than the ovarium. *Stigma* obsoletely 3-toothed, on a level with the anthers.

Fruit obovate, oblong, attenuate to the base, red, 1-seeded, apiculate by base of style, and crowned with the 2 abortive carpels, surrounded at the base by the perianth, the tube of the calyx resembling a short pedicel. *Seed* oblong; excavation passing in above the hilum, oblique, reaching nearly to the apex of the seed, dilated upwards. *Albumen* horny. *Embryo* below the middle.

This, which is the largest and finest species of the genus, is not likely to be confounded with any other. Its large peltate orbicular leaves, simple large pendulous spikes, and comparatively very large flowers, will at once distinguish it. In the leaves it is allied to L. longipes, but that species is almost stemless, the leaves are also dark green, and differently lobed. Martius's figure of the entire plant gives a much better idea of L. spinosa than of this species.

Major Jenkins informs me, "the leaves of the Chattah Pat are used for the same purposes as those of the Toko, but are much coarser, and only made use of by the lower orders. The demand for them is very great, scarcely a single ploughman, cow-keeper or cooly but has his Jhapee or Chattah made of Chattah Pat."

57. (4) L. *acutifida*, trunco gracili, foliis flabelliformibus, pinnis 15-20 subæquilatis anguste cuneatis tricarinatis, lateralibus apice obliquis inæqualiter 3-4-lobis, terminali 4-5-lobo, intermediis trilobis lobulis (lateralibus exceptis) bipartitis sinubus acutis, spadice folia subæquante cum spicis floribusque fusco-pubescenti-hirto, ramis simplicibus vel bipartitis, spathis bilobis sericeo argenteove paleaceis, floribus inferioribus binatis superioribus solitariis, petalis calyce obconico ad medium tripartito longioribus, seminis pisiformis processu intrante cylindraceo rectiusculo.

L. acutifida, *Mart. Palm. p. 237. t.* 135, iii. iv. (excl. syn. Roxb.)

Hab.—Penang, whence I have specimens from Mr. Lewes, and Dr. Oxley. Malayan name *Plass tikooss.*

Descr.*—A small miniature Palm. *Trunk* 3-5 feet high, (sometimes 15-20 feet, *Mr. Lewes*), 10-11 lines in diameter, about 22 lines in diameter at the base, marked with incomplete rings, to which portions of the base of the petioles adhere.

Petioles in some of the specimens 3½-4 feet long, in others (and this seems the natural state) scarcely 18 inches long, plano-convex, armed towards the base along the margins with tooth-shaped, straight or sub-deflexed short prickles. *Rete* brown, copious, produced upwards into a long brown membranous ligula. *Pinnæ* 15-20, disposed in a subpeltate manner, generally linear-cuneate,

* Specimens, three entire small plants and several specimens of inflorescence and a few ripe seeds.

10-11 inches long, 8 lines broad; the intermediate ones the narrowest, unequally 3-4 lobed; the others 3-lobed, the central lobe deeply bipartite; the central pinnæ 4-5 lobed, (the inner lobes deeply bipartite, the lateral ones entire.) Between the lobes threads are often to be found.

Spadices 12-18 inches long, nodding, covered below with greyish, above with ferruginous pubescence, rather stouter towards the apex. *Spathes* tubular with oblique mouths, covered with grey silvery adpressed hairs or rather paleæ; limbs more or less lanceolar, bi-lobed, lobes ending in acuminate scarious points; the second spathe nearly 6 inches long. *Spikes* generally simple, rarely dichotomous, adnate to the peduncle very high up, subulate, densely covered with tawny pubescence; the lowest 5 inches long.

Flowers numerous, sessile, spreading in every direction, articulated on short stalks, lowermost in pairs, upper ones solitary. *Calyx* obconical, trifid to the middle, tawny pubescent, segments obtuse. *Corolla* $\frac{1}{3}$ longer than the calyx, similarly pubescent externally, furrowed internally, tripartite to the middle, segments half lanceolate acute. *Annulus* of the *stamens* 6-toothed. *Filaments* (free) short, setaceous from a broad base. *Anthers* oblong. *Ovarium* smooth, sculptured at the apex, obovate-oblong, about the length of the tube of the corolla, of three carpella, cohering by their apices: *ovula* solitary, erect, anatropous. *Style* about equalling the stamina, filiform, three-sulcate. *Stigma* obsoletely cup-shaped, obscurely 3-denticulate.

Fruit about the size of a large pea, roundish-oblong, surrounded at the base by the flattened-out limb of the perianth, and as it were stalked by the tube of the same, dry. *Seed* pisiform, tinged with reddish; teguments very thin, adhering firmly to the albumen; from the hilum enters a deep process, so that it is horse-shoe shaped on a longitudinal section. *Albumen* horny, equal. *Embryo* subcentral.

Obs.—The stems of this plant afford the well known walking sticks known by the name of "Penang Lawyers." These are prepared by scraping with glass, and polishing. Mr. Lewes informs me, "Each stem is well-scraped, by which the epidermis is altogether removed ; care must be taken not to take away much more, as the inside is like the substance of a rattan. It is on this account that the smaller, thinner sticks are so much sought for, and are so rare. The sticks are then straitened by fire. No other process is used."

The plant seems to be confined within narrow geographical limits; it is not known I believe about Malacca, where its place seems supplied by the following closely allied species. Martius, however, states it to be found throughout the Malayan peninsula.

I have an impression that under this species as given by Martius, two distinct ones will be found ; for though the description agrees well with my Penang specimens, yet the drawing of the spadix represents the parts nearly of the same size as in L. spinosa.

L. pumila, Blume, appears only to be distinguished from this by the broader equal teeth of the pinnæ, the intermediate ones of which are the broadest, being described as 16-21 lines broad and 6-8-toothed, while the two innermost ones are said to be only an inch broad.*

58. (5) L. *glabra*, (n. sp.) trunco gracili 3-5 pedali, foliis flabelliformibus, pinnis 16 subæquilatis lineari-cuneatis tricarinatis, lateralibus apice 3-4-lobis dentatisve, terminali 4-lobo, intermediis trilobis lobis (lateralibus exceptis) obtusissimis bipartitis sinubus latis, spadice folia subæquante cum spathis spicis floribusque glabro, ramis 3-5-partitis, spicis gracilibus, floribus inferioribus binatis, calyce cyathiformi brevissime tridentato, corolla triplo longiore infra medium tripartita, ovariis usque ad medium cohærentibus.

Hab.—Solitary on Goonong Miring, an offset of Mount Ophir. Flowers in February. Malayan name, *Plass Goonoong.*

* Syst. Veg. ed. Sch. 7, 2. p. 130.

DESCR.—A miniature Palm. *Trunk* 3-5 feet high, rather slenderer than that of the preceding. *Petiole, rete* and *ligula* much the same as those of the preceding. *Lamina* of the same size as the preceding, flabelliform; *pinnæ* about 16, linear-cuneate, tricarinate, the lateral ones obliquely and unequally 3-4 toothed or lobed, the central one 4-lobed, the two inner lobes bifid, the rest 3-lobed with the central lobe bifid; all the divisions obtuse.

Spadices about equalling the leaves, in some of the specimens 3 feet long, nodding, quite smooth, as are the spathes, which have acutely bipartite points. *Branches* distant, adnate to the spadix high up. *Spikes* several on one branch (except the uppermost ones), quite smooth, slender, 2-3 inches long, spreading.

Flowers also smooth, rather distant, on short articulated stalks; lower ones in pairs. *Calyx* cup-shaped, with three very short teeth. *Corolla* deeply tripartite, three times longer than the calyx, segments linear lanceolate. *Filaments* (free) subulate from a broad base, rather long. *Anthers* ovate. *Pollen* ovate, 1-plicate. *Ovarium* obovate oblong, of three carpella adhering nearly to the middle. *Ovula* solitary, erect, anatropous. *Style* filiform, rather shorter than the ovarium. *Stigma* subsimple.

Fruit about the same size as that of L. acutifida, but obovate. *Seed* of the same shape, the intrant process is rather larger than in the preceding.

I first met with this on Mount Ophir; subsequently I have received specimens from the same locality from my collector E. Fernandez. It is closely allied to the preceding, (Penang Lawyer,) from which indeed the leaves are scarcely distinguishable, except by the broad sinuses of the lobes and their more obtuse points. The smooth inflorescence and flowers, however, at once distinguish it from both that species and L. pumila, Blume. I am not aware of its stems being used for walking sticks.

59. (6) L. *longipes*, (n. sp.) subacaulis, petiolis (4-5 pedalibus) triquetris apicem versus inermibus, lamina orbiculari-

peltata (atroviridi,) pinnis circiter 20 cuneatis, lateralibus oblique truncatis 3-4-dentatis, terminali latiore truncata sub 11-dentata, dentibus omnibus bifidis et irregulariter denticulatis, spadice erecto petiolis multo breviore thyrsoideo-ramoso, spicis (ramorum pluribus) undique patentibus, floribus solitariis numerosis parce pilosis, calycis cylindracei dentibus rotundatis bifidis, ovario medium supra fusco-villoso.

Hab.—Solitary in dense forests, Ayer Punnus (Rhim) and Goonoong Miring, Mount Ophir, but not above an elevation of 1000 feet. Forests near Lainear, to the south of Mergui. Flowers nearly all the year. *Plass Bhatto* of the Malays.

Descr.—A nearly stemless Palm, otherwise of considerable size, with dark green peltate leaves. *Leaves* 5-7 feet long. *Rete* of stout leathery fibres. *Petioles* stout, 4-5 feet long, rather obtusely triquetrous, armed (except the upper third) along the two inner angles with stout, horny, conical, tooth-shaped prickles. *Lamina* 2-2$\frac{1}{4}$ feet long, 3-4 feet broad, peltate-flabelliform; *pinnæ* 20-22, the lateral ones narrowest, obliquely cut off, unequally 3-4-lobed, lobes irregularly denticulate; the terminal one cuneate, 5 inches broad, truncate, 11-keeled above, with as many short, truncate, broad, bifid, denticulate lobes as keels: intermediate ones narrower, generally 3-keeled, otherwise similar: upper margins of all blackish-brown.

Spadix stout, much branched, much shorter than the leaves, 1$\frac{1}{2}$-3 feet long, erect, undulate, flexuose. *Spathes* compressed, lax, almost inflated, laceroso-fibrous at the ends, when young grey from a covering of cellular paleaceous cellules. *Branches* adnate to the peduncle high up, bearing many spreading, subulate, scurfy-pubescent spikes, 3-5 inches long.

Flowers numerous, sessile, green, slightly hairy outside. *Calyx* subcylindrical, 3-toothed, teeth bifid! *Corolla* almost twice as long as the calyx, divided to a little below the middle into three broad, cordate, lanceolate segments. *Annulus* of the *stamina* subtruncate, projecting considerably above the faux of the corolla. *Filaments* (free) short, setiform. *Anthers* cordato-ovate, slightly inflexed. *Ova-*

rium turbinate, toward the base smooth and tripartible, above entire and covered with fuscous villi. *Ovula* solitary, erect, anatropous. *Style* cylindric, rather shorter than the ovarium, hollow at the apex. *Stigmata* three, minute, on a level with the annulus.

Fruit (immature) subbaccate, sitting on the stout pedicel-like tube of the calyx: surrounded at the base by the perianth, and annulus, apiculate by the style, one seeded. *Endocarp* thin, subosseous.

This, judging from Schultes' description,* appears to be somewhat allied to Blume's L. ramosa, quoted by Martius under L. spinosa.

It is very distinct from the other species known to me by its inflorescence, which is so divided and short as to be almost a thyrsiform panicle, its short trunk but otherwise large stature, and dark leaves, in the orbicular spreading of the divisions of which it resembles L. peltata.

60. (7.) L. *triphylla*, (n. sp.) nana, subacaulis, pinnis tribus pluridentatis (dentibus marginali excepto emarginatis), lateralibus oblique cuneatis præmorsis, terminali abrupte præmorsa, spadice foliis breviori vix spithamaeo, floribus paucis solitariis, fructibus pisiformibus processu intranti curvato.

Hab.—In dense forests, Ayer Punnus, (Rhim,) Malacca. Only one specimen was procured.

Descr.—A very dwarf Palm, the whole height not exceeding 2½ feet; the *stem* being about 3-4 inches long. *Leaves* 1-2 feet long. *Petioles* plano-convex or canaliculate, armed below the middle with straight or somewhat hooked, deflexed, rather long prickles. *Rete* well developed. *Lamina* of three cuneate *pinnæ*, the lateral ones obliquely præmorse, the terminal (which is 5-6 inches long, 2½ wide) truncate: as many short teeth as there are carinæ, all

* Syst. Veg. ed Schultes.

except the lateral one on either side emarginate; those of the terminal one being the shortest and about 12 in number.

Spadix (fruit-bearing) nodding, cernuous, scarcely a span long, smooth, except the spike bearing part, which is scurfy-pubescent. *Spathes* smooth, bipartite. *Branches* four, lowermost dichotomous. *Spikes* about an inch long, marked with the scars of a few flowers. *Berries* about 5 on the largest spike, sub-distichous, red, the size of a pea, seated as it were on a short stout stalk (the tube of the calyx,) and surrounded at the base by the spreading cordate-ovate acuminate segments. *Seed* like a small pea. *Intrant process* curved, so that its upper part becomes nearly horizontal. *Embryo* subcentral.

The stature and leaves of this will at once distinguish it. In the teeth of the pinnæ it approaches L. pumila, and especially L. longipes.

It appears to be distinguishable from very young plants of L. spinosa by the longer petioles, and less deeply toothed pinnæ. The perianthium also does not appear to be pubescent, and the fruit is pisiform.

LIVISTONA.

R. Br. Prod. Fl. Nov. Holl. ed. 2da. 123. *Syst. Veget. ed. Schult.* 7. *No.* 1491. *p.* 1307. *Mart. Progr. Palmar. p.* 10. *Palm.* 102 (part. sub nom. Coryphae rotundifoliae) 109, (part) 110, 111, 135, 145, 146. *Endl. Gen. Pl. p. 252. No.* 1754.

Livistonia, *Gen. Pl. ed. Spreng. p. 283. No.* 1465.

Saribus. *Rumph. Hb. Amb.* 1. *t.* 8.

Char. Gen.—*Flores* hermaphroditi. *Perianthium* utrumque tripartitum. *Stamina* 6, filamentis e corolla liberifactis distinctis, (basi dilatatis). *Ovaria* 3, apice cohærentia. *Styli* connati. *Stigma* subsimplex. *Drupa* (unica maturescens) monosperma. *Albumen* cavitate ventrali. *Embryo* dorsalis.

HABITUS.—Palmæ *Asiae orientalis et australis, saepius arboreae, perennantes.* Foliorum petioli *saepius armati;* laminæ *segmenta profunde bipartita, interdum acuminatissima pendula, lateralia longiora.* Rete *copiosum.* Spadices *axillares, paniculatim ramosi; pedunculis* spathis *vaginantibus obtectis.* Flores *minuti, albidi, glomerulati.* Drupæ *saepius inaequilaterales, glaucescenti-azureae.*

Discrimina vera inter Licualam et hoc genus ponuntur tantum in foliis palmatim flabelliformibus, filamentis in annulum liberum vix coalitis et baccis azureis. Fructus structura in utroque eadem.

61. (1) L. *Jenkinsiana,* (n. sp.) 20-30-pedalis, petiolis pertotam fere longitudinem armatis, lamina (foliorum) reniformi-flabelliformi diametro extremo 5-6 pedali subtus glauco pruinosa, segmentis 75-80 obtuse bilobis, lateralibus sub-1½ pedalibus centralibus duplo longioribus, calyce rotunde et membranaceim 3-dentato, fructibus subreniformi-rotundis magnitudine globuli sclopeti.

HAB.—Gubro Purbut, Upper Assam, in flower March 1836. Common throughout Assam, but most plentiful in the Nowgong district, *Major Jenkins. Toko Pat* of the Assamese.

DESCR.*—A Palm 20-30 feet high, with a thick round crown. *Trunk* in diameter 6-7 inches, rough towards the apex from the adhering bases of the petioles. *Leaves* 6-7 feet long. *Petiole* channelled above, armed almost to the summit; *ligula* cordate. *Lamina* reniform flabelliform, greatest breadth 5-6 feet, length from the apex of the petiole 3-3½ feet, divided into about 76-80, obtuse, bi-lobed segments, of which the extreme lateral ones are the deepest, being 18-inches long, while the central ones are scarcely half that length,

* Partly from living plants observed at Gubroo, partly from specimens received from Major Jenkins.

under surface glaucous cæsious. The outline of the undivided part is almost exactly cordate.

Spadices axillary, 2-3 feet long; branches a span or a foot long, dichotomous opposite the ends of the spathes; branchlets (spikes) lowermost 2 or 3 times divided, the others simple. *Spathes* chesnut red, sometimes split, concealing the greater part of the peduncle; scurfy outside, the one next the first branch 1½ foot long, 3-5 keeled, with a large, oblong, deeply bilobed, split limb.

Spikes to each branch many, 4-6 inches long, spreading, rather stout. *Flowers* several together, sessile on small knobs, small, greenish, without bracteæ *Alabastra* oblong. *Calyx* short, with a broad as it were lobed base, cup-shaped, with three short rounded teeth with membranous margins. *Corolla* about twice as long as the calyx, divided to a short distance from the middle into three triangular segments. *Stamina* 6, united as usual. *Filaments* free (at the faux,) short, setaceous from a very dilated base. *Anthers* oblong, versatile. *Pollen* lanceolar, with one fold. *Ovarium* obconical, yellow, with a depressed, red spotted, somewhat sculptured apex; *carpels* cohering by means of the short trisulcate filiform style. *Stigma* simple. *Ovula* solitary, erect, anatropous.

Drupe reniform, round, slightly attenuate at the base, the size of a musket ball, of a leaden blue colour, marked on one side with a depressed whitish line. *Seed* erect, presenting on the side corresponding with the above line on the fruit a broad raphe-like line. *Albumen* horny, opposite the centre of the above line deeply excavated; cavity as usual filled with a spongy substance. *Embryo* opposite the excavation or in the centre of the dorsal face.

It appears to be quite distinct from any published species. The fruit is larger than in any other.

Major Jenkins tells me: "This palm is an indispensable accompaniment of every native gentleman's house, but in some parts it is rare, and the trees are then of great value. I cannot call to my recollection having ever seen a Toko tree undoubtedly wild. The leaves are in universal use throughout Assam for covering the tops of doolees, (palkees,) and the roofs of khel boats, also for making the peculiar hats, or rather umbrella-hats (jhapees) of the Assamese. For all these purposes the leaves are admirably adapted from their lightness, toughness, and durability."

It has been therefore deemed not inappropriate to connect with it the name of the present Commissioner of Assam, whose name is so honourably and inseparably connected with that of the Province under his controul. To this constant contributor the Botanic gardens are indebted for a number of seeds, now vegetating, and for a number of young plants.

62. (2) L. *spectabilis*, (n. sp.) procera, petiolis per totam longitudinem armatis, foliis orbiculari-peltatis diametro extremo 9-10-pedali, segmentis circiter 90 profunde bipartitis, laciniis in filis longis pendulis acuminatissimis, calyce ad medium tripartito, baccis subrotundis globuli sclopeti minoris magnitudine.

HAB.—Solitary in the low littoral tracts, adapted to rice cultivation, Malacca. Penang. *Mr. Lewes.* Malayan name. *Sardang.*

DESCR.—A lofty palm, 50-60 feet high. *Trunk* smooth or armed towards the base with the hard persistent bases of the petioles. *Crown* ample, round. *Petioles* obtusely triangular, armed along the margins with very stout, conical, subulate, compressed, generally recurved thorns. *Lamina* orbiculari-peltate, 9-10 feet across, plaited deeply, divided into about 90 divisions. These are ensiform, deeply bi-lobed, the segments being gradually acuminated into flat pendulous threads. The central divisions reach to 2 feet from apex of the petiole, while the outer ones reach almost to the petiole itself. The length of their segments is $2\frac{1}{4}$-3 feet, those of the central divisions extending to about a foot from the base.*

* The long diameter of the leaf is about 6 feet, the cross diameter about 8 feet. The lateral divisions almost reach to the base, and their secondaries again do the same, about 4 feet long. The intermediate reach to about $1\frac{1}{2}$ foot from the base,

Spadices axillary, 4-5 feet long, alternately branched, nodding. *Branches* 1-1½ foot long, spreading, dichotomous at the mouths of the spathes, much divided into forked or simple spreading branchlets (spikes), 6-10 inches long. *Spathes* coriaceous, fuscous or chesnut coloured, concealing the whole peduncle, with erect adpressed acuminate limbs; the lower ones generally more or less reticulately split.

Flowers sessile, the lower ones several together, upper solitary. *Calyx* minute, cup-shaped from a broad base, divided to the middle into three round teeth. *Corolla* (in bud) depressed, a little longer than the calyx, divided nearly to the base into three broad segments. *Stamina* 6; *filaments* united to the corolla as far as the base of the segments, there (free) short, dilated. *Anthers* oblong-ovate or cordate-ovate. *Ovarium* oblong-obturbinate, sculptured at the apex, the three carpels cohering by the style, which is trisulcate, filiform, about three times shorter than the ovarium. *Ovula* solitary, erect, anatropous.

Spadix of the fruit nodding, otherwise unchanged, branchlets subsecund, yellowish. *Berry* globose, of the size of a small bullet, nearly dry, of an azure blue; smooth, somewhat oblique, surrounded at the base by the perianthium. *Endocarp* thickish, subosseous. *Seed* with a large cavity filled with the tegument. *Embryo* central.

Although the vernacular name given by Blume for L. rotundifolia is the same, and the fruit agrees well with the figure of Martius, yet there are so many discrepancies in his description, as regards the arming of the petiole, the degree of acumination of the segments of the leaves, which is described as less than in L. sinensis, and their general size, that I am compelled to consider this distinct.

Rumph's figure, quoted by Blume and Martius under L. rotundifolia, gives no idea of the habit except as regards the fruit-bearing spadix. And I do not think it probable that the retrofracted pendulous divisions of the leaves, for which this

are 4½ feet long, the secondary divisions about 3 feet long. The central divisions reach to about 3 feet from the apex of the petiole, are 3-3½ feet long, their secondary divisions 3 feet long, and even more acuminate and filiform than the rest.

species is more remarkable than perhaps any other,* would have escaped Rumph altogether. F. Bauer's beautiful figure† of L. inermis gives, excepting as regards the pendulous segments of the leaves and annulation of the trunk, a good idea of the habit of this Palm. I am not aware of its being applied to any use.

CHAMÆROPS.

Linn. Mus. Cliff. p. 10. *Gen. Pl. ed.* 6*ta.* 1764. *p.* 571. *No.* 1219. *ed. Schreb. p.* 772. *No.* 1688. *Jussieu. Gen. p.* 39. *Lam. Enc.* 4. *p.* 709. (*Palmiers*) *t.* 900. *Syst. Pl. ed. Schultes.* 2. *p.* XCIII. 1488. *Endl. Gen. p.* 253. *No.* 1759. *Mart. Progr. p.* 9. *Palm. p.* 247. *t.* 120. 124-5. *Pl. As. Rar.* 3. *t.* 211. *Andrews. Bot. Rep. t.* 599. *Bot. Mag. t.* 2152. *Lambt. in Linn. Trans.* 10. *t.* 8.

Chamæriphes. *Gaertn. Fruct. et. Sem.* 1. *p.* 25. *t.* 9.

CHAR. GEN.—*Flores* polygamo-mono-dioici. *Calyx* tripartitus. *Corolla* tripetala v. tripartita. *Stamina* 6-9, filamentis

* L. *sinensis,* 20 pedalis, petiolis inermibus, foliorum lamina reniformi-flabelliformi diametro 5-pedali, segments 80-85 ad medium bipartitis subulato-acuminatissimis pendulis, fructibus subolivæformibus inæquilateralibus.

L. sinensis, *Mart. Palm. p.* 240. *t.* 146, 1-11.

HAB.—Southern China, Martius. Cultivated in these gardens under the name Livistonia ? Mauritiana; said to have been introduced from the Mauritius in 1821.

The largest specimen is 20-25 feet high, with a stout obscurely annulated trunk. *Crown* round. *Leaves* much plicate, and also conduplicate along the centre, the lateral segments which are much the narrowest 2 feet or 2-2 inches long, their divisions about a foot long. *Spadices* smaller, but otherwise much like those of L. spectabilis. *Flowers* white, of an unpleasant smell, generally 4 together. *Calyx* with three rounded teeth with membranous margins. *Corolla* longer than the calyx, divided below the middle into three cordate erect segments. *Fruit-bearing spadix* nodding, with subsecund branches. *Berries* dull blue, oblong, 7 lines long, and 4½ wide. *Seed* oblong, of a greyish colour, on a longitudinal section reniform, intrant process subcentral. *Embryo* opposite to this, a little below the centre of the dorsal face, looking downwards.

This approaches in the acuminated pendulous segments of the leaves to L. spectabilis, but otherwise is quite distinct. It is not mentioned in the Hortus Mauritianus. A. D. 1837.

† Mart. Palm, t. 145.

basi coalitis. *Ovaria* tria. *Styli* 0. *Baccae* 1-3, monospermæ. *Semen* in facie ventrali sulcatum, æquabile vel ruminato-variegatum. *Embryo* dorsalis.

Habitus.—Palmæ *perennantes, frutescentes vel arboreae, nanae vel procerae.* Rete *saepius amplum.* Petioli *margine denticulati, vel spinosi, vel sublaeves.* Lamina *palmatim multipartita;* laciniæ *induplicatae, apice saepissime bilobae, filis intermediis saepius nullis.* Spadices *simpliciter aut composito-ramosi.* Spathæ *coriaceae, tubulosae, rameae paucae vel deficientes.* Flores *flavescentes, bracteati.* Filamenta *basi connata.* Baccæ *carne spissa parca, olivaeformes vel subrotundae.*

"Numerus partium haud raro auctus; loco ternarii quaternarius, quinarius vel senarius."

Affinitate proxima Livistonæ. Præbet transitum ad Phænicem per flores polygamos, staminum numerum auctum, baccas et structura seminis.

63. (1.) C. *Martiana*, trunco elato, frondium vagina cylindrica reticulata, petiolis margine leviter dentatis et supra paleis albis furfuraceis, lamina reniformi subtus glauca, laciniis 70-75 conduplicato-canaliculatis, segmentis apice bifidis, spathis partialibus pluribus, baccis olivæformibus lepidotis (flavescentibus).

C. Martiana, *Wall.* (sine charactere!*) *Mart. in Pl. As. Rar.* 3. *p.* 5. *t.* 211.

* The describer and investigator of the affinities of any undescribed plant is the proper person to name it. Working botanists should pay no attention whatever to those persons who insist on attaching their initials to objects they will not, or cannot, describe and elucidate. It was originally intended that the initials attached to the name of a species should be those of the botanist who first defined it, but now owing to flattery, indolence, incapacity and MSS. names, this very requisite signification is in a considerable measure lost. Some stringent rule is much required, for the present it may be sufficient to attach *sine charactere!* to all initials that fall under the above mischievous paradox.

Hab.—Bunipa in the great valley of Nipal, at an elevation of about 5000 feet above the level of the sea. Newar name, *Tuggu*. (Wallich.)

Descr.*—*Trunk* 20 feet high, irregularly annulate, of irregular diameter. *Crown* hæmisphærical, rather thin. *Leaves* 5 feet long. *Petioles* 2½-3 feet long, unarmed, generally partly twisted. *Lamina* reniform-orbicular or almost orbicular, concave, (rarely convex) 2 feet 2 inches long, about 4 feet broad; laciniæ about 75, conduplicato-canaliculate, glaucous underneath, with nodding ends; the central ones the broadest, about 16 inches long, obtusely bilobed to the depth of ½ or 1 inch; lateral ones about a foot long, linear acuminate, very narrow, acutely bilobed; intermediate ones 16 inches long, and acutely bilobed.

Spadices 3-5 feet long, very much branched; furnished at the base (and under each primary branch) with spathes: peduncle about a foot long. Lowermost *spathe* 1-1½ foot long, two-edged, semi-bifid at the apex: the third or fourth suffults a flower-bearing branch. *Spikes* 1-1½ inch long. *Flowers* minute, solitary or in pairs: at the base of each a minute membranaceous bracte. *Calyx* trifid; laciniæ ovato-triangular, sub-obtuse. *Petals* three times larger than the calyx, ovato-orbicular, erecto-patent. *Stamina* as long as the corolla. *Anthers* linear-oblong. *Ovaria* 3, ovate, covered with a silky wool: the fertile ones have very short styles terminated by a capitate stigma: the barren ones have longer styles without any stigma. *Berries* shaped like an olive, but twice as small, furrowed slightly along on one side: yellowish, sprinkled with adpressed dry squamules. *Seed* erect, of the size of a coffee seed: ventral face with a depression, filled with cellular substance; dorsal convex. *Albumen* cartilaginous-horny, horse-shoe-shaped on a transverse section. *Embryo* at the centre of the dorsal face.

This elegant Palm thrives tolerably well in the H. C. gardens in shady raised spots. The figure in the Pl. As. Rar. (*loc. cit.*) *improved* from a native drawing of a garden specimen

* From living plants in the H. C. Botanic Gardens, inflorescence and fruit chiefly from Martius, Palm. loc. cit.

does not give a good idea of the crown of the garden specimens, being too large and too thick, and without any old leaves hanging down. The representation of the inflorescence is probably quite wrong.

64. (2.) C. *khasyana*, (n. sp.) trunco mediocri, petiolis per totam longitudinem denticulato-scabris, fibrillitio e fibris erectis regidiusculis, lamina reniformi-flabelliformi profunde 60-65 partita, laciniis induplicatis bilobis vel bipartitis lobis centralium brevibus obtusis recurvis, spadice (fructus) bipedali, ramis primariis tribus, spathis subternis (basilaribus 2 rameo 1,) pedunculum communem omnino tegentibus, fructibus oblongis livido-cæruleis.

Hab.—Khassya hills : on precipices at Moosmai and Mamloo, alt. 4000 ft. ; not observed in flower or fruit.

Descr.*—A palm of moderate height, (the specimen measures 9-10 feet,) the *trunk* 5 inches in diameter in the thickest parts, obscurely annulate. Under the *crown*, which is thick, is an oblong mass (2 feet long) of flattened bases of petioles, and their retia which are of stiff fibres.

Leaves about $3\frac{1}{2}$ feet long : *petiole* 18 inches long, with irregular denticulate margins : *lamina* flabelliform reniform, (so is the entire part of the leaf) 2 feet long by $3\frac{1}{2}$ feet wide : divisions about 65, the lateral ones shortest, 12-14 inches long, but the deepest divided, (viz. to within 5-6 inches of the apex of petiole) linear, their segments $1\frac{1}{2}$-2 inches long, narrow, acute ; central ensiform reaching to within 10-12 inches of the apex of the petiole, about 16 inches long, shortly and obtusely bilobed, segments about $\frac{1}{2}$ inch long with recurved points ; intermediate divisions also ensiform, about 18 inches long, their segments narrower and deeper than those of the central. Young leaves covered with thick, white, paleaceous tomentum.

* Entire ? specimen of a trunk and crown, and two fruit-bearing spadices : these have been unnoticed since the return of the Assam Deputation in 1836. Seeds since received have germinated.

Spadix (fruit-bearing,) 2 feet long, nodding, compressed: the lower half concealed by the *spathes* of which there are three, two common ones, and one to one of the main branches. They are coriaceous, brown, with oblique mouths, and bilobed limbs, the lowest is about a foot long. *Branches* of the spadix quite exserted, quite naked, the terminal one dichotomous: divisions many. *Spikes* 4-6 inches long.

Fruit scarcely baccate, $\frac{1}{2}$ inch long, $2\frac{1}{2}$ lines broad, solitary or 2-3 together, but of distinct carpels, oblong, inæquilateral, obliquely apiculate at the apex, surrounded at the base by the calyx which has a stout cylindrical base, and three deep, broad oblong divisions, by a corolla of three cordate ovate petals, equal in length to the calyx, and by six sterile stamina: on one side may be found two abortive villous ovaries. *Seed* oblong, with the ventral face rather deeply furrowed, the furrow not reaching quite to the apex, reniform on a transverse section. *Albumen* with a scaly surface, along this line presenting a cavity filled with spongy tissue: horny, otherwise equal. *Embryo* in the centre of the dorsal face.

This species is closely allied to C. Martiana: it differs in its shorter stouter stature, the petioles toothed throughout, in the nature of the rete, and the texture of the leaves which is more like that of C. humilis. The paleaceous tomentum much more developed, and the berries are blueish, not yellow. The divisions of the leaves are much the same, excepting the secondary segments of the central divisions, which are shallow, obtuse and recurved.*

* Chamærops *Ritchiana*, (n. sp.) nana, sæpius subacaulis, petiolis inermibus, fibrillitio subnullo, lamina profunde palmatim 10-15 partita, laciniis induplicatissimis ultra medium bipartitis, segmentis rigidis angustis gradatim acuminatis.

Hab.—Khybur Pass, and generally in the low arid mountainous parts of Eastern Affghanisthan. Pushtoo name *Maizurrye*. Not observed in flower or fruit.

Descr.*—A small Palm, scarcely exceeding 2-3 feet in height, generally tufted, and generally almost stemless. There is scarcely any *rete*, but the bases of the petioles, where naturally covering each other, present a rust-coloured wool. *Leaves* from 20 inches to 3 feet in length, whitish-glaucous, coriaceous. *Petiole*

* From specimens brought from Affghanisthan, and a few seeds received from the Seharunpore Garden, of which one germinated in the H. C. Botanic Gardens.

Sect. II.

Folia pinnata. *Spatha* una completa. *Flores* dioici. *Corolla* fl. fœminei convoluto-imbricata. *Stamina* 6-9, raro 3, hypogyna. *Pistilla* 3, discreta. *Bacca*. *Semen* longitudinaliter exaratum.

Palmæ *perennantes, nanae et subacaules, frutescentes vel arboreae, saepius gregariae et locos aridos amantes.* Truncus *petiolorum cicatricibus vel basibus asper, rarius annulatus.* Petioli *inferne planiusculi depressi, superne compressissimi.* Rete *panniforme, copiosum.* Pinnæ *saepius fasciculatae, plurifariae, rigidae, glaucescentes, conduplicatae vel conduplicato-canaliculatae, venis diaphanis parallelo-striatae, rarius solitariae, bifariae, flaccidae, planiusculae; infimae in spinis degenerantes.* Inflorescentia *axillaris.* Spatha *completa, coriacea, bicarinata, primum antice aperiens, demum dextrorsum et sinistrorsum bivalvis, postremum decidua.* Spadix *saepius exsertus, racemi in modum ramosus, pedunculo compresso.* Spicæ

6-12 inches long, quite unarmed. *Lamina* palmate, laciniae (the fibres stout, often persistent,) 10-15 induplicate, divided to the middle or a good deal below into gradually acuminated rigid subsequently obtuse segments. The *seeds* seem to vary a good deal, some being oblong, others round, some again as large as a small marble, others not much bigger than a large pea, surface minutely wrinkled. *Raphe* tolerably distinct. *Chalaza* palmately branched. *Albumen* horny, very dense, with a good sized central cavity. *Embryo* near the base, narrow at the radicular end.

I have named it in honour of my friend Dr. Ritchie of the Bombay Medical Service, to whom I was indebted while in Affghanisthan for constant contributions of plants, and two valuable collections, one made between Candahar and Herat, and Herat and Bamean via Maimunna and Toorkistan, and another made about Pesh-Bolak and in the Khybur Pass. It is the only palm I met with in that country, and is of extensive use for making cordage, etc.; it may therefore appropriately commemorate an officer who was employed in Affghanisthan for a considerable time, and who was more extensively acquainted with that country than any other officer, excepting perhaps Major Pottinger.

It appears to be distinguished from C. humilis by its unarmed petioles, the want of a rete and the deeply divided laciniae of the leaves, which in C. humilis are quite entire,* or at the most bifid.†

* Desf. Fl. Atl. 2. p. 437. Syst. Veg. ed. Schult. 2. p. 1489.

† Mart. Palm. p. 248.

fasciculatae, subfastigiatae, saepius simplices. Flores *masculi, angulati.* Calyx *urceolatus, tridentatus.* Corolla *tripetala.* Stamina *hypogyna, saepius* 6. Antheræ *adnatae.* Pistillum *rudimentarium (an semper.?).* Flores *faeminei convoluto-clausi.* Calyx *maris.* Petala 3, *rotundata, carnoso-coriacea, convoluta.* Stamina *sterilia* 6. Ovaria *distincta.* Styli *distincti, recurvi.* Stigmata *subsimplicia.* Bacca *saepius oblonga, rubra vel demum nigrescens.* Albumen *aliquando ruminatum.* Embryo *centralis vel prope basin.*

Incolæ Africæ occidentalis et borealis, et præsertim Asiae tropicæ orientalis. Limes borealis specierum indicarum 30° grad ; australis 5° grad.

Praebent farinam (*Sago* speciem), succum vinosum (*Taree*) et prae alia Saccharum. Fructus (Phaenicis dactyliferæ) edules, Arabis et Persicis aestimatissimi. Folia unius tegetibus apta, et petioli corbulis.

PHÆNIX.

(*Char. Sectionis.*)

Linn. Gen. ed. 6*ta. p.* 573. *No.* 1224. *ed. Schreb. p.* 776. *No.* 1194. *ed. Spreng. p.* 283. *No.* 1467. *Juss. Gen. p.* 38. *Gaertn. Sem. fruct.* 1. *p.* 23. *t.* 9. *Lam. Enc. Meth. t.* 893. (part. e Gaertn.) *Roxb. Icones* 15. *t.* 31, 32, 33. *Suppt.* 5. *t.* 15. *Fl. Ind.* 3. *p.* 783. *Endl. Gen. p.* 253. *No.* 1763. *Mart. Progr. p.* 11. *Palm. p.* 257. *t.* 120, 124. 136, 164. (ex Endl.)

Elate. (*Linn. Mus. Cliff. p.* 12. auct. Mart.) *Ait. Hort. Kew. ed.* 2*da.* 3. *p.* 280. *Lam. Enc. Meth. t.* 899. (e Rheedio.) *Linn. Gen. Pl. ed. Schreb. p.* 777. *No.* 1697. *ed. Spreng. p.* 250. *No.* 1304. *Sp. Pl. Willd.* 4. *p.* 170. *No.* 1682.

Katu Indel. *Rheede Hort. Mal.* 3. *p.* 15. *t.* 22-25.

65. (1.) P. *acaulis,* trunco brevissimo bulbiformi, foliis fasciculatis linearibus conduplicatis sub-quadrifariis, spadicibus faemineis terra semi-immersis et in spathis e maxima parte inclusis, fructibus oblongis, embryone in centrum dorsi.

P. acaulis. *Roxb. Hort. Bengh. p. 73. Fl. Ind. 3. p. 783.** *Icones Suppt. 5. t. 15. Buch. Hamilt. Comment. in Hort. Malab. in Linn. Trans. 15. p. 88. Sprengel Syst. Pl. 2. p. 139.*

Hab.—Behar, (*Roxb.*) Elevated plains on the north side of the Ganges on a clayey soil. *Buchanan Hamilton.* Chota Nagpore. *Col. Ouseley.* Plains between the valley of Hook-hoong and Mogam. *Junglee Khujur.*

Descr.—"*Stem* none in plants 10 years old; at this age when in flower, the whole body of the plant, including the inflorescence, but exclusively of the foliage, is of an ovate form, and not exceeding six or eight inches in height from the surface of the ground. *Leaves (Fronds,* L.) pinnate; from two to six feet long. *Leaflets* in nearly opposite, rather remote fascicles; the superior ones folded, slender, ensiform, and about eighteen inches long; lower ones small, straight, rigid, and ending in very sharp, spinous points. *Petioles (stipes)* near the base flat, towards the apex triangular, smooth. Male. *Spathes* and *spadix* as in the female hereafter described. *Flowers* alternate, solitary, sessile, small, pale yellow. *Calyx* one-leaved, triangular; *angles* or *lobes* acute, unequal. *Corol* three petalled; *petals* obliquely-lanceolate, acute, slightly united at the base. *Filaments* six, very short, inserted into the base of the corol. *Anthers* linear, nearly as long as the petals. *Pistil* none. Female. *Spathes* universal, axillary, solitary, one-valved, about six inches long, with their base rather below the surface of the earth, generally splitting into two portions down the middle on each side. *Spadix* ramous, composed of many, simple, short, erect, flexuose branches; all are smooth, and of a pale yellow. *Flowers* alternate, solitary, sessile, in bractiform notches on the sides of the branches of the spadix. *Calyx* cup-shaped, truncate, with three obscure points at equal distances on the margin. *Petals* three, sub-rotund, thick and fleshy, concave, smooth. *Nectary* a small, six-toothed cup in

* Buchanan is here given as the authority, but this appears to be a mistake, see Linn. Trans, xv. p. 85.

which the germs sit. *Germs* three, each one-celled, and containing a single ovulum attached to the middle of the cell on the inside. *Styles* three, recurved, small and short. *Stigma* small. *Drupe* oval, fleshy, small, smooth, of a bright red, of the size of a very small olive, one-celled. *Seed* solitary, oblong, with a deep longitudinal groove on one side. *Embryo* in the middle of the back, or convex side of the seed." *Roxb. o. c. l. c.*

This species varies considerably in the size of the leaves and breadth of the pinnæ, and in the size and degree of exsertion of the male spadix. The male plant is probably scarcely distinguishable from that of the succeeding, but the female is at once by the shortness of the peduncle of the spadix, which is generally shorter, and never, so far as I know, longer than the spathes.

Dr. Royle* mentions a species closely allied to, if not identical with this, inhabiting the Kheree Pass, Siwalik Hills, at an elevation of 2500 feet, in company with Pinus longifolia. I omit his name, because it is not accompanied with any defining characters. Most probably it is the succeeding or a third species of this form, which requires much more examination than it has received.

I subjoin the description of a specimen sent by Colonel Ouseley, who informs me that it is considered by the natives as a distinct species. The only differences I can detect are the shortness and less induplication of the pinnæ, and the colour of the fruit.

P. *acaulis var. melanocarpa.*

Descr.—A dwarf palm not exceeding 2 feet in height, including the leaves. *Stem* bulbiform, 6 inches long, covered with the protuberant hardened persistent bases of the petioles, their points being spreading recurved. *Leaves* 1-1½ foot long, ascending then spreading. *Petiole* below flat, above quite compressed. *Pinnæ* subfasciculate, fascicles subopposite, some ascending on either side others spreading,

* Illustr. p, 394, 397.

attached by broad cartilaginous insertions above which they are conduplicate, glaucescent, spinous pointed, the upper ones the largest, 7-8 inches long, ½ inch broad, conduplicate near the base above this almost flat (at least the old ones): the lowermost are degenerated into strongish channelled 3-gonal spines, the rest present intermediate characters.

Spadices of both sexes buried among the persistent bases of the petioles, of the fruit only partly exserted, without spathes ; *spikes* 2-3 inches long, stout. *Fruit* suffulted by a green angular bracte, sessile, alternate, of the size of a small olive, at first reddish, afterwards black-purple: apex distinctly cuspidate, base surrounded by an angular tridentate calyx, by the imbricated broad petals, and by 6 small abortive stamina. *Endocarp ?* (tegument ?) thin, like silver paper. *Seed* one, erect, greyish, deeply furrowed on one side and with about 7 striæ on the remaining part of the surface. Along the same furrow the horny *albumen* is deeply grooved, the groove filled with spongy substance. *Embryo* at or a little below the centre of the dorsal face.

66. (2) P. *Ouseleyana,* (n. sp.) trunco brevissimo bulbiformi, foliis fasciculatis linearibus conduplicatissimis angustissimis, spadicibus fæmineis longe exsertis spathis multoties longioribus.

HAB.—Chota Nagpore, *Col. Ouseley.* Assam, *Major Jenkins.*

DESCR.*—Bulbous *stems* ovate, imbricated conspicuously with the hardened scale-like bases of the petioles, about a foot in length and 6 inches in diameter. *Rete* of a few rigid fibres. *Leaves* 2½-3 feet long. *Pinnae* entirely conduplicate, about a foot long, from the conduplication 2-2½ lines broad, subulate-acuminate; lowermost degenerated into short spines. *Male spadices* about a foot long, the ends of the uppermost *spikes* rather longer than the bivalved carinate *spathe. Female spadices* 2-2½ feet long with a few

* Specimens. A male and female specimen entire, but without flowers or perfect female spathes, communicated by Major Jenkins.

short flexuose spikes towards the apex, much longer than the spathes, which appear to be about a span long. *Peduncles* of both spadices much flattened.

Colonel Ouseley, Agent to the Governor General S. W. Frontier, first directed my attention to the distinguishing marks of this species, which I have therefore dedicated to him, and also as a tribute of respect for his exertions in bringing to notice the vegetable products of the districts under his charge, as well as the valuable grains of Central India.

67. (3) P. *farinifera*, trunco brevissimo, pinnis oppositis, spadicibus exsertis, fructibus oblongo-ovatis, embryone ad medium faciei dorsalis.*

P. farinifera, *Willd. Roxb. Cor. Pl.* 1. *p.* 55. *t.* 74. *Icones.* 15. *t.* 32. (inflor) *Fl. ind.* 3. *p.* 785. *Sprengel Syst. Pl.* 2. *p.* 139. P. pusilla. *Lour. Fl. Coch. ed. Willd. p.* 753. *Gaert. Sem. et. Fruct.* 1. *t.* 9. ?†

Hab.—Dry barren parts chiefly of the sandy lands at a small distance from the sea near Coringa. Flowers in Jan. Feb; fruit ripens in May. Telinga name *Chilta-eita. (Roxb.)* Common on all the hilly country between the Ganges and Cape Comorin *(Buchanan Hamilton.)*

Descr.—" *Trunk*, the little it has is only about one or at most two feet high, and so entirely enveloped in the sheaths of the leaves that it is never seen, the whole appearing like a large round bush. *Leaves* pinnate. *Leaflets* opposite, sword-shaped, much pointed, smooth, of a deep green. *Spathes* axillary, one-valved, concave on the inside, fitting the trunk or base of the leaf immediately with it; this concavity is bordered by two sharp edges; convex on the outside, there splitting longitudinally, leathery, smooth, withering.

* Char. e Roxb.

† This synonym is I think doubtful, as Roxburgh's figure does not agree with figs. f. g. of Gærtner.

Spadix erect, very ramous, branches simple, spreading in every direction, from eight to twelve inches long. MALE FLOWERS. *Calyx* small, slightly three-toothed. *Petals* three, oblong, white, rigid. *Filaments* six, very short, inserted into a fleshy globular receptacle. *Anthers* oblong, erect. FEMALE FLOWERS on a separate plant. *Calyx* as above. *Petals* three, orbicular, concave, equal, rigid, lasting. *Germs* three, though never more than one ever increases in size, the other two always wither, although they contain the rudiment of a seed every way like the fertile germ; ovate, each ending in a short recurved style. *Stigma* simple. *Berry* when ripe, of a shining black, of the size of a large French bean; the *pulp* is sweet and mealy, but in small quantity, the natives eat them as gathered from the bush without any preparation. *Seed* cartilaginous, of the shape of the berry, grooved longitudinally, as in the common date, pretty smooth, brown on the outside, of a light greyish white within, on the middle of the back there is a small elevation, under which is an oblong pit containing the embryo or first principle of the new plant."

The leaflets are wrought into mats for sleeping upon, &c. The common petioles are split into three or four, and used to make common baskets of various kinds, but they are not so good for this purpose as the Bamboo, which is very elastic, much more durable, and splits easily. The small trunk when divested of its leaves, and the strong brown fibrous web that surrounds it at their insertions, is generally about fifteen or eighteen inches long, and six in diameter at the thickest part; its exterior or woody part consists of white fibres matted together, these envelope a large quantity of farinaceous substance, which the natives use for food in times of scarcity. To procure this meal, the small trunk is split into six or eight pieces, dried, and beat in wooden mortars till the farinaceous part is detached from the fibres; it is then sifted to separate them, the meal is then fit for use. The only further preparation it undergoes, is the boiling it into a thick gruel, or as it is called in India, *Kanji;* it seems to possess less nourishment than the common sago, and is less palatable, being considerably bitter when boiled; probably a little care in the preparation, and varying the mode, might improve it; however, it certainly deserves attention, for during the end of the last, and beginning of this year, and again at this present time, May 1792, it has saved many lives. Rice was too dear, and at times not to be had, which forced many of the poor to have recourse to these sorts of food. Fortunately it is one of the most common plants on this part of the coast, particularly near the sea."—*Roxb. o. c. l. c.*

There is a (male) specimen called P. farinifera in the Botanic Gardens. It has a *trunk* 4 feet high, 6-8 inches in diameter, rough with the persistent bases of the *petioles*. The *leaves* are 3-4 feet long, spreading, the *pinnæ* in subopposite fascicles, (the lower generally in pairs,) sub-4 farious, (upper series sub-ascending, lower very spreading, but obliquely) canaliculate, conduplicate at the base, glaucescent, subulato-acuminate, 10 inches long, 6 lines wide, those next the spinous ones, which occupy the lowest 8-10 inches of the petiole, longest and narrowest. The *spadix* is 1-1½ foot long, the peduncle well exserted from the axilla and compressed.

This can scarcely be Roxburgh's plant, since it has a distinct stem and fasciculate pinnæ. It seems exactly intermediate in foliage between P. acaulis and P. dactylifera of these Gardens.

68. (4.) P. *sylvestris*, arborea, pinnis densis fasciculatis rigidis lineari-ensiformibus conduplicato-canaliculatis acuminatissimis, fructibus cylindraceo-oblongis, embryone ad vel supra centrum faciei dorsalis.

P. sylvestris. *Roxb. Hort. Bengh. p.* 73. *Fl. Ind.* 3. *p.* 787. *Icones.* (fl. et. fr.) 15. *t.* 31. *Ham. Comm. Hort. Mal. Linn. Trans.* 15. *p.* 86. Katou-indel. *Rheede. Hort. Mal.* 3. *t.* 22-25.*

Hab.—Common all over India, all soils and situations seeming to suit equally well. Flowers at the beginning of the hot-season, (Roxb.)

* The fruit here figured is very much smaller, and of a different shape than it is in Bengal, at least on uninjured trees.

The most common Palm of India. *Buchanan Hamilton.* Beng. *Khujjoor*; Sansc. *Khurjura;* Teling. *Pedda eita.*

Descr.—A very handsome palm, often when uninjured by extracting toddy, 35-40 feet in height. *Trunk* rough from the persistent bases of the petioles. *Crown* about hemisphærical, very large and thick. *Leaves* 10-15 feet long. *Petiole* compressed only towards the apex; at the base bearing a few channelled triangular short spines. *Pinnæ* very numerous, densely fascicled, glaucous, rigid, ensiform, 18 inches long, 1 inch 3 lines wide, conduplicate at the base, then canaliculate, subulato-acuminate, almost spinous pointed, 4 farious, some intermediately spreading, others crossing these above and below in an ascending direction. *Male spadix* 2-3 feet long: peduncle highly compressed. *Spathes* of about the same length, very coriaceous, almost woody, covered with brown scurf, separating into two boat-shaped valves. *Spikes,* exceedingly numerous towards the apex of the peduncle, and chiefly on its anterior face, generally in fascicles and simple, 4-6 inches long, slender, very flexuose. *Flowers* 3 lines long, very numerous, angular, oblique. *Calyx* cup-shaped, with three short rounded teeth. *Petals* 3-4 times longer than the calyx, concave, warty on the outside, on the inside deeply ridged and furrowed. *Filaments* (free,) scarcely any. *Anthers* linear, adnate, a little shorter than the petals.

Female spadix much the same, as are the spathes. *Spikes* inserted in distinct groups, 1-1½ foot long, not bearing flowers throughout the lower 4-6 inches, flexuose. *Flowers* distant, roundish. *Calyx* cup-shaped, obsoletely three-toothed. *Petals* 3, very broad, much convolute-imbricate, leaving a small opening at the apex. *Barren stamina* 3-4. *Ovaria,* three; *ovules* solitary. *Style* recurved, inwardly papillose.

Spadix of the fruit 3-feet long, nodding at the apex from the weight of the fruit, very compressed, of a golden orange colour. *Fruit* scattered on long pendulous nodding similarly coloured spikes, with brown orange swollen bases, oblong, very obtuse, 14 inches long, 7-8 lines wide, with an oblique mark of the base of the style, surrounded at the base by the perianth. *Pulp* yellow, moderate, very astringent, lined by irregular cellular white tissue, part of this adheres to the thin envelope that separates with the seed. *Seed* oblong, deeply grooved (margins of the groove slightly wrinkled) along its whole length on one side, on the other with a slight incomplete furrow, in the centre of which is a depression with a mammillate fundus, the situation of the embryo. *Albumen* on a transverse section horse-shoe-shaped. *Embryo* at or a little above the middle of the dorsal face.

My materials do not enable me to point out any distinction between this and P. dactylifera,* the true Date Palm. In appearance they would seem to be indistinguishable. Roxburgh says nothing in the Flora Indica regarding this in explication of his specific character. But in a pencil note to the unfinished drawing of P. sylvestris, he says the male flowers of P. dactylifera are most exactly like. Buchanan Hamilton considers it the wild state of the true Date Palm, so much cultivated in Arabia and Africa, and states, that on comparing young plants, he had not been able to see the smallest difference, except that the Arabian plant was rather the largest and more vigorous.† Compared with Gærtner's figure of P. dactylifera, 1, t. 9. the fruit of P. sylvestris is considerably smaller. The embryo also is on the central line.

I have only seen Martius's character of P. dactylifera, (loc. cit.) at which species the Botanic Garden copy of his Palmæ breaks off.

* The plant called Phænix dactylifera of these Gardens does not attain a greater height than 4-5 feet. *Trunk* remarkably stout, 1 foot or more in diameter, marked with the scars of the petioles. *Leaves* 7-8 feet long. *Petioles* compressed a long way down, in the lower 2 feet bearing many stout rigid channelled spines. *Pinnæ* fascicled, their direction as in P. sylvestris, but in a less marked degree, bifarious when young, 1 foot long, 1 inch broad, subulato-acuminate, those next the spines longest and narrowest.

Spadix 2-2½ feet long, branched at the apex; *peduncle* 1-1½ foot long, much compressed.

This plant is evidently closely allied to P. sylvestris, and with P. farinifera of the Gardens forms a complete transition from P. sylvestris to P. acaulis. Both it and this so-called P. farinifera require more examination.

† Comm. in Hort. Mal. op. cit. p. 82, 83, 85.

"This tree yields *Tari*, or Palm wine, during the cold seasons. The method of extracting it destroys the appearance and fertility of the tree. The fruit of those that have been cut for drawing off the juice being very small.

"The mode of extracting this juice is by removing the lower leaves and their sheaths, and cutting a notch into the pith of the tree near the top, from thence it issues and is conducted by a small channel made of a bit of the Palmyra tree leaf into a pot suspended to receive it. On the coast of Coromandel this Palm juice is either drunk fresh from the tree, or boiled down into sugar, or fermented for distillation, when it gives out a large portion of ardent spirit commonly called *Paria aruk* on the coast of Coromandel. Mats and baskets are made of the leaves.

"The Bengalees call this tree *Khujjoor*. They also boil the juice into sugar. In the whole Province of Bengal about fifteen thousand maunds, or about a hundred thousand hundred-weight, is made annually. At the age of from seven or ten years, when the trunk of the trees will be about four feet high, they begin to yield juice, and continue productive for twenty or twenty-five years. It is extracted during the cold months of November, December, January, and February; during which period, each tree is reckoned to yield from one hundred and twenty to two hundred and forty pints of juice, which averages one hundred and eighty pints; every twelve pints or pounds is boiled down to one of *Goor or Jaguri*, and four of *Goor* yield one of good powder sugar, so that the average produce of each tree is about seven or eight pounds of sugar annually.

"Another statement presented to me, gives a much larger produce, viz. the average produce of each tree is sixteen pints per day, four of which will yield two pounds of molasses, and forty of molasses will yield twenty-five pounds of brown sugar. The difference is so great, that I cannot well reconcile them, but am inclined to give most credit to the first.

"Date sugar, as it is here called, is not so much esteemed as cane sugar, and sells for about one fourth less." *Roxb. o. c. l. c.*

69. (5.) P. *paludosa*, arbuscula, trunco basi annulato, pinnis solitariis bifariis ensiformibus acuminatissimis patenti-

nutantibus, spathis antice aperientibus, spadicibus exsertis, fructibus ovatis, embryone hilum versus.

P. paludosa, *Roxb. Hort. Bengh. p.* 73. *Fl. Ind.* 3. *p.* 789. *Icones.* 15. *t.* 33, (indifferent.)

Hab.—The Sunderbuns, where it forms a considerable portion of those impenetrable woods which completely cover that extensive tract of country, (*Roxburgh.*) Along the Salueen, between Amherst and Moalmain. Penang, (*Mr. Lewes,*) where it is known by the name *Dangsa.* Sansc. name *Hintala;* Bengal. *Hintal.*

Descr—The specimens in the Botanic Gardens form very elegant impenetrable tufts. *Trunk* 12-15 feet high, 3½ inches in diameter, annulate at the base, otherwise covered with the brown, retiferous, armed petioles. *Leaves* gracefully spreading, 8-10 feet long. *Petiole* covered with scurf, brownish-glaucescent, in the lower 3 feet bearing irregularly spreading, hard, brown, triangular, channelled, rather long spines. *Pinnæ* bifarious, solitary, spreading, then curved downwards, not rigid, 2 feet long, 8 lines wide, exceedingly acuminate, bifarious, conduplicate at the base, otherwise flat, underneath glaucous-cæsious, the lowest longest and narrowest. *Spadix* (*male*) about a foot long. *Spathes* coriaceous, bicarinate, opening anticously, orange brownish; keels with irregular edges, that of the spadix about equalling it: of the female half as short. *Flowers* yellow, more distant than in the other species. *Calyx* cup-shaped, less regularly three toothed than in P. sylvestris or farinifera. *Petals* three. *Filaments* six, short.

Spadix (female) about 1½ foot long, flowers greenish. *Calyx* as in the male. *Petals* roundish, concave. Sterile *stamina* 6. *Ovaria* three, styles recurved, longer than in the other species.

Spadix of the fruit 3-4 feet long, erect, yellowish orange, branched at the apex. *Spikes* of the same colour, generally several together, with cartilaginous thickened bases, about a foot long, nodding, rarely branched. *Fruit* sessile, on thickened knobs, spreading or pointing downwards, first yellowish, then red, lastly black-purple, oval, 6-7 lines long, 3-4 wide, with a small oblique apiculus at apex, at the base the more or less split perianth. *Seed* ovate, compressed, with a rather deep furrow on one side, ceasing just above the middle, and with an indistinct furrow on the opposite side. Groove of the *albumen* deeper at either end than in the middle. *Embryo* near the base.

This species is not likely to be confounded with any other. Its habit is less genuine than in the others. It is at once distinguished by the bifarious flaccid flat solitary pinnæ, the shape of its fruit and the situation of the embryo.

"The trunks of the smaller trees serve for walking sticks, and the natives have an idea that snakes get out of the way of any person having such a staff. The longer ones serve for rafters to their houses, and the leaves for thatch." *Roxb.*

It is well worth cultivation on account of its elegance, and its being adapted for bank scenery.

So far as I know, it is the most southerly species of the genus, at least of the Northern hemisphere.*

(To be continued.)

On some Plants in the H. C. Botanic Gardens. By W. GRIFFITH, *Esq., Corr. Memb. Royal Acad. Soc. Turin. etc. etc. Asst. Surgeon, Madras Establishment.*

GEODORUM.

Jackson in Andr. Bot. Rep. 10. *t.* 626. *R. Brown in Hort. Kew. ed.* 2. 5. *p.* 207. *Endl. Gen. Pl. p.* 200. *No.* 1433. Cistella. *Blume. Tabellen.* 55. Limodorum. *Roxb. Cor. Pl. t.* 39-40.

* I have very lately received the leaves and fruit spadices of a fifth species from Dr. Wight, who informs me that he communicated imperfect specimens of the same to Dr. Martius many years ago with the MSS. name P. pedunculata. It appears to be at once recognisable by the great length of the peduncles of the fruit spadices, which are 3½-4 feet long. An account will appear in the Supplement.

Char. Gen.—*Sepala* et *petala* subconformia, subsecunda. *Labellum* cucullato-ventricosum, sessile, cum columna continuum, basi sub-calcaratum. *Anthera* bilabiata. *Pollinia* 2. postice foveolata.

Habitus.—Herbae *terrestres tuberosae.* Folia *plicata.* Scapi *apice recurvato-penduli.* Flores *saepissime spicati, congesti, postici.*

G. *laxiflorum,* (n. sp.) scapo foliis breviore, spica pendula laxiflora, sepalis oblongis, petalis oblongo-ovatis duplo latioribus, labello subcalcarato rotundato cochleariformi a medio supra dilatato undulato emarginato.

Hab.—Assam, *Major Jenkins.* Flowers here in May.

Descr.—Old *stems* or tubers short, obturbinate, marked with the scars of fallen leaves. *Leaf stem* about a foot high, including the *leaves* which are 3-5, the more perfect 8-10 inches long, ovate-lanceolate, conduplicate, sub-acuminate, undulate. *Scape* twice as short, with a few membranous, whitish sheaths. *Bractes* narrow-lanceolate, shorter than the ovarium. *Flowers* 8-10, whitish, rather large. *Perianth* spreading. *Sepals* linear-oblong, obtuse, the lateral rather broader, with oblique emarginate points. *Petals* oblong-lanceolate, twice as broad. *Labellum* sub-calcarate at the base, roundish, cochleariform, entire, upper-half undulate, sub-deflexed, emarginate: colour white, floor tinged with yellow, at the base where it is joined with the labellum is a patch of purplish, short cellular hairs. *Column* stout, short, with similar but more minute hairs at the base: lateral teeth of the apex distinct. *Anthers* whitish, lower lip chiefly purple. *Clinandrium* shallow, prolonged or acuminate behind, its floor keeled, with a conical shining tooth towards the stigma, with which it is apparently continuous. *Pollen-masses* oblong, excavate behind. *Caudicula* broadly spathulate, cucullate towards the pollen-masses. *Gland* roundish.

This species is nearly allied to G. dilatatum, (Limodorum recurvum, Roxb.) but differs from it in the thinly flowered spike, the broad petals, and the round cochleariform entire labellum, which when spread out is of a cordate shape.

G. *appendiculatum*, (n. sp.) scapo foliis breviore, spica pendula, floribus congestis, sepalis lineari-vel spathulato-oblongis, petalis oblongo-ovatis latioribus, labello subcalcarato apice late obreniformi fundo (partis centralis) cristato, columna basi elongata in pedem subæquantem.

G. dilatatum, *Lindl. Bot. Reg.* 8. *t.* 6?

Hab.—Assam. Flowers here in May.

Descr.—A foot or rather more in height. *Leaves* about four, oblong-ovate, shortly acuminate. *Scape* a span in height. *Spike* pendulous. *Bractes* linear-lanceolate, acuminate, longer than the ovaria. *Flowers* crowded, white. *Sepals* linear-oblong, nearly equal. *Petals* ovato-lanceolate, rather broader. *Labellum* subcalcarate, keeled below along the middle, with a reniform emarginate crenato-repand apex, when flattened out almost three-lobed. The floor, along the upper half presents a flat slight elevated *crest*, terminating in a toothed or denticulate manner at the base of the reniform part. *Column* produced at the base into a foot nearly as long as itself, white; lateral *teeth* of the apex obsolete. *Pollen masses* oblong, roundish. *Caudicula* short, narrower than usual. *Gland* roundish, comparatively small.

This species is nearly allied to G. pallidum, but is distinguished by the shape of the crested labellum and the prolonged base of the column.

A drawing of it exists here, among those executed during Dr. Wallich's superintendence, named Geodorum pallidum, *Don*, an erroneous name, if Dr. Lindley's synonymy of G. pallidum be correct. A variety exists with flesh-coloured flowers, and the labellum variegated with purple, this I apprehend is the G. dilatatum, Bot. Reg. loc. cit.

G. *pallidum*, scapo foliis breviore, spica pendula, floribus congestis, sepalis lineari-oblongis subæqualibus, petalis oblongo-lanceolatis duplo latioribus, labello sub-calcarato sub-trilobo lateribus basin versus erectis columnam fere obtegentibus apice dilatato fundo processigero.

G. pallidum, *Don. Prodr. Fl. Nepal. p.* 31. ? *Lindl. Gen. et Sp. Orch. p.* 176. Limodorum candidum. *Roxb. Icones. Suppt.* 5. *t.* 103. *Fl. Ind.* 3. *p.* 470. Bêla-pôla. *Rheede. Hort. Mal.* 11. *t.* 35. ?

Hab.—Sylhet. Moulmein. Flowers here in April and May.

Descr.—*Spike* pendulous, conical. *Flowers* rather small, crowded. *Sepals* linear oblong, the lateral ones rather broader. *Petals* oblong-lanceolate, twice as broad. *Labellum* keeled below, sub-calcarate, almost three-lobed, the side towards the base erect and almost concealing the column, dilated about the middle, apex emarginate, subtruncate with revolute margins, the floor with indistinct irregular cellular longitudinal processes. *Column* short, sprinkled in front with purple dots; lateral *teeth* of the apex obsolete or small, bluntly conical.

This appears to me to be Roxburgh's Limodorum candidum; as it agrees tolerably well with the figure quoted above. It appears to me sufficiently distinct from Roxburgh's drawing of Limodorum recurvum, (G. dilatatum,) to which Dr. Lindley seems inclined to refer it, by the small flowers, narrow sepals, and the shape and disposition of the labellum.

G. *attenuatum* (n. sp.) scapo foliis breviore, spica nutante pendula, floribus congestis ascendentibus vel erectis, sepalis petalisque subæqualibus oblongis, labello ecalcarato calceolariformi e basi dilatata bicristata attenuata, columna nanissima.

Hab.—Burmah. Flowers here in May.

Descr.—About 10 inches or a foot in height. *Leaves* about 3, ovate or oblong-ovate, acute, 4-6 inches long. *Scape* about twice as short. *Spike* truncate. *Bractes* whitish, linear, about as long as the ovaria. *Flowers* white, inodorous, ascending or erect. *Perianth* less spreading than usual. *Sepals* oblong, mucronulate, the lateral rather broader. *Petals* more oblong, rather broader. *Labellum* ecalcarate, keeled along the middle underneath, very concave and broad below the middle, above attenuate into a concave, almost conduplicate, emarginate, crenated apex. It has two short converging *crests* at the base, which leave a small cavity between them. Colour white, crests and attenuated apex yellow. *Column* very short, stout, sprinkled with purple cellular pubescence below the stigma and along the broad line of union of the lip. A bidentate tooth on either side of the apex. *Anthers* white, with dark purple sides and under-lip. *Pollen masses* oblong. *Caudicula* broad, short. *Gland* very broad and large.

This species is at once recognised by the as it were truncate spike, the ascending flowers, less spreading perianth, shape of the labellum and extremely short column.

A drawing of it exists, marked in pencil G. candidum, Wallich, without any description or explanation, or information. This same name will be found in No 7374 of this Botanist's Catalogue, and is referred to G. pallidum, (Don.) in Lindl. genera and species. The Limodorum candidum of Roxburgh, as has been seen, is a very different plant. It is one among many instances that a Botanist, who attaches MSS. names profusely and without examination, who thinks Herbaria useless to Indian Botanists, and who does not even keep his series of drawings complete, can never be sure of recognising one of his own species. And if in a small genus of 6-8 species one or two instances of such confusion arise, what may not be expected in extensive genera; what cumbersome and useless additions to synonymy, if any, the least, attention be paid to such names.

The remaining Indian species of this genus are as follows:—

G. *purpureum*, scapo foliis longiore, racemo pendulo, floribus alternis, labello ovato acuto picto.

G. purpureum. *R. Br. in Hort. Kew. ed. 2da. 5. p.* 207. *Lindl. Gen. sp. Orch. p.* 175. Limodorum nutans. *Roxb. Corom. Pl.* 1. *t.* 40. *Icones* 13. *t.* 63. *Fl. Ind.* 3. *p.* 470. Malaxis nutans. *Willd.* 4. *p.* 93.

Hab.—Moist valleys among the Circar hills. (*Roxb.*)

Roxburgh's drawing represents a spike not a raceme: it is the only Indian species yet known in which the scape exceeds the leaves in length.

G. *citrinum*, scapo foliis breviore, spica pendula, floribus congestis, sepalis petalisque æqualibus acuminatis, labello subcalcarato apice obtuso integerrimo.

G. citrinum. *Andr. Bot. Rep.* 10. *t.* 626. *R. Br. in Hort. Kew. ed.* 2-5. *p.* 207. *Lindl. Gen. sp. Orch. p.* 176.

Hab.—Pulo Pinang. Chittagong.

Flowers large, straw-coloured. *Labellum* yellow at the apex and marked on either side with a faint purple intromarginal line.

G. *dilatatum*, scapo foliis breviore, spica pendula, floribus congestis, sepalis petalisque (latioribus) oblongo-lanceolatis, labello subcalcarato apice dilatato crenulato.

G. dilatatum. *R. Br. in Hort. Kew. ed. 2da.* 5. *p.* 207. *Lindl. Gen. sp. Orch. p.* 175. Cistella cernua. *Blum. Bijd. p.* 293. *Tabellen. t.* 55. Limodorum recurvum. *Roxb. Corom.* 1. *t.* 39. *Icones* 13. *t.* 62. *Fl. Ind.* 3. *p.* 469. Malaxis cernua. *Swz. Willd.* 4. *p.* 124.

Hab.—Valleys among the Circar Hills.

Roxburgh's figure of this species, (Cor. Pl. loc. cit,) which is copied from his original drawing referred to above, represents the flowers as larger, the labellum shovel-shaped or panduriform, yellowish in the lower half, longitudinally veined with purple in the dilated apex.

The following may be proposed as a temporary arrangement of the species.

1. G. purpureum.
2. — attenuatum.
3. — pallidum.
4. — dilatatum.
5. — appendiculatum.
6. — laxiflorum.
7. — citrinum.

EXPLANATION OF PLATE XXIV.

Geodorum laxiflorum.

1. End of a spike.
2. Flower, in front.
3. Labellum, ditto.
4. Labellum and column.
5. Anther, under face.
6. Pollen masses, front and back views.
7. Column and stamen in front.

Geodorum appendiculatum, (upper figures.)

1. Apex of a spike.
2. Flower in front.
3. Labellum and column.
4. Anther, under face.
5. Pollen masses, etc., back view.
6. Column viewed obliquely, anther removed.

Geodorum attenuatum, (under figures.)

1. Apex of a spike.
2. Flower, side view.
3. Labellum, obliquely.
4. Anther, under face.
5. Pollen masses, front.
6. Column, in front, anther removed. All but figures 1. of each series representing the spikes, more or less magnified.

APPENDICULA.

Blume. Bijdr. p. 207. *Tabellen.* 40. *Lindl. Gen. et Sp. Orch. p.* 227. *Endl. Gen. Pl. p.* 205. *No.* 1483.

CHAR. GEN.—*Perianthium* connivens. *Sepalum* tertium subfornicatum, lateralia cum pede columnæ adnata calcar obtusum saccumve mentientia. *Labellum* cum pede columnæ continuum, inclusum, indivisum, vel subtrilobum, appendicutum. *Columna* nana. *Anthera* dorsalis. *Pollinia* 8, vel abortu pauciora, in glandulam sessilia.

HABITUS.—*Epiphyticae.* Caules *simplices vel ramosi.* Folia *disticha; lamina dextrorsum sinistrorsum versa.* Vaginae *in paucis utrinque processu stipuliformi auctae.* Racemi *oppositifolii, vel* Glomeruli *paleacei terminales.* Flores *minuti.*

A. *callosa,* caulibus caespitosis simplicibus, foliis oblongo-parallelogrammicis basi deltoideo-cordatis apice bidentatis (sinu mucronato), glomerulis florum terminalibus paleaceis, petalis lineari-acuminatis, labelli sub-trilobi lobis lateralibus dentformibus centrali cordato-ovato basi calloso apice rotundato, columna apice biauriculata.

A. callosa, *Blume. Bijdr. p.* 303. *Lindl. Gen. et spec. Orch. p.* 230.

HAB.—Penang. *Mr. Lewes.* Flowered here in October, succeeding well in broken potsherds.

DESCR.—*Stems* 6-10 inches long, tufted, erect or spreading, covered with the sheaths of the leaves, which have black scarious margins, and are prolonged at the apex on either side into a linear-setaceous black process, *(stipula.) Lamina* of the *leaves* exactly bifarious, perpendicular, (looking right and left,) oblong, parallelogrammic, deltoideo-cordate at the base, at the apex bidentate with the sinus mucronate: they are $2\frac{1}{2}$ lines long, $1\frac{1}{4}$ broad, coriaceous, one-veined, parallel striate. *Head of flowers* terminal, oblique or sub-erect, paleaceous, sometimes proliferous. *Flowers* generally expanding one at a time, almost immersed in the paleae, minute, half-resupinate, whitish. *Perianth* ringent. *Sepals* acute, the anticous one ovate, concave, the lateral very oblique at the base and forming with the foot of the column and base of labellum a large roundish sac. *Petals* the length of the sepals, linear-acuminate. *Labellum* included, continuous at the base with the foot of the column with which and the lateral sepals it forms the sac, 3-lobed; the lateral lobes, (up to which it is parallel with the column,) tooth-shaped, erect, the central ovate-cordate, conduplicate, with minutely undulate margins; its base occupied by a sulcate subtrilobed callus. *Column* short, roundish, obliquely ascending, almost deficient behind, obtusely auriculate on either side at the apex, the auricles concave and sanguineous inside. *Rostellum* linear-linguiform, almost vertical, projecting beyond the auricles; *stigma* vertical. *Anthers* dorsal, fleshy, almost immersed, bilocular, cells 4-locellar. *Pollen masses* 8, clavato-pyriform, sessile on an oblong brownish gland. *Ovarium* 6-costate.

As it agrees tolerably with Blume's character, I have referred it to his A. callosa. But it is to be regretted that such short insufficient characters should be resorted to, when such variation in form runs through so many organs. Characters should always be as prospective as possible, and with this view should express the peculiarities of each of the organs from which they can be drawn.

The presence of the divisions on the margin of the sheaths near the base of the lamina is remarkable. They are probably analogous to such stipulae as those of Rosa, which are nothing but the lowermost undeveloped lobes of the leaf. Such stipulae have not, so far as I know, been hitherto observed in Monocotyledons, although the possibility of their existence is indicated by some species of Smilax and Dioscorea.

The section of Appendicula to which Blume refers this, is closely allied to Agrostophyllum, (and perhaps to Glomera,) from the former of which it differs only in habit, which is very peculiar, and the structure of the column.

EXPLANATION OF PLATE XXVI.

(left hand.)

Appendicula callosa.

Portion of a flowering stem, (natural size.)

1. Flower, or rather spike, laterally.
2. End of labellum, inner surface, in front.
3. Flowers, laterally, sepals removed.
4. Labellum and column, laterally.
5. Column, anther reflexed, laterally.
6. Anther, under face.

9. Column, front view, } foot removed.
8. Ditto, back, }

7. Pollen masses.

All but the figure of the flowering stem more or less magnified.

XIPHOSIUM.

Char. Gen.—*Perianthium* posticum, ringens, glabrum. *Sepala* carinata, lateralia cum pede columnae in gibberem connata. *Labellum* cum pede columnae articulatum, tremulum, trilobum. *Columna* pede elongato. *Anthera* terminalis. *Pollinia* 8, ope materie pulverea viscosa copiosa cohærentia. *Ovarium* triquetrum.

Habitus.—Rhizomata *repentia.* Pseudo-bulbi *unifolii.* Scapus *bracteis imbricantibus* (*quarum summa maxima conduplicato-ensiformis*) *obtectus.* Flores *variegati.*

Locus artificialis inter Epidendreas, Lindl., naturalis mihi ignotus.

X. *acuminatum,** (n. sp.) sepalis acuminatis, petalis cuneato-lanceolatis, labelli lobo centrali acuminato reflexo obsolete 1-cristato.

* A second species, may be thus distinguished.

*X. roseum,** sepalis obtusis oblongis, petalis oblongis, labelli lobo centrali obtuso patente tri-cristato.

Eria rosea. *Lindl. Bot. Reg.* 12. *t.* 978. *Gen. sp. Orch. p.* 67.

It may be proper to remark, that Dr. Lindley in his Gen. and Sp. places this without any specification in the body of the genus Eria, although in the Bot. Reg. l. c. he mentions the smooth flowers, and the carinate midrib of the sepals as peculiar to it.

* Char. e fig. et descr. in Bot. Reg.

Hab.—Khassya Hills, Churra Punjee, alt. 4300 feet. Flowers here in November.

Descr.—*Rhizomata* creeping, covered with imbricated scaly sheaths. *Pseudo-bulbs* ovate, rather compressed, obsoletely 4-cornered, young ones rather scurfy. *Leaf* (one to each pseudo-bulb,) oblong-lanceolate, attenuate into a longish channelled petiole, concave, coriaceous, acute, more or less arched. *Scape* arising from the base of the last pseudo-bulb, terminating the rhizoma, a span or a foot in length; the *peduncle* almost entirely concealed by imbricated green bractes, the uppermost one being very long, conduplicate-ensiform. From the fissure of this, about its middle, emerges a short *spike* of flowers, which are of some size, prettily variegated, and of a waxy aspect. To each of the 3-5 *flowers* there is a long, (equalling the whole flower,) linear, very acuminate spreading bracte. *Perianth* ringent, posticous. *Sepals* oblong-lanceolate, acuminate, keeled along the centre of the back; the lateral oblique, forming with the foot of the column a stout gibbosity; colour brownish red with red streaks, and green keels. *Petals* flesh-coloured, pale, with reddish streaks, lanceolate, attenuate to both ends, connivent, somewhat shorter than the sepals. *Labellum* articulated with the foot of the column, tremulous, three-lobed: lateral lobes small, roundish, erect, terminal sub-lanceolate, acute, with an obsolete crest along the centre, reflexed from the middle. An oblique inconspicuous crest at the base of each of the lateral lobes. The general colour sanguineous, central lobe tawny yellow. *Column* curved (with its foot forming a hook,) white, somewhat three-toothed at the apex; teeth rounded, anticous (dorsal) one the smallest. *Rostellum* entire, short, tongue-shaped. *Anther* fleshy, two-celled; cells 4-locellar. *Pollen masses* 8, cohering by fours with a large viscous elastic powdery-looking flat body. *Ovarium* triquetrous (almost three winged,) the angles continuous with those of the sepals, reddish brown.

I met with this plant about Churra Punjee in October 1837. It was introduced into these gardens, where *Buxoo* tells me it has been called Eria carinata, by Mr. Gibson.

It appears to me impossible to force this plant into a genus so natural as that of Eria, without violating all one's ideas of natural affinities; I have therefore ventured to constitute a new one, the name of which has reference to the sword-shaped bracte-imbricated peduncle, and which will include Eria rosea of Dr. Lindley. Technically it is distinguishable from Eria by the remarkable inflorescence, the smooth perianthium, carinate sepals and triquetrous ovarium. The habit is peculiar.

I imagine it would come as an Eria into Dr. Lindley's section Tonsæ, which appears to contain more than one genus, as exemplified by Eria convallarioides, planicaulis, clavicaulis ? although these are taken from a very partial list of species.*

EXPLANATION OF PLATE XXV.

(left hand.)

Plant reduced about one-half.

1. Flower and end of the spike, natural size.
2. Flower, laterally, sepals and labellum removed.
3. The same, one petal removed.
4. Labellum, laterally.
5. Anther, underface.
6. Pollen masses, in front.
7. Column and anther, in front.
8. Ovarium, double transverse section.

All but the figure of the Plant, and No 1, more or less magnified.

APORUM.

Blume Bijd. p. 334. *t.* 39. *Lindl. Gen. sp. Orch. p.* 70. *Endl. Gen. Pl. p.* 192. *No.* 1364.

Dendrobium. *Roxb. Fl. Ind.* 3. *p.* 487. 488. *No.* 13. 14. 15. *Icones.* 13. *t.* 72, 73.

Herba supplex. *Rumph. Hb. Amb.* 3. *t.* 51.

* Index Bot. Reg. 1838-1841.

Char. Gen.—*Perianthium* bilabiatum: labium superius sepalis et petalis, inferius labello formatum. *Sepala* lateralia obliqua, cum pede columnæ connata. *Petala* angustiflora. *Labellum* cum pede columnæ articulatum, indivisum vel trilobum, cristatum callosum vel nudum. *Columna* basi longe producta. *Pollinia* 4, per paria collateralia.

Habitus.—Herbæ *epiphyticæ.* Caules *simplices vel ramosi, apice in quibusdam flagelli in modo attenuati foliis denudati florigeri.* Folia *disticha, compressissima, sæpius scalpelliformia.* Pedicelli *florum basi paleis cincti.* Inflorescentia *centrifuga, vel irregularis.* Flores *terminales vel axillares, vel in speciebus caulibus apice attenuatis quasi racemosi, invicem expandentes, inconspicui.*

Genus structura floris a Dendrobiis quibusdam, (exempli gratia D. crumenato), nullo modo diversum. Folia nullo modo equitantiæ.

A. *Jenkinsii* (n. sp.), caulibus spithamæis, foliis anguste scalpelliformibus obtusis subteretibus, floribus solitariis terminalibus et axillaribus, labello spathulato-obovato apice sub-truncato undulato reflexo, columnæ pede longissimo trivenio apice bifurco.

Hab.—Assam, *Major Jenkins*, by whom it was introduced into these Gardens, where it flowers in October.

Descr.—*Stems* simple, grouped together, scarcely more than a span long. *Leaves* narrow scalpelliform, compressed, $2\frac{1}{4}$ inches long, $1\frac{1}{2}$ line broad, very fleshy, obtuse. *Flowers* terminal, solitary, rather large, white. *Pedicel* $1\frac{1}{2}$ inch long. *Perianth* two-lipped, upper lip formed by the sepals and petals, the lower by the labellum. *Upper sepal* lanceolate-oblong: the *lateral* much broader, very oblique, united with the foot of the column. *Petals* spathulato-lanceolate, rather narrower than the third sepal, with reflexed spreading points. *Labellum* entire, ascending-reflexed, revolute towards the apex, where it is emarginate; spread out spathulato-obovate, with folded or undulate margins; colour white, with a yellow line down the centre. *Column* very short, furnished with an erect small tooth on either side of the anther, with an extremely long curved foot, which is three-veined, bifurcate at the apex. *Stigma* occupying almost the whole face of the column. *Anther* sub-immersed, cucullate. *Pollinia* 4, pyriform, curved.

The flowers, which vary a good deal in size in distinct individuals, have the smell of Dendrobium crumenatum, but to a less powerful degree.

I have adhered to the usual terms in describing the column, although they are scarcely applicable, the prolonged foot belonging partly at least to the labellum and lateral sepals. Mr. Brown's character of Dendrobium, Prodr. Fl. N. Hol. p. 188, may have some reference to this, which, as it regards a diversity of origin of a structure much used in generic definitions, is worth investigation.

The following are the Indian species of this genus.

A. *Leonis*, foliis patentissimis breve et late scalpelliformibus obtusis, floribus terminalibus, labello lineari-oblongo pubescenti fimbriato-dentato apice emarginato subdilatato.

A. indivisum. *Bl. Lindl. Gen. Sp. Orch. p.* 70. A Leonis. *Lind. Bot. Reg.* 26. *misc. not. p.* 59. *No.* 126.

Hab.—Singapore. *Cumming.* Tanjong Cling. Ayer Punus (Rhim) Malacca.

Stems a span long. *Leaves* sometimes so much approximated that the stem resembles a coarse double-edged saw: varying in size, but always broadly and shortly scalpelliform. *Flowers* reddish brown (Lindl.), subsessile. *Petals* oblong-lanceolate, twice as broad as the third ovate sepal.

A. *anceps*, foliis scalpelliformibus ascendenti-patentibus acutis, floribus terminalibus vel axillaribus, labello cuneato emarginato crenulato.

A. anceps. *Lindl. Gen. sp. Orch. p.* 71. *Lodd. Bot. Cab. t.* 1895. Dendrobium anceps. *Swz. Lindl. Bot. Reg.* 15. *t.* 1239. *Roxb. Icon.* 13. *t.* 73. *Fl. Ind.* 3. *p.* 487.

Hab.—On trees, Delta of the Ganges and Irrawaddi, etc.

About a span in height. *Stems* simple or branched. *Leaves* often narrow lanceolate, *Flowers* green, or more usually brownish-ochroleucre. *Labellum* represented in Bot. Cab. with two reddish longitudinal lines.

A. *sinuatum,* " foliis lanceolatis equilateris approximatis acutis, floribus solitariis axillaribus, labello cuneato elongato intra apicem linea hippocrepica crassa sinuata circumdato."

A. sinuatum. *Lindl. Bot. Reg.* 1841. *misc. not. p.* 1. *No.* 3.

Hab.—Singapore. *Cumming.*

" It has the habit of A. anceps, but its leaves are much narrower and longer, and the flowers are pale yellowish green." *Lindl.*

A. *cuspidatum,* " foliis lanceolatis, floribus axillaribus, labello emarginato apice crispo per medium obsolete bilineato."

A. cuspidatum. *Lindl. Bot. Reg.* 1841. *misc. not. p.* 2, *No.* 7.

Sent by Dr. Wallich to Messrs. Loddiges.

A. *micranthum,* foliis lanceolato-scalpelliformibus approximatis acutis, floribus terminalibus, labello lineari-oblongo bilobo fundo appendice carnoso truncato aucto.

A. micranthum. *Griff. Calc. Journ. Nat. Hist.* 4. *p.* 375. *t.* 17.

Penang. *Mr. Lewes.*

Stem about a span high, simple. *Leaves* ascending, adpressed. *Flowers* white, minute, much smaller than in any other species. *Lobes* of the *labellum,* erroneously said (op. cit.) to be three-lobed, nulate.

A. *Roxburghii*, caule ramoso apice attenuato florigero, foliis scalpelliformibus acuminatis, floribus racemosis, labello cuneato apice trilobo crenulato lobo medio emarginato.

Dendrobium Calceolum. *Roxb. Icon.* 13. *t.* 73. *Fl. Ind.* 3. *p.* 488.

Hab.—Amboyna.

Flowers large, "dull orange, and slightly veined with dull-red." *Petals* linear spathulate, very narrow. *Labellum* represented as almost 4-lobed, or 3-lobed, with the central lobe emarginate.

The quotation from the Hb. Amb. in the Flora Indica is wrong. Roxburgh probably meant Herba supplex, t. 51. fig. 1.

The species appears to have been passed over entirely.

A. *acinaciforme*, caule ramoso apice attenuato florigero, foliis scalpelliformibus subacutis, floribus racemosis, labello obovato-cuneato emarginato leviter undulato.

Dendrobium acinaciforme. *Roxb. Icones.* 13. *t.* 72. *Fl. Ind.* 3. *p.* 487. Aporum Serra. *Lindl. Gen. sp. Orch. p.* 71. Herba supplex. *Hb. Amb. t.* 51, *f.* 2. (auct. Roxb.)

Hab.—Amboyna, *Roxburgh.*; Assam, *Major Jenkins.*

Habit much like that of A. Roxburghii. The *flowers* are however very much smaller, and yellow. *Petals* narrow lanceolate.

The Assam specimens vary a good deal, generally the stems are simple, the flowers whitish, and the labellum almost bilobed. Sometimes however the stem is branched: the leaves broader, and so compressed as to be almost flat, and the lip faintly spotted with red. In one instance the flower was solitary and terminal.

A. *subteres*, (n. sp.) caule subsimplici apice attenuato florigero, foliis distantibus subteretibus compressis arcuatis patentibus, floribus racemosis, labello spathulato emarginato plicato-undulato fundo sub-tricristato.

HABIT.—On trees. Ayer Punnus (Rhim), Malacca.

DESCR.—A slender species not exceeding a foot in height. *Stems* very flexuose, very attenuate. *Leaves* many times longer than broad. *Flowers* small. *Petals* linear spathulate, very narrow.

In general size this approaches to the Assam specimens of A. acinaciforme: it appears to be distinguished from all others, (setting aside Blume's species, the characters of which are quite insufficient,) by the narrow subterete, distant leaves.

EXPLANATION OF PLATE XXV.

(left hand.)

Aporum Jenkinsii.

Portion of a plant, natural size.

1. Flower, laterally.
2. Flower, in front.
3. Labellum and column, laterally.
4. Labellum inner surface, in front.
5. Column and anther, obliquely, part of the foot of the column, removed.
6. End of the foot of the column.
7. Column and anthers, back view.
8. Upper part of the column with the anther, in front.
9. Anther, under face.
10. Pollinia.

All but the figure of the plant more or less magnified.

EUPROBOSCIS.

CHAR. GEN.—*Perianthium* posticum, connivens, carnosum. *Sepala* lineari-oblonga, lateralia conduplicato-carinata. *Petala* anguste lanceolata, (apice reflexa.) *Labellum* simplicissimum, integerrimum, semi-convolutum, cum basi columnae obliqua continuum. *Columna* verticalis, antice in rostellum bicrure longum attenuatum. *Stigma* verticale. *Anthera* dorsalis, rostrata. *Pollinia* 8 cerea, rotunda. *Caudicula* longissima. *Glandula* linearis.

Habitus.—Epiphytica, *cæspitosa.* Pseudobulbi *turbinati, novelli* 2-4 *folii.* Folia *carnosa, oblonga, emarginata.* Scapus *subclavatus, erectus.* Flores *spicati,* 1-*bracteati, minuti, viridescentes.*

Hab.—Nepal, communicated by Major H. Lawrence. Flowered here in March, April, 1844.
Euproboscis pygmaea.

Descr.—A minute plant, scarcely exceeding 4 inches in height, apparently forming thick tufts. *Pseudo-bulbs* turbinate. *Leaves* ovate-oblong, the smaller ones almost round, fleshy, emarginate, one-veined, channelled. *Scape* erect, 3-4 inches high, roundish, almost club-shaped with a few membranous sheaths. *Flowers* spiked, small, inconspicuous, green, scentless, suffulted by a small scale-shaped bracte, in bud depressed flat, two-edged. *Perianth* posticous, connivent; sepals nearly equal, oblong, fleshy, the lateral conduplicate-carinate. *Petals* narrow lanceolate, of the same length with the sepals, points recurved, spreading. *Labellum* the length of the sepals, very entire and simple, much like the petals, half-convolute, continuous with the base of the column. *Column* vertical, very short, very oblique indeed deficient behind, in front (anticously) elongated into a long rostrate two-legged rostellum. *Anther* parallel with the column, dorsal, fleshy, prolonged into a long beak. *Pollinia* 8, round, minute, incumbent in fours. *Caudicula* very long. *Gland* linear about half as long. *Ovarium* simple.

This is one of the many species that so much weaken the distinctions employed by Dr. Lindley to arrange naturally the plants of this difficult family. Its affinities appear to me to be with Neottieæ, particularly with certain pseudo-bulboid forms allied to Anœctochilus; yet its pollen masses are obviously waxy. In this respect and in the column generally, it approaches to Appendicula, the flower of which however does not depart from the ordinary structure of a natural section of Vandeæ.

I see nothing in Lindley's Gen. and Spec. approaching it technically except Appendicula, from which however it is too distinct to need any comparison.

EXPLANATION OF PLATE XXVI.

(right hand.)

Euproboscis pygmæa.

Plant, natural size.

1. Flower, obliquely,
2. Ditto, front of posticous face.
3. Flower, sepals removed.
4. Same, petals likewise removed, anther reflexed.
5. Pollen masses.

All but the figure of the Plant more or less magnified.

Correspondence.

Extract of a letter from M. Guibourt, *Professor of Pharmacy, Paris, to* *Dr.* Mouat, *Professor of Materia Medica, Calcutta.*

To the Editors of the Calcutta Journal of Natural History.

Dear Gentlemen—I am induced to forward to you for publication in your Journal, the enclosed extract from a letter addressed to me by Professor Guibourt of Paris, because it will be the means of widely making known, what are deemed by the first authorities in Europe, desiderata respecting the Materia Medica of India. I have succeeded in collecting a few specimens, and also some definite information respecting certain of the substances mentioned by Monsieur Guibourt; but my time is so fully and incessantly occupied in more immediate and pressing official duties, that I am quite unable, single-handed, to do justice to so important and interesting a subject. I venture, therefore, to solicit the aid and co-operation of all who take an interest in the matter, and are able from leisure and favourable position to collect specimens, and furnish me with any information concerning them. I shall be happy to defray every expense attendant upon collecting, packing, and transporting all specimens with which I may be favoured, and of acknowledging them, with the source from which they were derived, through the medium of your valuable Journal, if you will accord me your kind permission to do so.

I shall take a future opportunity of publishing the memoranda I am collecting, concerning those articles of the Indian Materia Medica, which may be introduced as efficient substitutes for the more costly drugs imported from Europe and America; as well as any which possess peculiar and valuable properties, hitherto unknown to us, or not yet established by competent and trustworthy authority. I am unwilling, however, to intrude myself upon the notice of the profession and the public with premature conclusions, or hasty, ill-conducted experiments, which subsequent trial and observation may prove to be unfounded and incorrect.

I have, &c.

FRED. J. MOUAT, M. D.

Medical College, 1*st Oct.* 1844. *Profr. of Materia Medica, &c.*

L'Inde est sans contredit l'une des contrées les plus riches en matière utiles à la Pharmacie, aux arts ou à l'économie domestique. Mais nous avons encore eu si peu de communications directes avec elle, que vous ne devrez pas etre étonné de notre ignorance sur des choses qui vous paraitront n'offrir aucune difficulté. De plus, la situation de Calcutta, qui en fait l'entrepôt central des productions l'Asie et d'une partie de l'Afrique, nous fait espérer que vous pourrez nous donner des éclaircissementa sur des objets étrangers au Bengale, mais qui doivent y arriver par la voie du commerce. Voici donc les substances sur lesquelles je desire principalement appeler votre attention.

Costus Arabique.—Racine long tems attribuée au *Costus speciosus* de la famille des Scitaminées. J'ai montré la fausseté de cette opinion, et j'ai pensé que le Costus devait être produit par une plante Synanthéreé* voisine des Carlines. Enfin j'ai supposé que cette racine etait originaire des contrées voisines du cours de l'Indus. Il serait utile de verifier ces différentes assertions et de nous envoyer la racine du *Costus speciosus*, afin de montrer sa différence avec le Costus arabique. Celui-ci est une racine grosse comme le pouce et plus, grisatre, d'une odeur forte d'iris et de boue melangées, d'une saveur amère et un peu âcre.

Bois de Couleuvre, ou *Lignum colubrinum.*—On a donné ce nom aux racines de plusieurs végéteaux qui ont jou idaus l'Inde de la réputatiox de guérir la morsure des serpents venimeux. Nous sommes desireun de nous les procurer toutes, et notamment les suivantes.

Racine du *Strychnos Nux Vomica.*

——— du *Strychnos colubrina*, ou *Modira Caniram* de Rheede.

——— du *Tsjeru-Katavalli-Caniram* de Rheede.

——— de *l' Ophioxylum serpentinum.*

——— de *l' Ophiorhiza Mungos.*

——— du *Soulama amar-ea.*

* Procurable in the Botanic Gardens.

Curcuma ou *Turmeric.*—Pourrait on avoir des échantillous d'herbier des differents Curcuma cultíves à Calcutta, ou croissant naturellement au Bengale ; chacune des espèces ètant accompagnée de la racine.*

Autres racines que l'on désire de procurer, avec les noms spécifiques des plantes *atch-root, bish, bishma* ou *bickma, nirbishee,* (Aconitum ferox,) *madar,* (Asclepias gigantea, procera,) *Periploca indica, Smilax zeylanica.*

Nard Indien, ou Spicanard.—Deux racines viennent de l'Inde sous ce nom, 1° le *vrai nard jatamansi,* produit par le *Valeriana Jatamansi* ou *Nardotaschys Jatamansi,* DC. et le *nard radicant de l'Inde,* ou *nard du gange* de Dioscoride, dont l'origine est encore inconnu. Pourrait on se procurer : 1° un individu sec du *Valeriana Jatamansi,* avec sa racine ; 2° un échantillon de quelques onces à une livre de *vrai nard jatamansi ;* 3° un individu sec du *Valeriana Hardwickii* de Wallich, avec sa racine ; 4° un individu sec du *Fedia grandiflora,* Wallich, ou *Nardostachys grandiflora.* Je soupçonne que cette espèce produit le nard radicant de l'Inde.

Rhubarb.—Dans ces derníères annèes quelques personnes ont attribués la rhubarb de Chine ou du Thibet an *Rheum australe.* Je la crois toujours produite par le *Rheum palmatum ;* mais pour en être plus certain nous prions M. Mouat de nous faire parvenir des échantillons certains des racines des differénts, *Rheum* qui croissent dans l'Himalaya ou qui sout cultivés à Calcutta.†

Ecorce d'Anacarde. (Semecarpus Anacardium.)—Nous desirons beaucoup nous procurer l'écorce de cet arbre,‡ et connaitre les différents noms qûélle peut porter dans l'Inde, ainsi que les usages auxquelles on peut l'employer.

Ecorce d'Alyxie aromatique.—Ecorce blanche, aromatique, venant des iles Moluques. Elle nous manque complètement.

Ecorce de Bé-lahé.—Ecorce tres amère employée comme fébrifuge à Madagascar et aux iles Maurice. Est elle connue à Calcutta ?

Autres écorces que l'on desire se procurer avec l'indication des arbres qui les fournissent :

Souroul-puttay, Naga-puttay, Konnay-puttay, Karoovelum-puttay, Kally-puttay, Marudum-puttay, Poola-puttay. Lodu-puttay, Odium-puttay, Awarai-puttay, Popli-puttay, Vaymbadum-puttay, Velum-puttay, Attico-puttay.

Bois d'Aloès.—J'ai essayé, dans *l'Historie abrègée des drogues simples,* de détruire la confusion quiexiste dans les différents bois *d'aloú,* de *calam-*

* No species of Rheum is cultivated here.

† Dr. Falconer has published this plant under the name Aucklandia Costus in a late number of the Linn. Trans. to which we have not access.

‡ Procurable in the Botanic Gardens.

bac, du'galloche, de *garo,* &c. et je pense avoir reconnu, soit dans les droguiers, soit dans le commerce, ceux de ces bois produits par *l'Aloexylum Agallochum, l'Aquilaria secundaria* ou *malaccensis,* et *l'Excœcaria Agallocha ;* mais ces déterminations ont besoin d'être confirmées par des échantillons puisès dans des lieux d'origine ; nous prions donc M. Mouat 1° de nous faire parvenir un échantíllon de chacun des bois d'Aloù, de Calambac ou d'Agalloche que l'on trouve dans le commerce de l'Inde, avec les notions que vous pourrez recueillir sur leur origine.

2°. De nous procurer, indépendamment de cela, s'il est possible, le bois authentique de chacun des arbres suivants : *Aloexylum Agallochum, Aquilaria secundaria, Excœcaria Agallocha,** *Michelia Champacca.*†

Santal citrin. Peut-on se procurer des échantillons certains de *Santal citrin* du *Malabar,* de la *Cochinchine* et de *Timor,* afin d'en reconnaître les différences de qualìté signalées par les auteurs. Vieut-il du *Santal citrin* des iles Sandwich, où est il produit par le *Santalum Freycinetianum.*

Santal blanc à l'odeur de rose.—Jâi décrit sous ce nom un bois que l'on trouve quelquefois en petite quantité dans le commerce de la droguerie à Paris. Il est en bûches peu volumineuses, cylindriques, pourvues d'une ècorce grise, assez dure et compacte. Le bois est très pesant, très dur, très compact, comme imprègnè d'huile, susceptible d'un beau poli ; il a une saveur amère et une odeur de rose tres marquée. L'origine en est inconnue. Trouve t'on quelque chose de semblable dans le commerce de l'Inde?

Y trouve t'on egalement du *bois violet* et du *bois de roses* venant de la Chine?

Plusieurs ouvrages font aussi mention d'un *bois d'agra,* que l'on dit pourvu d'une odeur très agréable et être très estimé en Chine. Le connait on dans l'Inde?

Bois de Santal rouge et Caliatour.—D'après Rumphius le *Bois de Caliatour* serait le meme que le Santal rouge de l'Inde ; mais on observe entre eux des différences, si constantes dans la couleur et la texture que je les regarde comme produits pour le moins par deux espèces différentes de *Pterocarpus.* Voici donc les questions que je propose de résoudre.

1°. Le *Bois de Caliatour* vient-il du Coromandel, de Ceylon, de Madagascar, ou de la côte d'Afrique? Connait on l'arbre qui le produit?

2°. Le *Bois de Santal rouge dé l'Inde (Pterocarpus Santalinus* ou *Segapooshandanum)* peut-il être distingué du *Santal rouge des iles Moluques,* que je crois produit par le *Pterocarpus indicus ?*

3°. Peut on se procurer les bois du *Santal rouge d'Andaman,* produit parle *Pterocarpus d'albergioides ?*

* Procurable in the Botanic Gardens. † Ditto.

4°. Peut-on se procurer les bois du *Pterocarpus flavus*, et du *Pterocarpus Marsupium ?* Ces différents arbres laissent découler des sucs rouges, auxquels on a donné longtems le nom de *Sang dragon*, mais qui font probablement partie des Kinos actuels du commerce.

Autres Bois que l'on desire se procurer.

Bois rouge de l'Inde. *Inga bigemina.**

Autre bois rouge de l'Inde ou *Shem-marum. Swietenia febrifuga.*†

Bois satiné de l'Inde. *Swietenia Chloroxylon.*‡

Bois jaune de l'Australasie. *Oxleya xanthoxyla.*

Diababul de l'Inde. *Acacia arabica.*§

Carin-towarai-marum.

Poorsung-marum.

Weskali-marum.

Waghai-marum.

Poollicem-marum. *Tamarindus indica.*||

Feuilles dites, *Cassa elley*, et leur nom botanique.

Fruits ou semences huileuses nommées, *Mara-enney.*

Fruit nomméé *Boa-tam-paijang* ou *Boochgaan tam-paijang*, quel est l'usage de ce fruit dans l'Inde ? ai-je eu raison de l'attribuer au *Sapindus rubiginosus*, Roxb.

Lichens tinctoriaux de l'Inde. Des échantillons avec l'indication des couleurs qu'iles peuvent produire.

Produits Vêgêtaux.

Suc d'Aloès.—Echantillons des différents aloès employés daus l'Inde, avec l'indication des contrées et des espèces *d'aloe* qui les fournissent aìnsi que le procédé d'extraction.

Opium.—Un echantillon des différents opiums commerciaux fabriqués dans l'Inde, et des détails sur la manière de les obtenir.

Cachous, Gambeers et Kinos.

Nous sommes très desireux de nous procurer des échantillons de tous les sucs astringents employés dans l'Inde, et qui sont connus en Europe sous les noms ci-dessus, et nous aurions une grande obligation à M. Mouat s'il pouvait y joindre une notice sur les contreés et les arbres qui fournissent chaque espèce. Voici principalement les sortes sur lesquelles nous dèsirons des renseignements.

1°. *Cachou de Colombo* en Ceylon.

2°. *Cachou de Mysore* nommé *Coury.*

3°. Autre *cachou de Mysore* nomme *Cassu.*

* Procurable in the Botanic Gardens. † Ditto. ‡ Ditto.
§ Ditto. || Ditto. ¶ Ditto. ** Ditto.

4°. *Cachous* des provinces supérieures du Gange apportés à Calcutta.

5°. *Cachou blanc* ou *Katha Suffaid.*

6°. *Cachou de Pégu* nommé aussi *Cascaty*, ou *Cashcuttie.* Quel arbre le produit?

7°. *Cachou de Siam.*

8°. *Gambeer cubique.*

9°. *Gambeer cubique de Java.*

10.° *Gambeer prismatique jaune de Singapore*, ou *Gambeer en aiguilles.*

11°. Les differents Gambeers circulaires et *estampés* ou marques d'an cachet.

12°. *Cata gambra* du Japon.

13°. Suc astringent du *Pterocarpus Marsupium.*

14°. ———————— ———— *santalinus.*

15°. ———————— ———— *indicus.*

16°. ———————— ———— *dalbergioides.*

17°. ———————— *Butea frondosa.*

18°. ———————— de *L'Eucalyptus resinifera* de l'Australasie.

19° Quelle est l'origine de la substance nommée en Angleterre *East Indian Kino*, ou *Amboyna Kino?*

20°. Quelle est l'origine du suc astringent nommé *Facaoli, Tagale* ou *Takale ?*

Sagou.—Les différentes espèces apportées par le commerce, avec leur lieu d'origine et des notions sur les arbres qui les produisent.

Gommes de l'Inde.—Les différentes gommes solubles dans l'eau et analogues à la gomme Arabique, que l'on récolte dans l'Inde, soit quelles proviennent d'Acacia, soit quelles soient tirees d'autres arbres.

Bdellium de l'Inde.—Il nous est arrivé, il ya quelques années, une gomme résine brunatre, un peu molle, que l'on a cherché à vendre sous le nom de *Myrrhe de l'Inde*, mais qui etait plutôt une sorte de bdellium. La connait on à Calcutta?

Copal dur et Copal tendre.—De quelle contrée vient la Résin Copal qui arrive de l'Inde, et principalement de Calcutta en Europe? En supposant que le Copal ne soit pas originaire de l'Inde, ou du Bengale, y mèle-t-on, dans les entrepôts de l'Inde, quelque résine indienne? quelle est, entràutres, l'origine d'une résine en belles larmes ovoídes, transparentes, vitreuses et presque 'incolores, que l'on trouve mèlée au copal?

Peut t'on se procurer la résine du *Vateria indica* on *Elœocarpus copalliferus?* et celle des différents *Dammara* des iles Moluques, surtout la résine du *Pinus Dammara* ou *Dammara alba* de Rumphius?

De même celles des *Canarium, Amyris* et autres arbres résineux de l'Inde ou des îles Moluques?

Gomme Gutte—Poùrroit ou enfin connaitre par un échantillon authentique avec fleurs et fruits, l'arbre dont ou extrait la Gomme Gutte dans le pays de Pegu et de Siam? Trouve ton de la gomme gutte extraite du *Carcapuli, Cambogia Gutta,* L. ou *Garcinia Cambogia,* DC.? et de la gomme gutte de Ceylon extraite du *Garcinia Morella,* DC. ou *Hebradendron cambogioides* de Graham?

Résine Laque.—De quelle partie de l'Inde vient principalement la résine Laque? Sur quels arbres la trouve-t-on principalement? Quel est, entr' autres, l'arbre qui produit la *Laque en bâtons de Mysore,* nommée je crois *Komburruk?* Quelle preparation fait-on subir à la laque pour la convertir en *Laque plate* ou *Laque* en *écailles,* ou pour fabriquer le *Lac-laque* et *Lac dye?*

Styrax liquide.—Cette substance fait elle partie de la matière médicale de l'Inde? De quelle contrée la tire t' on? Quel arbre la produit?

Benjoin.—Se procurer des échantillons des différentes sortes de Benjoin du commerce à Calcutta, avec leur lieu d'origine.

Camphre de Bornéo, du *Dryobalanops Camphora,* et *Huile de camphre* du meme.

Monsieur.

Je crains que l'étendue des notes précédentes, le nombre de demandes qui vous sont faites ne vous fassent repentir de vos offres de service, vous voyez, dans tous les cas, que nous ne sommcs pas gens à négliger celles qui nous sont faites. Nous vous faisons nos excuses d'en user si librement avec vous, et nous recevrons avec reconnaissance les communications que vous voudrez bien nous faire, relatives aux sujets demandés, ou à tous les autres qui vous paraîtront devoir fixer notre attention.

Je suis, Monsieur et honoré confrère, avec la plus parfaite consideration.

Votre tres humble serviteur,

G. Guibourt,

Paris, Rue Fedeau, No. 22. *Professeur à l'Ecole de Parmacie.*

Note on the Snow Line on the Himalaya. By Capt. T. Hutton, *Bengal Army.*

It would appear from Captain Jack's remarks in No. 15 of this Journal, relative to my paper on the snow line of the Himalaya, that I have inadvertently allowed myself to be misunderstood. The truth of the main point for which I contended, is admitted by Captain Jack, and likewise I suspect by yourself, namely that *the snow lies no longer deeper and lower down on the Northern aspect of "the Himalaya," than it does on the Southern aspect;* this being admitted, the minor points may be easily disposed of.*

Captain Jack objects to my stating that "dense forests and vegetation occur along the Southern slopes while they are nearly altogether wanting on the Northern face;" in making this statement, I referred, not to the Southern slopes of *secondary or minor ranges on the Cis-Himalayan aspect,* but to the fact that forests and dense vegetation are found on the South of the principal chain or true Himalaya, while on the Northern aspect of that great range they are nearly altogether wanting. This assertion will, I doubt not, be borne out by every one who has crossed into Tartary: for while to the South of the great chain we find superb and stately forests, on the North there is scarcely a tree to be seen, and the few that are occasionally met with are either stunted Cypresses growing in the moist soil of ravines, or poplars planted round a village by the hand of man for economical purposes.

The reason why the minor ranges South of the Himalaya are clothed with forests on their Northern aspect is, I think, to be attributed to the fact that the dip of the strata being to the North or North-east, affords abundant soil on that side for the growth of vegetation, while the Southern out-crop, on the other hand, generally presents a bare and rocky escarpment on which little else than grasses and ferns can find soil enough to nourish them. North of the Western Himalaya, however, be the dip to whatever point it my, *there are no forests at all.*

In saying that vegetation *attracted* moisture, I have probably erred, and I thank Captain Jack for the courteous manner in which he has pointed out my mistake. I should rather have said that as vegetation is known to absorb or imbide moisture without which it cannot flourish, so the actual presence of dense forests proves, that the Southern climate is damper than the Northern one, which, coupled with the facts that the sun has less power on the northern aspect, and that the periodical rains do not extend thither, seems, according to my idea, a

* The difference between Captains Jack and Hutton, is rather a difference about words than any real difference of opinion as to the fact, Captain Hutton having inadvertently omitted in the first instance to distinguish according to conventional terms, the aspect of the Principal Mountain Chain of the Himalaya, from that of the Principal mountain groups, subordinate groups, and mountains—Geographical terms, the use of which is essential to the clear understanding of the question.—Ed.

farther reason for the longer continuance of the snow on the North than on the South.

The last number of the Journal contains some remarks on this subject from Mr. Batten, who appears to disagree with me '*in toto.*' I do not however see any reason to alter what I have said, especially since my statements are fully corroborated by the observations of Captains Cunningham and Jack, made in the year 1842, in different parts of the Himalaya and likewise at different seasons. It appears to me that Mr. Batten's desire to convince you that "*every one who has visited the Himalaya,*" does not hold opinions opposed to those of Captain Webb, has lead him into something very like a contradiction of his own opinions, a refutation in fact of his own doctrines, for he starts with an assertion that "*the perpetual snow line is at a higher elevation on the Northern slope of "the Himalaya" than on the Southern slope ;*" although immediately afterwards he "willingly allows that the North side of a hill retains the snow longer and deeper than the South side, and this observation equally applies in Bhote."

Now if the snow lies longer on the north than on the south, and if there be any eternal snows, it is clear, that it must be found on the northern aspect and not on the southern, which is precisely what I have endeavoured to prove.

Mr. Batten says "that at the same moment of time, (say of any day in September) when in Thibet, or Chinese Tartary, little or no snow is found; at 17,000 or even 18,000 *feet odd* above the sea by one traveller, another traveller in the Himalaya on the south side of the high peaks finds deep snow at 14,000 feet and *even lower.*" Now Captain Jack's observations bear rather strongly on this very point, and prove the reverse of Mr. Batten's statement, for he says, that he "crossed the Borendo Ghat, *on the 25th September* 1842, and there was no snow at all on the southern aspect, or on the very summit of the Pass; but descending a few yards on the northern aspect, to the base of a rock which was nearly perpendicular, he had the pleasure of seeing his baggage, &c. descending most rapidly by their own gravity, upon an unbroken bed of snow extending 250 to 300 yards in one slope, forming an angle of about 45°."

Another traveller in these regions, the well known and enterprising Dr. Gerard, has stated "that the line (of perpetual snow) in the latitude 30° 30′ in Asia is fixable at 15,000 feet on the Southern or Indian aspect of the Himalaya mountains, and on the northern (not the Tartaric) may be concluded at 14,500 feet. This gives a difference of 500 feet in favour of the northern side. Dr. Gerard then proceeds to state, that "the Haus Bussun is the last pinnacle of the chain before it is broken by the Sutlej, and could not have been more than five miles from him, but it was not visible from where he then was, on the Borendo Pass. The cheebs of the Pass are perfectly naked long before this time of the year, (August 1822,) and the trough formed by them, although sheeted with snow at the summer solstice, is now, (August,) bare rock down to the ravine on the south side, with the exception of some accumulations, which will be very much diminished before another month; *and some seasons,* as the former (1821,) *the whole face of the declivity is without a patch of snow. On the north side there lies a vast field which never dissolves.* At about 1,000 feet below the crest it breaks up, but continues in slips and scattered masses to the bottom of the dell, or where the stream finds a regular channel at 13,500 *feet;* and where the cliffs are steep, it occurs *at a much lower* level." *(Lloyd and Gerard's Tours in the Himalaya, p.* 327-328.*)*

These observations then appear to furnish a complete answer to Mr. Batten's challenge, and prove that the perpetual snow line must be looked for on the Northern aspect of the mountains, as it is evident from the facts mentioned by Captain Jack, Dr. Gerard, Dr. Lord, Captain Cunningham and myself, that the snow in some seasons deserts the Southern aspect altogether, and consequently that *there is no perpetual snow on the Southern aspects;* it may perhaps sometimes last for several years without entirely disappearing, but yet there are occasional seasons in which the whole Southern snow of particular localities is dissolved, and thus at once destroys its right to be called *eternal;* on the northern side of the high peaks it *never entirely melts,* and consequently the perpetual snow occurs only on that aspect. A person may therefore reside several years in these hills without seeing the whole of the Southern side uncovered at one time, although every year he may witness the denudation of some localities on that aspect, and thus he may be led to suppose that the southern snows are eternal, an opinion which is above shewn to be erroneous.

The mere continuance of snow on any spot does not suppose that snow never melts there. Were that the case, a progressive and unceasing accumulation would be the result; the position of the *snow line,* or what is often erroneously called *the line of perpetual congelation,* is determined solely by this circumstance, that during one complete revolution of the seasons, or in the course of a year, *the snow which falls is just melted, and no more.*"*

* Professor Forbes' Travels through the Alps. p. 18.

Mr. Batten asks, "*How can any facts of one observer in one place falsify the facts of another observer in another place?*" Had I been unsupported by good authority, I should long have hesitated to array my own opinions against those of Captain Webb, but when I found that *the facts which I had seen* were corroborated by the testimony of Dr. Lord and Captain Cunningham, I should have been to blame had I not come forward, and made at least *an attempt* to set the matter in its proper light. The observations are no longer those "*of one individual in one place,*" but of several competent observers in different parts of the mountains, and extend in fact from the Hindoo Koosh to the banks of the Ganges. Different travellers in different years, or even in different parts of the range in the same year,—may differ as to the amount of snow to be met with on the Southern aspect; but a series of observations made through several successive years along the whole range, would assuredly prove, that in no part of the Southern aspect was *the snow perpetual, bi-ennial* or *sept-ennial,* or for any term of years it may it some places rest, but sooner or later it will fade away, and prove that *the only perpetual snow line is on the Northern aspect.*

I trust, therefore Mr. Batten will forgive me for repeating that I believe the hitherto received opinion to be erroneous, and that it has been fully proved from the testimony of trustworthy and able observers, that *the snow lies longer and deeper, and lower down on the northern aspect of the Himalaya, than it does on the Southern side.*

THOMAS HUTTON, *Capt.*
Mussooree, 21*st February,* 1844. *Bengal Army.*

From J. H. BATTEN, *Esq. C. S. to* J. M'CLELLAND, *Bengal Medical Service, in reply to Capt.* HUTTON's *remarks on the line of Perpetual Snow in the July Number of the Calcutta Journal Natural History* 1843, *Dated Camp, Kaleedoongee, Kemaon, December 9th* 1843.*

MY DEAR SIR,—I have had the pleasure of receiving your polite and kind note dated the 17th ultimo, and I beg you to accept my best acknowledgments for the liberal tone shewn in your explanation of the note appended by you to Captain Hutton's paper.

* This letter has been kept back with a view of publishing at once all that is to be said on both sides of the question. It should have appeared in the last number, but from the quantity of matter previously in type, we had not room for it as well as Captain Hutton's letter on the same subject, which we were anxious should both appear at the same time.—ED.

2. I have not been able to procure a sight of Captain Jack's notes; but, unless that gentleman takes up a totally different ground to that on which Captain Hutton bases his arguments, there can be nothing for me to discuss in opposition to him.

3. On a second perusal of Captain Hutton's article in your July Number, I find that he *can* only be understood to debate the question whether snow lies deepest and longest on the Northern or the Southern slopes of the *several* heights in the snowy range, and the mountainous tract which that range crowns; and that he does not in reality (though in appearance he does) attack the observations of Webb and others concerning the *fact*, that *on the Northern slope of the Himalya the line of perpetual snow is not so low as on the Southern slope.* I am now convinced that Captain Hutton confounds the singular with the plural number; viz. *slope* with *slopes.* The following extract from his paper shews, that he considers the Northern side of *every* hill in these mountains, that is, in Bissehr, Sirmoor, Bareh, Thakooraiën, Gurhwal, Kumaon, the Neipal Territories, &c. &c.) to be the Northern slope of the Himalya! and the Southern slope of *every* hill to be *(exclusive of its Northern side)* the Southern slope of the Himalya!!

Extract.

"But the same facts which are here insisted on as facts, are observable at Simla, without travelling even to the Snowy range; *for,* (the Italics are mine) it is notorious to all who have visited the hills, that the snow lies longest on the Northern face of Mt. Jacko than on any other part of it." He then mentions the result of a snow storm in the spring of 1836, which was visible in May, and adds, "The same facts are well known likewise at Mussooree." Allow *me* to add, *and to every man, woman* and *child,* at *Almorah* and *at every human habitation in the whole Northern hemisphere, where snow is ever seen at all.* This very day the ladies and gentlemen now freezing in the snow at Nynee Tal would doubtless, be very happy to find themselves on the Southern side of Ayâr Pâta;—but still, though on the North side of one hill in the Ghagur range, they are, I dare say, rejoicing that they are not on the Northern slope of the Himalya. This same Ghagur range, by the way, is notorious (like Jacko) for the snow on its Northern face, as those who look out of their windows at Almorah can testify, and still more those who have been snowed up at the Ramgurh bungalow, or who have slidden and slipped down the icy road thereunto.

4. If a person living at any one of the hill stations is able without travelling to support Captain Hutton's arguments, he and I evidently cannot be discussing the same subject; and I have, I fear, made an

useless parade in my first letter of all my Himalyan wanderings. Vain, also, *in regard to Captain Hutton and his seconders,* have been the travels, surveys and writings of Moorcroft, the Gerards, Webb, Hodgson, Herbert and Traill. These distinguished men conceived that the Northern slope of the Himalya meant the high land in Chinese Tartary and Thibet, (including some part of Kunawur and the Bhote Mehals which lie North of the greatest peaks); and it never entered into their minds to conceive that the Northern *Kuds* of Simla and Mussooree were a part of the Northern slope of the Himalya. The commonest book on Geology or Geography distinguishes between the side of the Himalya which faces India, and that which faces Chinese Tartary. The very Hand Books and the Primers of Zoological and Botanical Science take care to separate the *Habitat* 'Himalya' from the Habitats Neipal, Kumaon, &c. Mr. Hodgson never confounds Cachar with the Lower Hills, still less Lassa with Katmandoo. If we allow 80 miles of slope between the high snowy peaks and the plains of India, (the actual distance,) we may surely allow 80 miles to form a slope on the Tartaric side, however gentle it may be in comparison. But I do not require even 50 miles on that side. All the phenomena for which I contend, are to be found within that distance.

5. Here I might end, having shewn Captain Hutton (and I will add yourself, in revenge for your note against the Kumaonees,) the danger of mis-stating the language of others, as such a mis-statement or misinterpretation is likely to be followed by the argument of *reductio ad absurdum* against the language and reasoning of the thoughtless objectors themselves. But, it is just possible that Capt. Hutton really means something which the common interpretation of his language does not allow, and, as I have before said, appearances are against him. As this gentleman may, perhaps, be taken as an authority, it becomes necessary to be very explicit as a counter-authority, and I rely fully on your promise to publish my statements in this letter, as you did those of Captains Hutton and Jack.

6. *Firstly.*—I assert that among scientific men the Himalyan range means the chain of *highest* elevation in the mountains which form the Northern boundary of India.

Secondly.—That in this chain some of the peaks are flanked by the beds of rivers which rise on their Northern side, while others are not so flanked, but send off rivers, to join those flowing to the Ocean, from their Southern bases. They also, of course, send off rivers on their Northern side to join flanking drains. That, of the former class of peaks are those at Gungootree, Buddrinath, and Mèlum, where Passes by river beds penetrate the Himalya; viz. the Neelung, the Mana and the Juwahir Passes. That, of the latter class of peaks are Bunderpooch, at the foot of which rises the Jumna, Kedarnath at the source of the Mundaknee, and Nundidevi at the source of the Pindur.

Thirdly.—That where the Passes by river beds occur, there, a marked difference exists between the Northern and Southern *extended bases* of the *same* peaks, the side to India being more steep and always quite impassable at a lower elevation, ; the side to Tartary at a higher elevation and on easier ground, being passable by men and cattle in the summer months

Fourthly.—That from 1st July to 1st October as a general rule, and universally from 15th July to 15th* September, whole tracts of country lying North of the high chain of the Himalya elevated from 15,000 to 19,000 feet above the sea, are found free from snow, (except in crevices,) that human habitations and markets thronged with traders exist at 15,000 feet and even above that height, and that high roads for traffic with pasture for cattle and bushes for fuel, cross *snow-less* elevations of 17,000 feet odd.†

Fifthly.—That none of the phenomena described under the last head are found on the Southern side of the Great Himalyan Chain.

7. It is easy to add comments to these assertions. In any September, compare the spot called the Pinduree Glaciers (11,000 feet,) with Melum, the same height. One place all ice, the other all fields and habitations. Compare the crest of the Mana Pass (18,000 feet) with Maha Punt behind Kedarnath temple, the former a high road from Mana to Dápa, Toling, &c., the latter a place of death amongst "thick ribbed ice" for pilgrims at a short distance from the temple, height of temple (11,300 feet) certainly at less than 15,000 feet. How very few villages are there found above 9,000 feet in any part of the Cis-Himalyan Mountains. How many towns and marts are there neàr the sources of the Sutlej, overhanging the ravine of that river, (calculated by Moorcroft and Webb to be 15,000 feet above the sea.) Dapa, Doompoo, Keoonglung, Misser, &c. Tuklakote, East of the Manessurovur Lake, on the upper Gogra, is supposed to be at least 15,000 feet above the sea; and the Pergunnah of *Prooang*, of which it is the capital, is certainly

* This is the only period at which the perpetual snow line can be discovered, that is, after the melting of winter snow, and the first falls of the Autumn.

† This is quite conclusive of the higher elevation of snow on the Thibetan side; as there are no inhabited plateaus at such an elevation on the south side, as far as we know.—Ed.

a more fertile tract than the Kuimaon, Pergunnans of Dharma and Becanse-Bhote, which must be crossed to reach it. These very Bhote Mehals which I have previously quoted as exemplifying the Northern phenomena, are, because lying South of the Passes, or Water's beds, from which rivers flow to the North, (though lying North of the Great Peaks) uninhabitable except for five months of the year. The places in Thibet above named, besides Gurtokh, Roodukh, &c., are inhabited throughout the year.

8. But my illustrations are not required. I am only one witness, and that a very humble one. If you will open Montgomery Martin's History of the British Colonies, vol. i, *Asia,* (my copy is the second edition,) pages 95 to 110, you will find an accurate account of the country on both sides of the Himalya supported by authority, and the contrast between the North and South side is particularly described. *There,* all the allusions are to Upper Kunawur and the country beyond it, (Capt. Hutton's *own* Kunawur,) and not to Heoondes behind Kumaon and Gurhwal,—so that Capt. Webb, and others are additional and independent authorities for the same kind of facts. The Kumaonees, too, are the more valuable authorities, as the highest peaks* of the surveyed tract between the Kalee and Sutlej are situated in Kumaon, and our Passes at once take us into Thibet, and do not conduct us like those beyond Simla into an intermediate and peculiar tract like Kunawur. I also particularly request your attention to Royle's Illustrations of Himalyan Botany, first ed. (1833,) vol. i. pp. 32 to 40; vol. iii. pp. xviii xix. xx.; vol. xi. pp. xxi xxii. and xxiii. The Roman Numbers shew that the remarks are a part of the Introduction. The Arabic Numbers denote a part of the actual work; but the Index of any edition will be a sufficient guide. The mere reprint of Dr. Royle's admirable observations would in fact be a sufficient reply to Capt. Hutton, (I would particularly request *his* attention to the account of *Zinchin* by the Gerards,) that is, always supposing that he and Capt. Jack are really attacking Webb, Herbert, &c., and do not confine their facts and remarks to Mounts *Huttoo* and *Jacko* in the Simla territory.

I remain, My dear Sir,
Your's very faithfully,
J. H. Batten.

Camp. Kaleedoongee, Kumaon, Terrai, Dec. 9th 1843.

* Nundidevi is 25,750 feet, and the rest in proportion. The Western Peaks rarely attain 21,500 feet, and the Passes do not exceed 16,000 feet, and are often lower.

P. S.—The *causes* of the phenomena discussed in this letter, as also of those connected with the forests and general appearance of the hills in the Mountain Provinces (I mean in regard to Northern and Southern exposures,) ought to form the subject of another article, which, if you like, I will write, but these things have all been accounted for by better men.

Memoir of William MACLURE, *Esq. By Dr.* S. M. MORTON.

[From the Journal of the Academy of Sciences, Philadelphia.]

The most pleasing province of Biography is that which commemorates the sway of the affections. These, however, variously expressed, tend to the diffusion of Religion, of Virtue and of Knowledge, and consequently of Happiness. He who feeds the hungry, or soothes the sorrowful, or encourages merit, or disseminates truth, justly claims the respect and gratitude of the age in which he lives, and consecrates his name in the bosom of posterity. The benefactions of a liberal mind not only do good of themselves, but incite the same spirit in others; for who can behold the happy results of useful and benevolent enterprise, and not feel the godlike impulse to participate in and extent them?

The study of Natural History in this country, though late in attracting general attention, has expanded with surprising rapidity. Thirty years ago all our naturalists were embraced in a few cultivators of Botany and Mineralogy, while the other branches were comparatively unheeded and unknown. The vast field of inquiry was devoid of labourers, excepting here and there a solitary individual who pursued the sequestered paths of Science, filled with an enthusiasm of which the busy world knew nothing. How widely different is the scene which *now* presents itself to our view! Behold the multitude which throngs that once neglected arena, and mark the cheering results! We see the unbounded resources of the land brought forth to the light of day, and made to minister to the wants and the intelligence of humanity. Every region is explored, every locality is anxiously searched for new objects of utility, or new sources of study and instruction.

In connection with these gratifying facts, it will be reasonably inquired, who were they who fostered the early infancy of Science in our country? Who were they who stood forth, unmindful of the sneer of ignorance and the frown of prejudice, to unveil the fascinating truths of Nature?

Among the most zealous and efficient of these pioneers of discovery was William Maclure.

This gentleman, the son of David and Ann Maclure, was born at Ayr in Scotland, in the year 1763; and he there received the primary part of his education under the charge of Mr. Douglas, an intelligent teacher, who was especially reputed for classical and mathematical attainments. His pupil's strong mind readily acquired the several branches of a liberal education; but he has often remarked, that from childhood he was disposed to reject the learning of the schools for the simpler and more attractive truths of natural history. The active duties of life, however, soon engrossed his time and attention; and at the early age of nineteen years he visited the United States with a view to mercantile employment. He landed in the city of New York; and having made the requisite arrangements, returned without delay to London, where he commenced his career of commercial enterprise as a partner in the house of Miller, Hart & Co. He devoted himself to business with great assiduity, and speedily reaped a corresponding reward. In the year 1796, he again visited America, in order to arrange some unsettled business of the parent establishment: but in 1803 we find him once more in England, not, however, as a merchant, but in the capacity of a public functionary; for Mr. Maclure was at this time appointed a commissioner to settle the claims of American citizens on the government of France, for spoliations committed during the revolution in that country. In this arduous and responsible trust, Mr. Maclure was associated with two colleagues, John Fenton Mercer and Cox Barnet, Esqs.; and by the ability and diligence of this commission, the object of their appointment was accomplished to general satisfaction.

During the few years which Mr. Maclure passed on the Continent in attention to these concerns, he took occasion to visit many parts of Europe for the purpose of collecting objects in Natural History, and forwarding them to the United States—which from his boyhood had been to him the land of promise, and subsequently his adopted country. With this design he traversed the most interesting portions of the old world, from the Mediterranean Sea to the Baltic, and from the British Islands to Bohemia. Geology had become the engrossing study of his mind; and he pursued it with an enthusiasm and success to which time, toil and distance presented but temporary obstacles.

Instructed by these researches, Mr. Maclure was prepared, on his return to the United States, to commence a most important scientific enterprise, and one which he had long contemplated as the great object of his ambition, viz.: a Geological Survey of the United States.

In this extraordinary undertaking we have a forcible example of what individual effort can accomplish, unsustained by government patronage, and unassisted by collateral aids. At a time when scientific pursuits were little known and still less appreciated in this country, he commenced his herculean task. He went forth with his hammer in his hand and his wallet on his shoulder, pursuing his researches in every direction, often amid pathless tracts and dreary solitudes, until he had crossed and recrossed the Alleghany mountains no less than fifty times. He encountered all the privations of hunger, thirst, fatigue and exposure, month after month, and year after year, until his indomitable spirit had conquered every difficulty, and crowned his enterprise with success.

Mr. Maclure's observations were made in almost every state and territory in the Union, from the river St. Lawrence to the Gulf of Mexico; and the Memoir which embraced his accumulated facts, was at length submitted to the American Philosophical Society, and printed in their Transactions for the year 1809.*

Novel as this work was, and replete with important details, its author did not suspend his researches with its publication, but resumed them on a yet more extended scale, in order to obtain additional materials, and test the correctness of his previous views. In after life he often recurred with pleasure to the incidents connected with this survey; some of which, though vexatious at the time, were subsequently the theme of amusing anecdote. When travelling in some remote districts, the unlettered inhabitants seeing him engaged in breaking the rocks with his hammer, supposed him to be a lunatic who had escaped from confinement; and on one occasion, as he drew near a public house, the inmates, being informed of his approach, took refuge in-doors, and closing the entrance held a parley from the windows, until they were at length convinced that the stranger could be safely admitted.

Incidents of this kind, and many others which occurred to him, appear to have influenced the following remarks in the Preface to his Geology: " All inquiry into the nature and properties of rocks, or the relative situation they occupy on the surface of the earth, has been much neglected. It is only since a few years that it has been thought worth the attention of either the learned or unlearned; and even now a great proportion of both treat such investigations with contempt, as beneath their notice. Why mankind should have so long neglected to acquire knowledge so use-

* This memoir is entitled, " Observations on the Geology of the United States, explanatory of a Geological Map." It was read January 20, 1809, and is published in the sixth volume of the Society's Transactions.

ful to the progress of civilization—why the substances over which they have been daily stumbling, and without whose aid they could not exercise any one art or profession, should be the last to occupy their attention—is one of those problems perhaps only to be solved by an analysis of the nature and origin of the power of the few over the many."

Notwithstanding that Mr. Maclure thus felt himself almost alone in his pursuits in this country, he did not relax his ardour in the cause of science, but continued to extend and complete his Geological survey; which, after receiving his final revisions, was again presented to the Philosophical Society on the 16th of May, 1817, eight years after their reception of the original draft. The amended memoir was now republished, both in the Society's Transactions and in a separate volume, accompanied by a coloured map and sections; and while it placed its author among the first of living Geologists, excited a thirst for inquiry and comparison which has continued to extend its influence over every section of our country.

It is not proposed, in this place, to analyze this valuable contribution to American Science. It may be sufficient to remark, that every one conversant with Geology is surprised at the number and accuracy of Mr. Maclure's observations; for the many surveys which have been recently conducted in almost every State in the Union, have only tended to confirm his correctness as to the extent and relative position of the leading Geological formations of this country; while the genius and industry which could accomplish so much, must command the lasting respect and admiration of those who can appreciate the triumphs of Science. In the evening of his days Mr. Maclure beheld with unmixed pleasure, the progress of Geology in his adopted country: he saw State after State directing Geological surveys under the supervision of zealous and able naturalists: he rejoiced to observe how their observations hamonized with his own; and it was among his most pleasing reflections, as age and infirmity drew near, that he had once trodden almost solitary and unheeded, that path which is now thronged with votaries of science and aspirants for honour.

In truth, what among temporal considerations is more remarkable and gratifying than the progress which has been made in elucidating the Geology of this country during the past thirty years? So extended a field, so many obstacles, and so little patronage, seemed at first view to present insuperable difficulties; and it was feared, and not without reason, that while every part of Europe was explored under the patronage of national governments, the vast natural resources of this country would long remain unsearched and unimproved; not for the want of zeal and talent, but from a deficiency of that encouragement which is necessary to great and persevering exertion. Happily, however, the day of doubt has passed; and our State governments now vie with each other in revealing those buried treasures which minister so largely to the wealth, the comfort and the intelligence of man.*

The time which Mr. Maclure allotted to repose from his Geological pursuits was chiefly passed in Philadelphia; where he watched the rise of a young but promising institution, devoted exclusively to Natural History, and numbering among its members whatever our city then possessed of scientific taste and talent. This institution was the Academy of Natural Sciences of Philadelphia; and as its history, from this period, is inseparably connected with the life of Mr. Maclure, let us pause and inquire into its origin and progress.

The Academy was founded in January, 1812, at which period a few gentlemen, at first but seven in number, resolv-

* We hope a day may yet arrive when this example will not be lost, as it has been hitherto, upon the Government of India.—Ed.

ed to meet once in every week for the purpose of conversing on scientific subjects, and thus communicating to each other the results of their reading, observation and reflection.

Although Mr. Maclure was absent from the city at the initiatory meeting, he had no sooner returned than his name was enrolled on the list of members; and from that hour, and with this circumstance, the prosperity of the institution commenced. Arrangements were soon after entered into for the delivery of courses of lectures, chiefly on Chemistry and Botany; and the library and museum were at once replenished with books and specimens from Mr. Maclure's European collections.

On the 30th of December, 1817, Mr. Maclure was elected President of the Academy; to which office of confidence and honour he was annually re-elected up to the time of his death, a period of more than twenty-two years.

Under his auspices the Journal of the Academy (which now numbers eight octavo volumes) was commenced with energy and talent; and such was his interest in its progress, that a considerable portion of the first volume was printed in an apartment of his own house.

Among the most ardent of Mr. Maclure's colleagues at this time was Mr. Thomas Say, a gentleman who united in a remarkable degree the love of science and the social virtues. Enthusiastic in his favourite studies, and possessed of a singular tact for detecting the varied relations of organized beings, he early attracted the notice and secured the esteem of Mr. Maclure; and the friendship which thus grew up between them, continued unaltered by time or circumstance to the end of life. How much the Academy and the cause of Natural History owe to the united efforts of these gentlemen, I need not declare; for not only here, but wherever their favourite pursuits are loved and cultivated, their names will be inseparably interwoven with the records and the honours of science.

During the year 1817 Mr. Maclure chiefly occupied himself in the publication of his Geology in a separate volume; after which he devoted himself with assiduity to the interests of the Academy. Previous to the year 1819 he had already presented the institution with the larger part of the fine library he had collected in Europe, embracing nearly fifteen hundred volumes; among which were six hundred quartos and one hundred and forty-six folios on Natural History, Antiquities, the Fine Arts, Voyages and Travels. "The value of these acquisitions was greatly enhanced by the fact that they were possessed by no other institution on this side of the Atlantic. The Academy therefore derived from this source a prosperity and permanence which, under other circumstances, must have been extremely slow and uncertain; while Science at the same time received an impulse which has never faltered, and which has been subsequently imparted to every section of our country."*

In the winter of 1816-17 Mr. Maclure visited the West Indies, for the purpose of ascertaining, by personal observation, the Geology of that chain of islands known as the Antilles. With this view he visited and examined nearly twenty of these islands in the Carribean Sea, from Barbadoes to Santa Cruz and St Thomas inclusive. He bestowed especial attention on those portions of the series which are of volcanic origin, of which the Grenadines form the southern and Saba the northern end of the chain. The results of this voyage of observation, in which he was accompanied by his friend Mr. Lesueur, were submitted to the Academy on the 28th of October 1817, and soon afterwards published in the Society's Journal.†

In 1819 Mr. Maclure's active mind was again directed to Europe. Embarking at New York he went direct to France, and not long afterwards to Spain. He was induced

* Notice of the Academy of Natural Sciences, p. 13.

† Journal of the Academy of Natural Sciences, vol. i.

to visit the latter country on account of the liberal constitution promulgated by the Cortes, which promised a comparatively free government to a country long oppressed by every species of bondage. His plan was to establish a great agricultural school, in which physical labour should be combined with moral and intellectual culture. His views were almost exclusively directed to the lower and consequently uneducated classes, whom he hoped to elevate above the thraldom to which they had been subjected by the institutions of their country. He purchased of the government 10,000 acres of land near the city of Alicant; and having repaired the buildings, and placed the estate in complete order, he prepared to commence his scheme of practical benevolence. Scarcely, however, were these arrangements made when the Constitutional government was overthrown, and the old institutions, with all their abuses, were again imposed upon this unfortunate country. The property which Mr. Maclure had purchased from the Cortes had been confiscated from the Church; and as the priesthood were now reinvested in their estates, they at once dispossessed him without ceremony or reimbursement.

Disappointed and mortified by this adverse termination of his plans, Mr. Maclure abandoned them as hopeless, and prepared to return to the United States. Before doing so, however, he visited various parts of southern Spain with a view to scientific investigation. But even in this unoffending employment he found himself surrounded by new dangers, which compelled him to relinquish much that he had proposed to accomplish in these researches; and his feelings, and the causes which gave rise to them, are forcibly expressed in a letter to his friend Professor Silliman, dated Alicant, March 6, 1824.

"I have been much disappointed in being prevented from executing my Mineralogical excursions in Spain, by the bands of powerful robbers that have long infested the astonishingly extended surface of uncultivated and inhospitable wilds in this naturally delightful country. Not that I require any money worth the robbing to supply me with all that I need—for the regimen which I adopt for the promotion of my health, demands nothing but water and a very small quantity of the most common food—but these barbarians have adopted the Algerine system of taking you as a slave, to the mountains, where they exact a ransom of as many thousand dollars as they conceive the property you possess will enable you to pay."*

On returning to the United States in 1824, Mr. Maclure was still intent on establishing an Agricultural School, a plan similar to that he had attempted in Spain. At this juncture the settlement at New Harmony, in Indiana, had been purchased by the eccentric author of the Social System; and many intelligent persons, deceived by a plausible theory, went forth to join the Utopian colony; and Mr. Maclure himself, willing to test the validity of a system which seemed to promise something for human advantage, resolved to establish, in the same locality, his proposed Agricultural School. He did not, at the same time, adopt all the peculiar views of this fugitive community, to many of which, in fact, he was decidedly opposed; but he consented to compromise a part of his own opinions in order to accomplish, in his own phrase, "the greatest good for the greatest number." For this purpose he forwarded to New Harmony his private library, philosophical instruments and collections in Natural History, designing, by these and other means, to make that locality the centre of education in the West. That the Social scheme was speedily and entirely abortive, is a fact familiar to every one; but Mr. Maclure having purchased extensive tracts of land in the town and vicinity of New Harmony, continued to reside there for several years, in the hope of bringing his school into practical operation.

* American Journal of Sciences, vol. viii, p. 187.

In leaving Philadelphia for New Harmony, Mr. Maclure induced several distinguished naturalists to bear him company, as coadjutors in his educational designs; and among them were Mr. Say, Mr. Lesueur, Dr. Troost, and a few others who had already earned an enviable scientific reputation.

For various reasons, which need not be discussed in this place, the School did not fulfil the expectations of its founder, who was at length constrained to relinquish it; and the less reluctantly as the approach of age, and the increasing delicacy of his constitution, admonished him of the necessity of seeking a more genial climate. We accordingly find him, in the autumn of 1827, embarking for Mexico in company with his friend Mr. Say. They passed the winter in that delightful country; and employed their time in observing and recording the various new facts in science which there presented themselves; and on the approach of summer they returned to the United States.

Mr. Maclure was so pleased with the climate of Mexico, and so solicitous to study the social and political institutions of that country, that he determined to return the same year; and with this intent he visited Philadelphia, proceeded thence to New Haven, and presided for the last time at a meeting of the American Geological Society in that city on the 17th of November, 1828. Of this institution he had also long been President, and took an active interest in its prosperity, which was strengthened by his regard for his friend Professor Silliman—a man whom we all esteem for his zealous and successful exertions to advance the interests of Science, as well as for his extensive acquirements and his many virtues. On this occasion Mr. Maclure declared his intention to bring back with him from Mexico a number of young native Indians, in order to have them educated in the United States, and subsequently diffuse the benefits of instruction among the people of their own race. This benevolent object, however, was not accomplished; for in the ordering of Providence he did not live to return.

From New Haven Mr. Maclure proceeded to New York, and embarked for Mexico. Time and distance, however, could not estrange him from that solicitude which he had long cherished for the advancement of education in his adopted country; and from his remote residence he kept a constant correspondence with his friends in the United States, among whom was the author of this memoir.

Mr. Say* died in 1834, at New Harmony; and Mr. Maclure was thus deprived of one of his oldest and firmest friends. The loss seemed for a time to render him wavering as to his future plans; but convinced, on reflection, that his educational projects in the West could be no longer fostered or sustained, he resolved to transfer his library at New Harmony to the Academy of Natural Sciences. This rich donation was announced to the Society in the autumn of 1835; and Dr. Charles Pickering, who had been for several years librarian of the institution, was deputed to superintend the conveyance of the books to Philadelphia; a trust which was speedily and safely accomplished.

This second library contained 2259 volumes, embracing, like the former one, works in every department of useful knowledge, but especially Natural History and the Fine Arts, together with an extensive series of maps and charts.

Mr. Maclure's liberality, however, was not confined to a single institution: the American Geological Society, established, as we have already mentioned, at New Haven,

* Mr. Say was one of the founders of the Academy; and among the last acts of life, he provided for the further utility of the institution by requesting that it should become the depository of his books and collections. This verbal bequest was happily confided to one whose feelings and pursuits were congenial to his own; and the Academy is indebted to Mr. and Mrs. Say for some of its most valuable acquisitions.

An interesting and eloquent Memoir of Mr. Say, was written by Dr. Benjamin Hornor Coates, and published under the auspices of the Academy in 1835.

partook largely of his benefactions both in books and specimens; and in reference to these repeated contributions, Professor Silliman has expressed the following brief, but just and beautiful acknowledgment: "This gentleman's liberality to purposes of science and humanity has been too often and too munificently experienced in this country, to demand any eulogium from us. It is rare that affluence, liberality and the possession and love of science unite so signally in the same individual."*

Since the year 1826 the Academy had occupied an edifice in some respects well adapted to its objects; but the extent and value of the library, suggested to Mr. Maclure the necessity of a fire-proof building. In order to accomplish this object he first transferred to the Society a claim on an unsettled estate for the sum of five thousand dollars, which was followed in 1837 by a second donation of the same amount. Meanwhile, having matured the plan of the new Hall of the Academy, and having submitted his views to the members, he transmitted, in 1838, an additional subscription for ten thousand dollars.

Thus sustained by the splendid liberality of their venerable President, the Society proceeded without delay in the erection of the new Hall. The corner stone was laid at the corner of Broad and George streets, with due form, on the 25th of May 1839; on which occasion an appropriate Address was delivered by Professor Johnson. The edifice thus auspiciously begun, was conducted without delay to completion; so that the first meeting of the Society within its walls was held on the 7th day of February 1840.

Mr. Maclure had fervently desired and fully expected to revisit Philadelphia; but early in the year 1839 his constitution suffered several severe shocks of disease, and from that period age and its varied infirmities grew rapidly upon him.

* Amer. Jour. of Science, vol. iii, p. 362.

Under these circumstances he became more than ever solicitous to return to the United States, to enjoy again the companionship of his family and friends, and to end his days in that land which had witnessed alike his prosperity and his munificence.

He made repeated efforts to accomplish this last wish of his heart; and finally arranged with his friend Dr. Burrough, then United States Consul at Vera Cruz, to meet him at Jalapa with a *littera* and bearers, in order to conduct him to the sea-coast. Dr. Burrough faithfully performed his part of the engagement; but after waiting for some days at the appointed place of meeting, he received the melancholy intelligence that Mr. Maclure, after having left Mexico and accomplished a few leagues of his journey, was compelled by illness and consequent exhaustion to relinquish his journey.

Languid in body, and depressed and disappointed in mind, Mr. Maclure reluctantly retraced his steps; but being unable to reach the capital, he was cordially received into the country-house of his friend Valentine Gomez Farias, Ex-President of Mexico, where he received all the attentions which hospitality could dictate. His feeble frame was capable of but one subsequent effort, which enabled him to reach the village of San Angel; where, growing weaker and weaker, and sensible of the approach of death, he yielded to the common lot of humanity on the 23d day of March, 1840, in the seventy-seventh year of his age.

The death of Mr. Maclure was announced to the Academy on Tuesday evening, the 28th of April, on which occasion the following Resolutions were unanimously adopted:—

Resolved, That the Academy has learned with deep concern, the decease, at San Angel, near the city of Mexico, of their venerable and respected President and benefactor, William Maclure, Esq.

Resolved, That although his declining health induced him to reside for some years in a distant and more genial clime, this Academy cherishes for Mr. Maclure the kindest personal recollections, and a grateful sense of his contributions to the cause of Science.

Resolved, That as the Pioneer of American Geology, the whole country owes to Mr. Maclure a debt of gratitude, and in his death will acknowledge the loss of one of the most efficient friends of Science and the Arts.

Resolved, That as the patron of men of science, even more than for his personal researches, Mr. Maclure deserves the lasting regard of mankind.

Resolved, That a member of the Academy be appointed to prepare and deliver a discourse commemorative of its lamented President.

Resolved, That the Corresponding Secretary be requested to communicate to the family of Mr. Maclure a copy of these Resolutions.

Mr. Maclure died before he had accomplished *all* his views in respect to this Institution; for, looking forward, as he did, to renewed personal intercourse with its members, he intended to inquire for himself into the most available modes of extending its usefulness. This, as we have seen, was denied him; but the spirit of Science which was inherent in him, has descended upon his brother and sister; and to these estimable and enlightened individuals, we owe the consummation of all that their brother had proposed in reference to the Academy, which will be hereafter enabled to devote its resources exclusively to the advancement of those objects for which it was founded.

Thus closed a life which had been devoted, with untiring energy and singular disinterestedness, to the attainment and diffusion of practical knowledge. No views of pecuniary advantage, or personal aggrandizement, entered into the motives by which he was governed. His educational plans, it is true, were repeatedly inoperative, not because he did too little, but because he expected more than could be realized in the social institutions by which he was surrounded. He aimed at reforming mankind by diverting their attention from the mere pursuit of wealth and ambition, to the cultivation of the mind; and espousing the hypothesis of the possible "equality of education, property and power" among men, he laboured to counteract that love of superiority which appeared to him to cause half the miseries of our species. However fascinating these views are in theory, mankind are not yet prepared to reduce them to practice; and without entering into discussion in this place, we may venture to assert, that what Religion itself has not been able to accomplish, Philosophy will attempt in vain.

Mr. Maclure's character habitually expressed itself without dissimulation or disguise. Educated in the old world almost to the period of manhood, and inflexibly averse to many of its established institutions, he was prone to indulge the opposite extremes of opinion, and became impatient of those usages which appeared to him to fetter the reason and embarrass the genius of man; and while he rejoiced in the republican system of his adopted country, he aimed at an intellectual exaltation which, to common observation at least, seems incompatible with the wants and impulses of our nature.

Fully and justly imbued with the importance of disseminating practical truth, he strove through its influence to bring the several classes of mankind more on a level with each other; not by invading the privileges of the rich, but by educating the poor; thus enforcing the sentiment that "knowledge is power," and that he who possesses it will seldom be the dupe of designing and arbitrary minds. With a similar motive he endeavoured to inculcate the elements of Political Economy, by the publication of epistolary essays in a familiar style, which have been embodied in two volumes with the title of *Opinions on Various Subjects*. They discover a bold and original mind, and a fondness for innovation which occasionally expresses itself in a startling sentiment; but however we may differ from him on various questions, it must be conceded that his views of financial operations were remarkably correct, inasmuch as he predicted the existing pecuniary embarrassments of this country, at the very time when the great mass of observers looked forward to accumulating wealth and unexampled prosperity.

Let it not be supposed that Mr. Maclure's benevolent efforts were restricted to those extended schemes of usefulness to which we have so often adverted. Far, very far from it. His individual and more private benefactions, were such as became his affluent resources, influenced by a generous spirit. He habitually extended his patronage to genius, and his cordial support to those plans which, in his view, were adapted to the common interests of humanity. There are few cabinets of Natural History in our country, public or private, that have not been augmented from his stores; and several scientific publications of an expensive character, have been sustained to completion by his instrumentality. While in Europe he purchased the copper-plate illustrations of some important works both in Science and Art, with the intention of having them republished at home in a cheaper form, in order to render them accessible to all classes of learners. Among these works was Michaux's Sylva, which is now going through the press in conformity to his wishes.

He was singularly mild and unostentatious in his manner; and though a man of strong feelings, he seldom allowed his temper to triumph over his judgment. Cautious in his intimacies, and firm in his friendships, time and circumstance in no degree weakened the affections of his earlier years. Though affable and communicative, Mr. Maclure was very much of an isolated man during the last thirty years of his life; partly owing to a naturally retiring disposition, partly to the peculiarity of some of his opinions, in respect to which, though unobtrusive, he was inflexible—but mainly to that frequent change of residence which is unfavourable to social fellowship. Hence it is that of the thousands who are familiar with his name in the annals of Science, comparatively few can speak of him from personal knowledge.

In person he was above the middle stature, and of a naturally robust frame. His constitution was elastic, and capable of much endurance of privation and fatigue, which he attributed chiefly to the undeviating simplicity of his diet. His head was large, his forehead high and expanded, his nose aquiline; and his collective features were expressive of that undisturbed serenity of mind which was a conspicuous trait of his character.

Those who knew him in early life, represent him to have been remarkable for personal endowments; a fact which is evident in the full-length portrait now in possession of his family, and which was painted upwards of forty years ago by the celebrated Northcote. The lithographed likeness which accompanies this memoir, is copied from a portrait taken by Mr. Sully in 1824, at which period Mr. Maclure was about sixty-three years of age.

Such was William Maclure, whose long, active and useful life is the subject of this brief and inadequate memorial. His remains are entombed in a distant land, and even there the spirit of affection is raising a tablet to his memory. But his greater and more enduring monument, is the edifice within whose walls we are now met to recount and perpetuate his virtues. Wherever we turn our eyes we behold the proofs of his talent, his zeal, his munificence. We see an Institution which, under his fostering care, has already attained the manhood of Science, and is destined to connect his name with those beautiful truths which formed the engrossing subject of his thoughts. We see around us the collections that were made with his own hands, vastly augmented, it is true, by the zeal of those who have been stimulated by his example. Here are the books which he read—to him the fountains of pleasure and instruction. Here has he concentrated the works of Nature, the sources of knowledge, the incentives to study; and, actuated by his liberal spirit, we open our doors to all inquiring minds, and invite them to participate, with us, in these invaluable acquisitions; and while we regard them as a trust to be transmitted unblemished to posterity, let us honour the name and cherish the memory of the man from whom we derived them.

Death of Mr. Loudon.

On the 14th of Dec. 1843, died, at his house at Bayswater, John Claudius Loudon, Esq., who, for nearly half a century, has been before the public as a writer of numerous useful and popular works on gardening, agriculture, and architecture.

Mr. Loudon's father was a farmer, residing in the neighbourhood of Edinburgh, where he was very highly respected; but Mr. Loudon was born on April 8th, 1783, at Cambuslang, in Lanarkshire, where his mother's only sister resided, herself the mother of the Rev. Dr. Claudius Buchanan, afterwards celebrated for his philanthropic labours in India. Dr. Buchanan was several years older than Mr. Loudon, but there was a singular coincidence in many points of their history. The two sisters were, in both cases, left windows at an early age, with large families, which were brought up by the exertions of the eldest sons; and both mothers had the happiness of seeing their eldest sons become celebrated. Mr. Loudon was brought up as a landscape-gardener, and began to practise in 1803, when he came to England with numerous letters of introduction to some of the first landed proprietors in the kingdom. He afterwards took a large farm in Oxfordshire, where he resided in 1809. In the years 1813-14-15, he made the tour of Northern Europe, traversing Sweden, Russia, Poland, and Austria; in 1819 he travelled through Italy; and in 1828 through France and Germany.

Mr. Loudon's career as an author began in 1803, when he was only twenty years old, and it continued with very little interruption during the space of forty years, being only concluded by his death. The first works he published were the following:—*Observations on laying out Public Squares*, in 1803, and on *Plantations*, in 1804; a *Treatise on Hothouses*, in 1805, and on *Country Residences*, in 1806, both 4to.; *Hints on the For-*

mation of Gardens, in 1812; and three works on *Hot-houses*, in 1817 and 1818. In 1822 appeared the first edition of the *Encyclopædia of Gardening;* a work remarkable for the immense mass of useful matter which it contained, and for the then unusual circumstance of a great quantity of woodcuts being mingled with the text: this book obtained an extraordinary sale, and fully established his fame as an author. Soon after was published an anonymous work, written either partly or entirely by Mr. Loudon, called the *Greenhouse Companion;* and shortly afterwards *Observations on laying out Farms*, in folio, with his name. In 1824, a second edition of the *Encyclopædia of Gardening* was published, with very great alterations and improvements; and the following year appeared the first edition of the *Encyclopædia of Agriculture.* In 1826, the *Gardener's Magazine* was commenced, being the first periodical ever devoted exclusively to horticultural subjects. The *Magazine of Natural History*, also the first of its kind, was begun in 1828. Mr. Loudon was now occupied in the preparation of the *Encyclopædia of Plants*, which was published early in 1829, and was speedily followed by the *Hortus Britannicus.* In 1830, a second and nearly re-written edition of the *Encyclopædia of Agriculture* was published, and this was followed by an entirely re-written edition of the *Encyclopædia of Gardening*, in 1831; and the *Encyclopædia of Cottage, Farm, and Villa Architecture*, the first he published on his own account, in 1832. This last work was one of the most successful, because it was one of the most useful, he ever wrote, and it is likely long to continue a standard book on the subjects of which it treats. Mr. Loudon now began to prepare his great and ruinous work, the *Arboretum Britannicum*, the anxieties attendant on which were, undoubtedly, the primary cause of that decay of constitution which terminated in his death. This was not, however, completed till 1838, and in the mean time he began the *Architectural Magazine*, the first periodical devoted exclusively to architecture. The labour he underwent at this time was almost incredible. He had four periodicals, viz. the *Gardener's*, *Natural History*, and *Architectural Magazines*, and the *Arboretum Britannicum*, which was published in monthly numbers, going on at the same time; and, to produce these at the proper times, he literally worked night and day. Immediately on the conclusion of the *Arboretum Britannicum*, he began the *Suburban Gardener*, which was also published in 1838, as was the *Hortus Lignosus Londinensis;* and in 1839 appeared his edition of Repton's *Landscape-Gardening.* In 1840, he accepted the editorship of the *Gardener's Gazette*, which he retained till November, 1841; and in 1842 he published his *Encyclopædia of Trees and Shrubs.* In the same year he completed his *Suburban Horticulturist;*

and finally, in 1843, he published his work on *Cemeteries*, the last separate work he ever wrote. In this list, many minor productions of Mr. Loudon's pen have necessarily been omitted; but it may be mentioned, that he contributed to the *Encyclopædia Britannica* and Brande's *Dictionary of Science;* and that he published numerous supplements, from time to time, to his various works.

No man, perhaps, has ever written so much, under such adverse circumstances as Mr. Loudon. Many years ago, when he came first to England (in 1803), he had a severe attack of inflammatory rheumatism, which disabled him for two years, and ended in an anchylosed knee and a contracted left arm. In the year 1820, whilst compiling the *Encyclopædia of Gardening*, he had another severe attack of rheumatism ; and the following year, being recommended to go to Brighton to get shampooed in Mahommed's Baths, his right arm was there broken near the shoulder, and it never properly united. Notwithstanding this, he continued to write with his right hand till 1825, when the arm was broken a second time, and he was then obliged to have it amputated ; but not before a general breaking up of the frame had commenced, and the thumb and two fingers of the left hand had been rendered useless. He afterwards suffered frequently from ill health, till his constitution was finally undermined by the anxiety attending on that most costly and laborious of all his works, the *Arboretum Britannicum*, which has unfortunately not yet paid itself. He died at last of disease of the lungs, after suffering severely about three months ; and he retained all the clearness and energy of his mind to the last.

His labours as a landscape-gardener are too numerous to be detailed here, but that which he always considered as the most important, was the laying out of the Arboretum so nobly presented by Joseph Strutt, Esq., to the town of Derby.

Never, perhaps, did any man possess more energy and determination than Mr. Loudon; whatever he began he pursued with enthusiasm, and carried out, notwithstanding obstacles that would have discouraged any ordinary person. He was a warm friend, and most kind and affectionate in all his relations of son, husband, father, and brother; and he never hesitated to sacrifice pecuniary considerations to what he considered his duty. That he was always most anxious to promote the welfare of gardeners, the volumes of this Magazine bear ample witness; and he laboured not only to improve their professional knowledge, and to increase their temporal comforts, but to raise their moral and intellectual character.

Observations on Organic Chemistry and its relations to Physiology. By JUSTUS LIEBIG, M.D., PH.D.

[Professor Liebig has requested us to state that his remarks upon physiologists and pathologists in this paper are intended to apply to those of Germany, and not to the physiologists and pathologists of this country. The criticisms upon his works which have appeared in England, at least such of them as have reached him, do not appear to require any animadversions on his part. But since the reviews of Schulz, Henle, and others have been recently reprinted in the English journals, Professor Liebig has thought proper to republish his answer to them in THE LANCET, in order to enable the English readers of those articles to form a just opinion of their true value. If there be any passage in Professor Liebig's reply not very agreeable to the taste of his adversaries, they must remember that there has been much in their attacks not very palatable to him, and, moreover, that he was not the aggressor, but he was compelled, in the interest of science, to stand upon his own defence.] *Lancet, Jan.* 1844.

The appearance of my work on "Chemistry, in its applications to Agriculture and Physiology," gave rise to criticisms from men from whom I should rather have expected aid in my endeavours to advance the science than opposition, characterised by intemperance and passion, rather than by candour and that liberal spirit which ought to guide us in our judgment on the labours of others. Many of these attacks were directed against persons whose friendship I value most highly, rather than against myself personally, or my book, and I, therefore, felt it my duty to defend my views, and to refute the objections advanced, in the manner they deserved. It was a different matter with respect to the objections made, and the difficulties involved in my statements, pointed out by Schleiden and Mohl; in them, under rather a repulsive husk, I could discern the true kernel of the love of science; I have, therefore, not replied to their writings, because instead of entering with them upon a mere war of words, I hoped to reconcile these gentlemen by my actions, convinced that we should at lengh agree. Those parts of my works which were opposed to their better experience, and which they particularly objected to, I have altogether left out of my 5th edition (3d English); other points, concerning the correctness of which I was too well assured to doubt, from any assertion of theirs, I retained, although these also might have been omitted without affecting the real value of the work.

The corrections which their remarks suggested were apart from the main purpose of my labours, and I have nothing to regret, save that the difference in the direction of our inquiries has deprived me of an opportunity of expressing how highly I appreciate the results of their great and comprehensive labours in vegetable physiology. In such honest and energetic endeavours as theirs for the advancement of science, there is so much devotedness and self-sacrifice, that even the merited approbation of an individual, although of no great value in comparison with the appreciation of the public, may, nevertheless, not be altogether unwelcome.

The publication of my "Animal Chemistry" placed me in the same awkward position with many physiologists. Schulz, Henle, and others appear to derive gratification in detaching sentences of my writings from their connection, and making them the object of severe criticism, by which the true relation of chemistry to physiology were made much more manifest to me than before. Such mistakes, either involuntary or intentional, I could not have supposed possible. I had really thought that the ordinary studies of the physiologist and the physician would enable them to form, at least, some judgment respecting the questions which I discussed. But from the attacks and objections which were made to my views I could immediately perceive that they emanated from persons who had never occupied themselves with physics or chemistry, and who were altogether unacquainted with the principles and true spirit of these sciences. This induced me to make very light of such opposition; I could confidently leave the decision to the future.

The ranks of my opponents, however, have been strengthened by the accession of an individual upon whose approbation and applause I was accustomed to reckon for many years, and who, by his great experience and labours, has acquired a well-founded right to pronounce a judgment upon questions connected with these sciences.

Immediately after the appearance of my first work on Agricultural Chemistry, Berzelius communicated to me, by letter, many objections to my views, and declared to me openly, and without reserve, how little his own experience agreed with my observations. These objections induced me to submit all the points at issue between us again to the test of a strict and minute examination, the results of which only tended to strengthen my conviction of the truth of my first impressions, and determined me to persevere in the direction I had taken.

I thought I had succeeded in removing all his doubts in the course of our correspondence, and I, therefore, was very much astonished to find all his objections re-appear in his "Twenty-first Annual Report of the

Progress of Chemistry." This proceeding was continued in his subsequent Annual Reports, and appeared at length so completely at variance with his former principles that I thought it my duty to call his attention to its injustice. I desired him to consider that our long standing and intimate friendship forbade me to repel his attacks in the manner they deserved, and that I therefore stood defenceless.

All this was unavailing; there was a chasm between us which no longer admitted of being filled up, and it is only after having suffered the most insulting and injurious attacks, that I perceive (to quote Berzelius's own words) "that it would be a misfortune to science to permit its interests to be set aside for friendship's sake." (Ann. Rep., 23, p. 576.)

In the Twenty-third Annual Report, Berzelius lays aside all moderation, and the same hostile disposition towards me is manifested in the new edition of his Manual; and he has been induced to express opinions upon my labours in inorganic chemistry which are totally unfounded and inexcusable.

Under these circumstances nothing remains for me save to expose, in all simplicity and candour, the relation in which Berzelius stands to the present state of organic chemistry. And when, in this exposition, I speak of physiologists and pathologists, and the bearings of chemistry on physiology, I must remind my readers that I allude to individuals, or to their intellectual tendencies, whose names I do not mention, because ere long they will cease to have any interest in connection with the matter, and, in fact, they do not at all belong to the subject in dispute.

During the last four years, since Berzelius has ceased to take any part in experimental investigations of the questions now arising in the science, his whole mental powers have been directed to theoretical speculations. But unsupported by his own experiments, his views have found no response in science. As long as he pursued experiments, and confined his inferences to them, the results he obtained were safe and trust-worthy guides in the field of science, but a new domain, foreign to him, has since been cultivated with success; phenomena have been observed, contradictory to views formerly held, and inexplicable upon principles derived from the acquisitions of science at that time. This has led to new modes of explaining the phenomena observed, irresistible to all those who have been themselves experimentally engaged in their investigation; and it is the contest of the former with the latter,—the necessary consequences of the progress of the science,—upon which Berzelius has entered in the spirit of a partisan, a contest the final result of which it is not difficult to foresee. When Berzelius first entered upon his career many hypotheses prevailed which he did not hesitate to combat in the interest of science; he went further, and history shows with what success he substituted, by his indefatigable investigations, better theories in their place. It is in the very nature of science that many of his views should meet with the same fate; more correct theories, notions nearer to truth, must at length replace them, and it is thus only that the truth, which is the aim and object of our researches, will at length be attained.

To combat these more modern views with reasons derived from observations made long since, and without deigning to enter anew upon personal investigations as to their truth, has been the way taken by Berzelius of late, a way which obviously cannot lead him to his object.

Every author of a long and laborious investigation has an undoubted right to draw his own inferences as to the nature and composition of the bodies he discovers, to assign to them a name, and to express them by formulæ, what part has Berzelius taken in these investigations? Has he shown the incorrectness of these formulæ by new experiments? Has he proved the fallacy of the inferences and conclusions by placing them in opposition to the results of his own experience? Nothing of the kind. Why, and for what reason, then, does he alter the formulæ of the chloric ether compounds of Malaguti, of the napthaline compounds of Laurent, of the benzoyl compounds, and the products of uric acid, with an arbitrariness hitherto unexampled? Why does he admit into the composition of these substances compounds which either do not at all exist, or to say the least, the existence of which is very doubtful? Has not his fixing the formulæ of cerebrote, cephalote, stearoconote, the formation of piotic, hypopiotic, and piotinigic acids, shown how little was gained thereby, and to what errors want of personal experience in this department led him.

None of those chemists whose labours Berzelius thought were thus improved adopted his views, and therefore an irreparable breach could not fail to ensue between them. Never, under any circumstances, would Berzelius have endured this kind of tyranny from others; he would have repudiated it with all his might; and that this has not yet been done to him by other chemists arises simply from the high esteem in which he is held for his immeasurable labours.

Abandoning himself to this course, which would, in former times, have been so utterly repugnant to him, he constructed, from an isolated instance of the atomic theory, "that equal constitution does not necessarily produce equal properties," the special theory of isomeric substances, and this led him to the invention of the *catalytic force.*

The power of platinum to facilitate the combination of gaseous substances,—that of yeast to resolve sugar into alcohol and carbonic acid,—that of sulphuric acid to resolve alcohol into ether and water,—differ from the ordinary phenomena of affinity, as those, for instance, which accompany the combustion of charcoal in oxygen gas, or the combination of sulphuric acid with potass. They were, at that time at least, or, according to the notions of Berzelius, inexplicable phenomena. Now, how did he facilitate our inquiries into these phenomena? Against all the rules of rational inquiry, against all logic, he considered these properties of sulphuric acid, of platinum, and of yeast, not as the effects of different causes, which was apparent to every one else, in such various substances, but ascribed all these different effects to one and the same cause, and this a new and unknown cause. He indeed, admits it to be unknown, but he treats it, in discussing unexplained phenomena, as a force with the properties of which we are perfectly acquainted.

If any one will take the trouble to place in the following passages, quoted from Berzelius, instead of the words *catalytic force*, the true meaning of the words, namely, *the unknown cause of phenomena not further investigated*, it will be seen how little has been gained by the assumption of the *catalytic force.* It will, also, at once be evident that with its admission all further inquiry into the true causes will be at an end.

To us it appeared, from the very outset, to be nothing better than *phlogiston* resuscitated.

" If, with this idea, we turn to the chemical processes in living nature, a new light breaks in upon us. When nature has placed diastate in the eyes of potatoes, this leads us to the way in which the insoluble starch becomes converted by the catalytic force into gum and sugar; but it does not follow therefrom that this catalytic process is the only one in vegetable life; we on the contrary, are led to assume that in living plants and animals thousands of catalytic processes take place between the tissues and the fluids,"—Berzelius, 15th Annual Report, p. 244.

" Mitscherlich has shown that the catalytic force of sulphuric acid becomes increased by concentration and elevation of temperature."—15th Ann. Rep., p. 352.

" Since a catalytic operation by contact is admitted (and this is at present an undoubted fact), it is impossible to say where it does *not* take place in chemical processes."—20th Ann. Rep., p. 455.

Certainly no one could consider it a crime in me that I did not deem these views admissible, and that, following my own conviction, I declared it to be a mistake to make our symbolic language an expression for changeable theoretical notions,—for the theory of volumes, for instance. And when instead of the obscure notion concerning the saturating power of the acids which then prevailed, I endeavoured to give a better one, according to my own apprehensions, and when I attempted to apply an indisputable axiom of mechanics to the phenomena of combination and decomposition, in what respect did I justly incur reproach? Upon phenomena imperfectly studied before I commenced, and upon new observations, I have based and established the theory of putrefaction and decay; I have shown that humus cannot be the source of the carbon of vegetables; I have, in the course of my investigations into the transformations which nitrogenous substances undergo in the presence of water and air, found ammonia to be the ultimate and only source of nitrogen in plants; and I have determined the necessity of the alkalies, the alkaline earths, and the phosphates, to vegetable life, which was so long disregarded by chemists and mistaken by physiologists.

What connection is there between these views, which are opposed to those of Berzelius, and my other labours? Why does my method of purifying antimony no longer, according to his account, yield antimony free from arsenic? Why is my method of preparing cyanide of potassium fraught with difficulties now, and no longer to be considered an improvement? Why does my separation of nickel from cobalt now exist only upon paper? Why does Berzilius incessantly warn us, in physiological investigations, not to go beyond his labours of thirty years since? Shall we then continue to consider blood corpuscules as *globulin*, and *caseine* as soluble in water?—albumen as an acid and a base? Or to assume a dozen substances as constituents of the *bile*, when our investigations have proved these things to be otherwise?

Shall we continue to bruise the liver and kidneys in a mortar in order to obtain a knowledge of their composition and vital functions? Of what avail have all these labours proved to physiology? Their results drag heavily along, in the MANUALS, a cumbrous and useless burthen; they introduced totally fallacious methods of investigation into chemical physiology, and created that aversion and nausea with which physiologists have regarded chemistry. What light could such investigations, made after the example of Fourcroy and Vauquelin, throw upon the mysterious processes of organic life? What advantage could possibly be derived from all these figures which were unconnected with questions of fact, from investigations made without any definite object, and conducted without method? Whilst, with the analysis of a silicate, the ultimate problem of the analyst was solved, the mere production of the animal constituents, and their analysis must be considered only as the beginning of the task of the chemist. I felt it right to reject all such results, and to urge incessantly upon chemists that figures are of no use whatever unless connected with definite questions; that these methods could prove of no avail to physiology; and that our labours, to be of any value, must be available as preparatory to those of physiologists.

I had an undoubted right to do this, as much as a man who perceives his fellow-travellers are pursuing a wrong road has to warn them to retrace their steps, more especially as one who has devoted his life to the improvement of this department of science. Must I remind Berzelius what has been done during the last twenty years in the chemical school at Giessen? He has been living all this time, and ought not to forget it so easily, even should it be forgotten by a younger generation.

I fear not to speak of my own labours, from hippuric acid to my recent investigation of urine, nor to mention those which I have made in common with Wöhler. I must remind Berzelius that, from the very outset of my career, all my efforts have been directed to the attainment of a definite object. I feel almost ashamed to recall to Berzelius' mind how much has sprung from my endeavours, and to remind him of the advantages that have been derived from my methods, and from the introduction and adoption of my apparatus. But I may be allowed to quote a passage from a paper on some nitrogen compounds, published ten years ago (Annalen der Chemie and Pharm., Bd. x., s. 3), since this will tend to render my object and purpose more clear and intelligible to him and also to my readers.

"Our insight into the mysterious processes of the animal organism will acquire a very different import if, instead of resting satisfied with decomposing the substances occurring in the various organs, into numerous other combinations, the properties of which teach us nothing, we follow their alterations and transformations, step by step, through elementary analysis, without heeding (for the moment) their properties; whilst in this manner, we arrive from one link to the other, we indubitably approach the point more and more from which the chain proceeds; infinitely distant though this point may be, yet we approach it.

"We know that the oxygen of the atmosphere stands in a definite relation to the blood in the respiratory process; we can show the alterations which the air undergoes, and observe the phenomena taking place in the lungs; but if the science of chemistry does not succeed in following up in the animal body all the alterations which take place in the organs, and in the substances acting upon the organs, and operated upon by them in return, and in obtaining an insight into these alterations, it is not worth while to occupy ourselves with them. So much I consider as certain, that the way which has been hitherto pursued fritters away our energies without producing any real advantage."

If this expression of my sentiments at that time be compared with my former or subsequent labours, and be taken in connection with the mass of valuable investigations, conducted by talented and skilful young chemists, at my instigation and under my observation,—investigations which embrace every constituent of the animal and vegetable kindoms, and form a great part of all we know thereof—every one, whether favourable or opposed to my views, will confess that all these labours have a common centre—that they are links of one and the same chain. The labours of Demarcay, on the nature of bile; the important investigations of fatty substances by Redtenbacher, Bromeis, Varentrapp, Meyer; of the constituents of blood and milk, by Jul. Vogel, Scherer, Jones, Rochleder, and of so many others,—what purpose can reasonably be assigned to them, except the practical confirmation of those principles upon which I proceeded at the very outset of my career, and which I developed ten years ago in the clearest manner possible, and to which I adhere now with the same conviction as formerly.

If my object had not been the attainment of truth, but merely the acquisition of some specious aud futile arguments, I might, with regard to the investigation of the nature and constitution of bile, have rested satisfied with Demarcay's figures; but I subsequently induced Kemp to undertake the same investigation, and after him Theyer and Schloser. These latter gentlemen, after a laborious investigation, which lasted for years, arrived at last at a knowledge of the true nature and constitution of bile, and were enabled to prove that the composition of the bile is not perpetually changing, as was previously supposed, and therefore that the gall-bladder is not like a common sewer, into which all the waste matters of the body indiscriminately flow. In this manner every individual fact was treated, and all its points fully ascertained and determined.

And now, after eighteen years of incessant labour, and after the application of the intellectual energies of so many individuals, when I venture to sum up our results, and to deduce such inferences and conclusions as legitimately flow from them, there comes a man—my friend—of the highest authority in science, and dares to brand the intellectual expression of all these labours as a mere play of fancy! He calls our results "probability-theories," and this simply, and for no better reason, than because we take the heart for a pressure and suction-pump, in the sense as the eye, for instance, is compared to a camera obscura,—because, by a mere error of the press, it is stated in my work, in one single place, that the urine is secreted from venous blood,—because we believe arterial blood passes through the kidneys and venous blood through the liver, and all this proves to him that the author has not sufficiently studied the principles of the science upon which he writes.*

Even admitting that these views are grossly erroneous, was their establishment the object of the author's labours? When he endeavoured to ascertain the composition of bile, of urea, of uric acid, of blood, and the organic tissues, and to discover their relations to the aliments and secretions, was it not perfectly indifferent, as far as his immediate object was concerned, whether the urine is secreted from venous or from arterial blood? and whether the heart is a force and suction-pump, or not?

When the chemist maintains that the blood is not formed from starch and sugar; that the bile is not to be found in the fæces, but is eliminated from the organism in a gaseous form; when he develops his theories that those remedies, which are products of organic life, take a share in the processes in the animal organism, similar to that which we positively know is taken by all the vegetable nutritive matters; when he further asserts that uric acid and urea are products of the transmutation of matter, and are not directly derived from the aliments; when he points out a close connection between nutriment, loss of heat, and consumption of energy; ought all these assertions, after the labours which have preceded them, and whereon they are founded, to be styled "probability-theories," "fantastic notions?" must all the investigations made during the last thirty years be deemed to have produced no result whatever capable of any useful application?

Must I, then, remind my opponents what notions prevailed, even so late as four years ago, on the nutrition of plants? Must I remind them of the fact, that the result of the last investigations of Boussingault, with regard to the advantages of the rotation of crops, consisted in his ascribing them to the destruction of weeds, and that the cereals receive their nitrogen from the manure, whilst the leguminous plants derive part of it from the atmosphere? How many proofs of the correctness of the principles laid down by me, could I not place in Berzelius' hands, obtained from the most intelligent, the most clear-headed farmers of England and Germany, who have had occasion to test and verify their correctness, in a simpler and safer method of cultivation—an infinite

* "Thus we have seen it stated in chemico-physiological works that the heart is a pressure as well as a suction-pump; that the urine is secreted from venous blood; that arterial blood, before it returns to the lungs, passes through the kidneys, whilst venous blood passes through the liver, &c. This proves sufficiently that the author had not thoroughly studied the principles of the science on which he wrote."—(Berzelius, Twenty-third Annual Report, p. 573.)

saving of labour and money, and in the more abundant crops of their fields.

Had a physician, who began his studies forty years ago, and who has not followed during all this time the discoveries made and the experience attained, started these objections, I should not have stooped to notice it. But do the analyses of fæces and urine, the first contributions to physiology which Berzelius made,—contributions which give us about as much information on the origin of fæces and urine as we might have derived from an analysis of garnet,—do these give Berzelius a right to style the results of our labours "probability-theories," because we connect other questions with them, and endeavour to derive from them certain useful applications.

I fully, and with pleasure, acknowledge the value which his invariably exact and conscientious labours have had in their time, and which they still possess, since they prepared the way for our present knowledge, and since without them *we* should have been obliged to go through the same laborious investigations. But is it impossible to over-estimate the labours of Berzelius? Is the field of scientific inquiry to be limited by the results of his investigations? Far from it. No such dominion as that exercised by Aristotle can now be conceded to any man. Nature still offers illimitable mines for us to explore, and shall he whose labours are rewarded with great discoveries feel no enthusiasm and express no gratification at his success?

For my own part, I confess that I felt my whole nervous system thrilling, as if pervaded by an electric current, when Wöhler and myself discovered that *uric acid* and all its products, by a simple supply of oxygen, became resolved into *carbonic acid* and *urea*, thus showing that there existed a connection between urea and uric acid, such as had never before been dreamed of, in its infinite simplicity,—when our calculation proved that *allantoin*, the nitrogenous constituent of the urine of the fætus of the cow, contains the elements of uric acid and urea, and when we succeeded in producing allantoin, with all its properties, from uric acid. Though few words passed between us whilst engaged in these investigations, how often have I seen the eyes of my friend glistening with delight! I felt the same thrilling sensation when, during my investigation of Melam, and whilst following up the ultimate products of cyanogen,—the most simple of all organic radicals,—I found that the atoms, instead of resolving themselves into more and more simple atoms, and finally into elementary atoms, re-arranged themselves into far more complex groups than cyanogen; and when, upon investigating the sulphureous and nitrogenous constituents of plants, I found with every new analysis my presentiment realised that they are all identical in constitution with the blood. All these facts spoke to me in a language which I believe I rightly understood, for I had taken the greatest pains fully to comprehend the exact meaning and signification of the words: ought I, then, to be censured for venturing upon the attempt to render their meaning as clear and intelligible to others,—to communicate to others the ideas these words seemed to convey to me?

The most difficult part of my task unquestionably was, that I had to address a public unskilled and inexperienced in the language of the phenomena; the physiologists and pathologists to whose pursuits my labours appertained did not understand the method of interpretation familiar to chemists, nor did they even know the meaning of the individual words. Thus, the Englishman who is but imperfectly acquainted with German, reproaches even our best translations of Shakspeare, with weakness, want of life and vigour, as compared with the original; thus, too, the German who reads for the first time a French translation of one of Schiller's poems, finds the version feeble and unmeaning; now, the real reason of this is, that those who judge thus, are ignorant of the real meaning and import of the words used in the foreign version, ignorant of what constitutes exactly equivalent expressions in both languages. A good French version of Schiller produes the same effect upon the mind of a Frenchman as the original does upon that of a German. To be able to judge what difference from the original may really be laid to the charge of the translator, a very correct and perfect knowledge of both languages is indispensable.

This is the relation in which many physiologists stand to the chemist, with regard to the consideration and solution of physiological questions. Everything which the chemist considers as unquestionable premises whence he may safely deduce conclusions appears weak and doubtful to the physiologist.

Their own inability to understand and appreciate the value of the reasons advanced, makes them believe that these reasons constitute a defective proof. Chemistry cannot be of any use to such persons in their inquiries,—from a fear of being unscientific they sacrifice the true logic of science,—the highest scientific theories become to them the grossest nonsense.

It is far easier to come to an understanding with the strictest mathematician than with such physiologists. The mathematician is kind enough to permit us to infer from two known quantities a third, or from three known quantities a fourth unknown one; the physiologist can permit nothing of the sort.

When the chemist places a calculation before the physiologist the latter asks him for his proofs; he is not satisfied with these, but he requires him to *prove* these proofs, and then to prove the proofs of the proofs! The chemist says, "I know the weight of a certain amount of tobacco, and the weight of the ashes remaining upon its incineration; I know also, therefore, the amount of what has gone off in the smoke." "Prove it!" exclaims the physiologist. If the chemist had weighed the smoke, disregarding altogether the weight of the tobacco and of the ashes, the physiologist would have considered the result far more correct, so strangely perverted are some people's intellects.

The Grand Duke of Hesse provides his soldiers with two pounds of bread *per diem*; the King of Prussia and the Emperor of Austria provide their soldiers with the same amount. Now, soldiers do not live upon bread alone, they partake of other aliments besides, and of all these aliments there remains nothing in the economy, nothing is permanent in the organism, except the bones. With military scrupulousness the sergeant major weighs all their other aliments down to pepper, salt, and vinegar; all these aliments, bread included, are examined as to their amount of carbon; the quantity of the fæces evacuated is determined, and so is the amount of carbon they contain. Thus we know the amount of carbon supplied by the aliments as well as of that eliminated by the fæces. Now, it has been positively ascertained that the carbon which enters the organism through the mouth has, besides the fæces, no other channel or exit except in the urine, and through the skin and the lungs; and, moreover, that the carbon is eliminated, in the form of carbonic acid, by the skin and the lungs; and that urea and water mean nothing else than carbonic acid and ammonia. We may, therefore, by a very simple calculation, deduce the unknown quantity from the two known quantities, and assert that an adult healthy individual, who is drilled during four hours every day, and has, at the same time, to carry a heavy burthen, burns in his organism about thirteen ounces and a half of carbon *per diem*.

This conclusion is as true as the assertion of the mechanician who, by the experiments made on a body of 100,000 soldiers, has ascertained that, on an average, a healthy full-grown man cannot carry above thirty pounds for eight hours consecutively without injury to his health. The statistician does not proceed upon the principle of the physiologist, who considers this conclusion erroneous because, forsooth, some feeble individual is not able to carry more than ten pounds, or because some strong person, whom he knows, can carry fifty or a hundred pounds.

Thus it has been ascertained that the average duration of human life is thirty and some years, and yet it is precisely at the age of thirty that the smallest proportion of individuals die. All these figures come as near to truth as it is possible to arrive; they are, therefore, considered as *really* and *exactly* correct, and serve as the basis of calculation for the terms of tontines and life-assurances, or for fixing the weight of the arms and baggage a soldier may bear.

The *strictly* scientific physiologist is not satisfied with this; observations taken from nature on this scale do not convince him. Regardless whether an individual or an animal has partaken previously of a repast or not, without troubling himself whether with a full or an empty stomach, he shuts him up in a cage and determines the amount of oxygen which he inhales, and the quantity of carbonic acid which he exhales. Instead of weighing the tobacco and its ashes, he weighs the smoke! as if the sources of error were not a thousand times more obvious and considerable in this method than in the former! But supposing even this determination were exactly correct, what information does it afford him? Neither more nor less than the amount of what an individual, shut up in such a cage, inhales and exhales under certain circumstances, not very minutely examined, and which do not, at any rate, correspond with the normal state. But it does not inform him how much carbon this individual consumes in twenty-fours hours. If the experimentalist had given a bottle of good wine to the individual in the cage, or if the latter had taken a copious draught of cod-liver oil previously to entering into the cage, very different proportions would undoubtedly have resulted.

One of my friends has, for 212 days, taken two ounces of cod-liver oil *per diem*, or a sum total of thirty-five pounds and a quarter, during that period, without increasing in weight; his fæces, upon examination, have been found to contain no trace of the oil. Now, if from this we infer that these thirty-five pounds and a quarter have been eliminated by the skin and the lungs, having served for the support of the respiratory process, what can be rationally objected to such a conclusion? This individual, from the moment he began to take liver-oil, could no longer drink wine, precisely because both these substances mutually prevent their elimination in the normal way, that is, in the form of oxygen compounds. But still the physiologist is unsatisfied, and repeats his "Prove it!" When I show him that the amount of carbon which a full-grown individual, in a state of free motion and labour, consumes, accounts sufficiently for the evolution of heat in his organism, he replies, "This proves nothing, for we do not even know what heat is;

we can produce heat by rubbing together two pieces of wood, or of metal; there may be unknown sources of heat in the organism." As if I had intended to prove the nature of heat! or as if it were worth while to enquire for unknown causes when the known ones give us a satisfactory and perfect explanation! What are unknown causes but the offspring of the imagination, the issue and manifestation of weakness, when the real causes of phenomena lie beyond the sphere of our apprehension.

Is the animal body a piece of wood or of metal, and can the same cause which produces heat by friction exist in the organism? And is it not altogether apart from the question to mix up the production of electricity in fishes with the enquiry into the production of animal heat? The natural philosopher knows, with positive certainty, that the electric currents in fishes are not the cause of their temperature; *if they were so, these animals would not be able to produce electric effects.*

When Volta constructed his admirable pile, he thought he had succeeded in making his apparatus similar in all points to the organs upon the existence of which, in the gymnotus and torpedo, the power of these animals to produce electricity depends. Is it in accordance with the logic of science to consider electricity to be the cause of phenomena and effects in organisms where no such apparatus can be found? When we have positively, and beyond the admission of a doubt, ascertained that nature herself, in order to produce electric currents, employs apparatus precisely similar to those which the philosopher employs for the same purpose, is it possible to deduce any other conclusion from this fact than that wherever we perceive electric effects in the organism they originate in the same manner as the electric current in the battery?

All the objections against my views which have hitherto come to my knowledge are precisely similar in their character to this reference of all the phenomena of heat to electricity. Berzelius says (23rd Annual Report, page 383),—" When, in consequence of a violent mental emotion, the feet of an individual acquires a temperature far *below* the normal temperature, while the forehead of the person thus affected feels heated far *beyond* the normal temperature, must it not be obvious to any reflecting mind that the mutual action between the constituents of the aliments and oxygen *cannot be said here to be the cause that the evolution of heat increases in one place and diminishes in another.*"

What can be said to such an objection as this, except that Berzelius has not understood what I intended to prove; that he has altogether misconceived my object?

I can determine, with the most positive certainty, the amount of alcohol necessary to heat a given amount of water or of iron and to maintain it at this temperature for a certain definite time; now, if in a stove or furnace altogether inaccessible to me, but provided with an aperture for the reception of the fuel, and another for the exit of the products formed by the combustion of this fuel, I find that these products consist of carbonic acid, water, and ammonia, and that the conversion of the fuel into these compounds depends upon a constant supply of atmospheric oxygen, can I rationally and logically ascribe the higher temperature which I perceive in this stove or furnace to any other cause than that which I see producing the same effect in an accessible furnace? Are my conclusions to be deemed fallacious because they do not explain the manner in which heat propagates itself in the water, or in the iron, or in the inaccessible stove, *i. e.*, in the organism? I never intended to explain from what cause, or in what manner, the head becomes heated when the feet grow cold, although it is quite in accordance with my views that heat should accumulate in one place when its diffusion in other parts is impeded.

I know an individual whose head grows cold as ice when his mind is affected by any strong emotion, while his feet, at the same time, become glowing hot, but I do not think myself justified on that account to place the seat of the evolution of heat in the lower extremities.*

Questions relating to the distribution of heat in the animal body, and innumerable others relative to the processes and actions of the constituent parts of living organisms, we may properly anticipate will be answered hereafter—time only is required for the solution of many unsolved problems. What is chiefly needed at present is the determination of principles, the settlement of methods for the pursuit of investigations. So long as physiologists and pathologists (the latter are the more

* Thus I read in a work on physiology, published some time ago, a very insulting commentary on the following sentence in my "Chemistry applied to Physiolgy and Pathology:"—"The *only* known and *ultimate* cause of the vital activity in the animal organism is a chemical process." The words *only* and *ultimate* were in *italics*, as they are here, but the preceding and succeeding sentences were altogether omitted. The former sentence says,—"We recognise in the animal organism only one cause as the ultimate cause of all production of energy, and this is the mutual action which the constituents of the aliments and the oxygen of the air exercise upon each other." The succeeding sentence continues,—"If we exclude the chemical process, that is, the air and water, in the germination of seeds, or the air in the respiration of animals, the manifestations of life take place no longer, or they cease to be perceptible." What I intended to say here must be obvious to every one; I might indeed, have underlined the word *known*, and might perhaps, have substituted condition for cause. But who would have thought, after reading my book through, that any one could be in doubt with regard to my views respecting the cause of the vital phenomena?

chargeable with the error) refuse to adopt the methods of physics and chemistry—methods which have been pursued with such signal success in these sciences—so long as they are unable to discriminate between useful and useless experiments, and rest satisfied with the weighing of smoke, it is impossible that they should make any real progress.

Why do these physiologists and pathologists reject our science? By abandoning the Aristotlean method, that of the phlogiston theorists, namely, converting effects into causes, Chemistry has, during the last fifty years, progressed with gigantic strides towards comprehending all the natural phenomena within its domain. This science is at present in a rapid course of development, especially in its organic department; it is endeavouring to advance from the simple facts already ascertained —its known data—to the investigation and apprehension of the more complex and more intricate phenomena which still remain mysteries to us. It has already made us familiar with the effects and actions of *forces* upon all the inorganic matters in nature, and it is now employed in seeking to ascertain and define the exact share which those forces take in the vital processes, the limit of their sway in the living organism, and thus to distinguish and separate the chemical actions from the operations of the ultimate cause of *vital phenomena*—from the effects of *life* itself.

Chemistry, in its bearings upon, and application to medicine and physiology, may be considered as a microscope, adapted to facilitate observations and investigations into the mysteries of nature, and to render the phenomena observed more intelligible to the intellectual eye, and more susceptible of useful applications.

To comprehend the living organism entirely and satisfactorily we must be acquainted with everything occurring within it. But how can we read and understand a book if we are acquainted with only half the letters of the language in which it is written, and but few of the rules by which the construction of the language is governed. The letters and the rules necessary to be known for the comprehension of this volume of nature have been the object of the most laborious researches of the most sagacious and best experienced men for a thousand years. These researches have proved unavailing, the end is not yet attained, because a wrong road was taken, and the means employed were not adapted to the object in view. A right direction, correct means, judicious and well considered methods, were formerly altogether wanting.

Medicine and physiology are, like other sciences, in a continual state of progress; enormous labours, the expenditure of incalculable energies, have elevated these sciences to that high degree of development which they have attained, to the exalted ground they now occupy.

The questions upon which everything at present hinges are these: Are the methods of inquiry and research hitherto in use for the apprehension of the mysterious processes of life incapable of improvement? Are not these methods rather antiquated and worn out? Are they really able to put us in possession of the results we covet? Can we rationally expect that they will yet furnish us with solutions of the many problems still remaining with respect to the functions of the most important organs in the animal economy? Will they ever teach us the nature of inflammation or of fever?

No one who looks attentively at the progress of medicine during the last hundred years, can fail of being convinced, that while there has always existed a most earnest desire for a clearer insight into the vital processes, and a more accurate knowledge of the causes exercising a disturbing influence upon them; that while abundant energies have been directed toward the attainment of the highest aim of the science, there has hitherto been an hiatus which it is necessary should be filled up, a connecting link to the disjointed observations, and which must of necessity be supplied ere a more extensive and profound knowledge of the mysteries of organic nature can be attainable. The information we are in quest of is, what are the other forces of nature which co-operate with the vital principle in producing and sustaining the manifestations of life, the processes continually going on in all living organisms?

The inability to distinguish, and separate from each other, various effects in complex phenomena, render it impossible to refer each especial effect to its true cause. Hence the brilliant discoveries of comparative anatomy and physiology, which have enriched these sciences more in the course of a few decades of years than the labours of a thousand years previously, have exercised but a slight influence upon medicine.

All great pathologists, all the more intelligent physiologists, have from the beginning clearly and distincly recognised chemistry as the great desideratum—the needed link—and they have attempted the solution of the several problems presented them with such scanty and insufficient means as chemistry afforded in its infancy, and in the various stages of its development. Paracelsus, Van Helmont, and Sylvius—chiefs in their age—attempted to apply the experience of chemistry to medicine, they referred all the physiological, pathological, and therapeutical knowledge which they possessed to chemical principles. But they regarded the fluids of the animal body exclusively, they bestowed the suffrage, in physiological and pathological questions, to them, to the entire disregard of the solid parts of the organism, and all the changes they witnessed and effects they studied were referred to the chemical operations of the animal fluids. But the definitions of acid, alkali, and fermentation, upon which they relied, and which they had borrowed from chemistry, failed, and these terms gradually acquired a very different signification.

The first principle of medical chemistry, namely, to take experience and experiment alone as the foundation and touchstone of theory, was altogether lost sight of in the explanation of vital phenomena, just because true experience—the real science of chemistry—could not keep pace with the progress of physiology and anatomy.

Thomas Willis, by giving an effectual impulse to the development of anatomy, prepared the overthrow of iatro-chemistry. Henceforth the solid parts of the body were more carefully and particularly studied, and the functions of the various organs, and every step in the progress of advancement made more and more evident the insufficiency of iatro-chemistry. The result was an estrangement and separation of medicine from chemistry. But never, not even during the prevalence of the theory of phlogiston, were chemical investigations and principles considered as non-essential to the apprehension of pathological and therapeutical phenomena. With a truly scientific spirit Boerhaave asserted the necessity of chemistry to medicine, pointed out their true relations, and exposed the folly of the iatro-chemists, and the vanity of alchemy.

Galileo, Kepler, Torricelli, and Lord Bacon, deposited in its grave the Aristotlean method of considering and explaining natural phenomena, so far as regarded its employment in natural philosophy, but they were unable to exercise any influence upon the theory of medicine, because chemistry itself, the foundation-stone of medicine, being threatened at that time in its own existence and independence as a science, found protection—a point of reliance and support, in the philosophical method of Aristotle.

The hypothesis of phlogiston, and the part it performed in natural phenomena, was, in fact, nothing more nor less than the union and incorporation of certain effects observed in nature, just in the same manner as the designation of other elements, *air*, *water*, *earth*, were incorporations of the conceptions of gaseous fluid and solid states of matter, and, at a later period, sulphur and mercury were general expressions of inflammability and metallic qualities.

The existence of phlogiston once assumed, the evolution of light and heat in combustion, and the alterations which substances undergo in chemical processes, were explained in the most satisfactory manner.

It was the phlogiston latent in bodies which was supposed to acquire motion, and to escape by the action of heat, and it was deemed perfectly rational to conclude that the properties of bodies must depend upon a certain proportion of phlogiston, salt, and earth, and that the metals should owe to phlogiston their hardness, their ductility, and their lustre. All was consistently enough explained. The existence of phlogiston seemed beyond a doubt, no one thought of attempting to prove it by any special argument. For were there no phlogiston there would have been no explanation of the phenomena. No phenomenon would have been explicable without phlogiston, all would have been darkness and doubt.

The advantage which the hypothesis of phlogiston presented at that time was that it kept together the ascertained facts and led to discoveries, as it served as a guide and stimulus to the search for new facts. The benefits of such an hypothesis are obvious enough; and yet, after all, it was nothing more than a mere description of phenomena—a *word which embraced the effects of many causes, and which word was taken and considered as the ultimate cause itself.*

At length the period arrived when this word lost its use and signification, when the better and more correct knowledge, the offspring of phlogiston, devoured its parent. The more minute and comprehensive study of heat, in specific and radiated caloric, the *more exact determination of the individual letters composing the word phlogiston,* led to the present state of chemistry, and the method arising from the study has led to the more profound and correct apprehension of chemical processes, and the causes by which chemical phenomena are produced, the introduction of which into physiology, pathology, and therapeutics, is the great desideratum of the present time.

The method of the phlogistic philosophers reached its climax in natural philosophy, and with this blossom the plant died, the leaves thereof faded, and the stem mouldered! The true fruit of it was the irresistible conviction which was forced upon every thinking and reasoning mind that no enduring results could be obtained by its means. New and better methods of investigation took its place, and herewith the essential condition was reached of a real and sound progress. Who does not recognise in the "vital principle" of the physiologists the old phlogiston theory dressed up and disguised in medical rags? As soon as you deprive them of this convenient phantasm all their explanations vanish into thin air! The simple search for phlogiston created a new science in chemistry; the search after the "vital principle" is preparing a new era in the medical sciences.

All that belongs to the phenomena of motion, to the form of the organs, their formation and development, the processes of absorption and secretion, have been ascertained by physiologists and anatomists, with a sagacity and with an expenditure of labour which must excite the greatest admiration. But the greater is the contrast when we compare therewith their explanation of the most simple chemical processes.

Chemistry inquires for the causes of fermentation, putrefaction, and decay, processes of gradual resolution of the higher order of atoms into the more and more simple, and finally into the original forms of these atoms, by the combination of which the most complex atom was formed. Chemistry here meets, in its way, with physiology, which attempts to solve the same problem by its own peculiar method. The physiologist discovers in fermenting fluids formations similar to the lower species of plants; he finds in putrefying matters a world of animalculæ; without entering upon any further inquiries, he assumes the mere concomitants of these processes to be their real causes. But is not this precisely analogous to the old phlogiston hypothesis? According to the physiologist, fermentation and putrefaction are effected by the development of fungi and infusorial animalculæ. But does this assumption render the process itself a whit the more intelligible? If the spores of fungi had generally the property of inducing fermentation in fluids, such a view would have some foundation, but such a property has not hitherto been observed by any one, nor has any attempt been made to prove its existence. When chemistry proves that in many processes of fermentation and decay, the resolution of complex atoms into simpler ensues without the presence of vegetable or animal beings, it is certainly most reasonable to suppose that the presence of these creatures, in the few instances where they are found, is purely accidental. If they were really the cause of the processes they ought to be found in all cases. I have elsewhere (Introductory Address, No. 10, LANCET, p. 395,) compared these notions with that of a child who attributes the flow of the Rhine to the water-mills at Mayence.

If the fungus be the cause of the destruction of the oak tree, and the microscopic animal the cause of the putrefaction of the dead elephant, what then causes the putrefaction and decay of the fungi and the animalculæ? They ferment and decay exactly in the same manner as the tree and the elephant; nothing remains of them but their non-volatile and earthy constituents.

Is it conceivable that plants and animals should be the causes of such effects as fermentation and putrefaction; that is, the destroyers and annihilators of organic bodies, parts of plants and animals, when they themselves, and their own constituents, are subject to the very same processes of decomposition?

The influences of atmospheric air, of the aliments, of motion and rest, of heat and cold, and of remedial agents upon the animal body, both in health and disease, have long been recognised, and yet, nevertheless, phlogiston until very recently has, either openly or covertly been assumed, in all theories constructed to explain these influences, to enact the principal part.

The existence of hydropathic institutions, those dens of covetous and rapacious gamblers, where the wretched invalid resorts to throw the dice for health and life; the rise and progress of the homœopathic system, which treats truth with scorn, and bids defiance to common sense, loudly proclaim the need which exists for the adoption of settled principles, definite methods of research, and a systematic arrangement to guarantee their attainment and retention.

What are denominated by physiologists vital processes, embrace, besides the *vis vitæ*, the effects of many unascertained causes, the knowledge of which is essential if we are desirous to advance to a real comprehension of the ultimate cause of life, and which we must investigate in the phenomena which characterise the totality of life.

This knowledge can only be atained by means of the most persevering and unwearied efforts and researches; the *power*, the *means*, the *instruments* necessary to arrive at these results exist, and are in our possession.

The only method by which we can succeed, however, is by endeavouring to fix by numbers, measure, and weight, the apparently uncertain and ever variable phenomena. This is the method of Galileo and Bacon, the profound acuteness of its device, the precision of its results, the universal utility of its application, have been brilliantly manifested in the progress of chemistry.

Twenty-five years ago chemistry began to be applied to the more minute investigation of the constituents of the vegetable and animal kingdoms; the results which have been obtained are expressed in numbers, weight, and measure, after this method; we must now endeavour to introduce the application of numbers, weight, and measure, into physiology and medicine, to substitute them for mere unmeaning and empty sounds. The chemistry of the present day, in its proposed application to physiology and pathology, has none of the characteristics of iatro-chemistry.

It is not the true chemist who has endeavoured to apply to the animal organism, his notions derived from purely chemical processes, he has not had the remotest intention of undertaking the explanation of any really vital phenomenon upon chemical principles. The only part which chemistry now and for the future can take in the explanation of the vital processes is limited to a more precise designation of the phenomena, and to the task of controlling the correctness of inferences, and ensuring the accuracy of all observations by number and weight.

The term *hydrogen*, for example, designates for every body a substance which is one of the constituents of water, but for the chemist the meaning of the term is far more comprehensive; it embraces an aggregation of properties; joined with other words, such as *chlorine*, *oxygen*, *sulphur*, *nitrogen*, &c., it presents to him a volume filled with thoughts and conceptions, and brings innumerable phenomena before his eye. The same may be said of a chemical *formula*, which is far more to the chemist than the expression of the results of an analysis; it renders intelligible to him the formation of the substance it designates, the products of its decomposition, together with the relations which it bears to other substances. Thus, by simply placing together the formulæ of alchol, of acetic acid, and of acetone, all the alterations and decompositions which attended the formation of acetic acid become at once perceptible. Without this method of designating chemical compounds no just apprehension of them is possible.

The physiologist, in his own way, has created for himself certain conceptions of *bile*, *saliva*, *cerebral substance*, *albumen*, *uric acid*, &c. including the physical properties of these substances, their colour, consistence, taste, &c., which he has ascertained, together with the relations he has observed them to bear to the organism and to its individual parts. But this physiological conception does not embrace all their properties and relations. In the hands of the chemist these organic matters manifest innumerable peculiarities in their relation to other substances, such as the raptitude to form combinations, to undergo decompositions; moreover, the knowledge of their elements, their invariable, composition, in short, all their chemical characters, belong to the word *bile*, *albumen*, &c., for the chemist. It must be perfectly obvious that the placing together of the words in the physiological sense can give us no information of their true import, their chemical meaning must form a part of their definition, if we are to comprehend all the points connected with them.

In the compound atoms of which the animal organism consists we observe the same fixed and immutable proportion as in inorganic nature. The laws of their chemical composition are as true for organic as for mineral substances. They ought not, and cannot, be disregarded by the true student of nature.

How strange it is that chemistry should have to fight a kind of battle in order to be permitted to render that assistance it can well afford to physiology, to extend and to augment, to make more precise and definite the significations of physiological terms and to correct the conception and definition of organic substances, their origin, properties, and relations!

It canot be disputed that a simple substitution of the *formula* of caseine for the word caseine, of the formula of cellular substance for the word cell, of the formulæ of bile, uric acid, &c., renders at once intelligible a number of relations which, without the formulæ, would be imperceptible, or, at least, in the greatest degree obscure. When the formula of caseine, compared with that of blood, tells us that caseine is identical in composition with the principal constituents of the blood, does not these bring us far nearer to the apprehension of its origin *from* the blood and its transformation *into* blood than we were before? A comparison of the formulæ of the constituents of the blood and of cellular substance points out to us how much oxygen must join, and how much carbon must separate from albumen or fibrine to convert these substances into cellular tissue; and if urea and uric acid are products of the transformation of living tissues, and ultimately of blood, does not the formula of urea and that of uric acid afford us a perfectly exact measure for the quantity of organic substance which has undergone this transformation? The formulæ speak for themselves, but what they tell us no longer belongs to chemistry, it now becomes a part of physiology.

I admit that the accurate determination of the composition and proportions of these bodies, and the assigning their numbers, appertains to the domain of chemistry, and may be called chemistry, but the application of the discoveries of organic chemistry to a more comprehensive and correct definition of the physiological conception, and to the more extensive apprehension of the properties, relations, and formations of these organic substances, belongs to chemistry only *de nomine*.

The production of iron from its ores is a metallurgic process, but the application of iron after it is produced to the manufacture of needles and innumerable purposes in the arts belongs not to metallurgy.

It is the same with respect to the methods of the chemist; it is only by mistake they are called exclusively *chemical* methods; they are methods in accordance with plain common sense and sound reason, and therefore are applicable everywhere and in all sciences.

The mineralogist is no longer misled by the infinitely various forms under which calcareous spar is found in nature; he is now, by the discoveries of science, enabled to recognise it under any form, and to refer them all to a common basis.

It must be the same in disease, the morbific agent,—the medicinal substance, may produce in two individuals effects very unlike in their manifestation, and yet the effects themselves must be the same; the symptom invariably indicative of this effect being observed in two, three, or four individuals, must be repeated in hundreds and thousands of instances. The symptoms in the aggregate, are, perhaps, never united in any individual, but if those present be correctly observed and rightly apprehended, it is impossible to mistake the causes of the disease, or to be in doubt as to the remedies required for its cure.

By simply making use of the acquisitions of chemists, of the profound knowledge now obtained respecting chemical forces, by applying the infinitely more precise knowledge we now possess of organic substances, and by introducing new methods, physiology and pathology will arrive at fixed and immutable principles. The acquisitions of anatomy can only in this way be rendered capable of useful applications, and no power on earth can stay the progress of science in this direction, which every one must acknowledge is the fruit of progress,—the offspring of the present age.

Ignorance will withdraw from science from the very moment in which it is compelled to verify conclusions by a well-regulated and consistent method of investigation, taking into account every condition of natural phenomena—every influence and contingency affecting the symptoms of disease. Even at the present moment physicians, by false interpretations of badly observed phenomena, lead each other astray and carry on interminable discussions and contentions about the most immaterial things. It was precisely the same with chemistry during its transition state, when the phlogistic theory was disproved. Everything was for the time unsettled, and every suggestion and hypothesis admitted; the old basis upon which the science rested was cast down, and the new one had not yet been established. All this is now altered; the true groundwork of the science is firmly established; the so-called practical chemist no longer looks down upon what is called theory with a smile of compassion or contempt, as is still frequently the case in medicine. No chemist relies any longer upon his own individual experience, in which he may be rivalled or surpassed by a clever peasant or shepherd. Formerly the chemist went to the soap-boiler, to the tanner, to the manufacturer, and artisan, whereas, at present, the soap-boiler, the tanner, the manufacturer, and artisan frequent our universities, because they know that it is science alone which can furnish them with the master-key—the magic spell—the "*open sesame*" to unlock all the mysteries of their pursuits.

Just as at the present day the influence which the application of chemistry will exercise upon the solution of physiological and pathological problems is, by many physicians, considered worthy only of ridicule, so formerly were the advantages derivable from chemistry to arts, manufactures, trades, and agriculture, when first indicated, only laughed at by those who were pleased to call themselves practical men.

It has proved most injurious to science that so many individuals have made experiments without first obtaining any well-defined notion of the design or meaning of experiment. Such people have had the power and the will, but rarely have they proposed any definite object, any well-directed aim; they have employed a lever, but they have not ascertained the point upon which it turned. The reason that so many experiments have been made in vain, is simply and solely to be ascribed to the fact that comparatively few experimentalists have known how to observe natural phenomena, or understood the import of experimental research. It has been wholly overlooked by them that we do not by experiments examine nature; we do not study the phenomena themselves through which nature is manifested to our senses, and experiments are only of value inasmuch as they teach us to discover the errors of our inferences and to rectify our false conclusions from observation. If we could climb up to the rainbow, and could maintain the floating rain-drops in their position until we had concluded our observations and arrived at a correct apprehension of the phenomena, we should not need experiments. But being unable to do this, the philosopher was compelled to have recourse to experiments, to turn and turn a plain, smooth, and then a triangular piece of glass for centuries, to measure and to calculate, ere he succeeded at last in apprehending the cause of the colours in the rainbow, their order and relations.

How admirable is that method, which with such scanty means could lead to the attainment of conclusions so correct as to the nature of phenomena which seemed to lie far beyond our reach! How much more accessible are those phenomena which plants and animals present to us in their vital processes! How much easier is the investigation into the conditions essential to life; the research for causes of disease, states which present themselves daily and hourly to our senses.

The animal body is as transparent as if made of glass to the intellectual eye of the physiologist. He knows definitely and positively the alterations which the air undergoes in the lungs, and yet, nevertheless, he requires an infinite number of experiments, without the least value in themselves, to enable him to form a satisfactory theory. He agitates blood with air, and as he afterwards detects a trace of carbonic acid in the air, although without perceiving the slightest absorption of oxygen, he is satisfied that this evolution of carbonic acid suffices to explain the respiratory process, and yet a handful of wet sawdust or a leaf would have produced exactly the same result. How would it be, supposing that blood would not in this way yield carbonic acid when removed from the organism?

Innumerable experiments have been made to prove the nutritive properties of carbonic acid for plants, which all gave a negative result. Although it was most positively known that carbonic acid is absorbed by the green-plant, that under the influence of light it becomes decomposed in the organism; that its carbon is assimilated and oxygen eliminated in a gaseous form. The experiments I allude to have no value whatever, because the experimentalists disregarded altogether the *conditions* necessary for the absorption and assimilation of carbonic acid by the plants, excluding everything, and neglecting every precaution, indispensable to the success of their experiments.

We hear every day of experiments of a similar kind. Thus, to ascertain whether sugar is capable of being transformed into fat in the living animal body, a dozen pigeons are stuffed daily with a quantity of sugar, which acts upon them like a medicinal substance, or a poison, and when after the lapse of from six to ten days they die of starvation, the experimentalist strangely expects to see them filled with fat, and is amazed to find himself disappointed. Thus, without knowing the conditions of the formation of fat in the animal organism, without stopping to inquire whether any conditions are required, the experiment is commenced by excluding every thing which would render its success possible. A state of artificial disease is produced in the animals; all nourishment is most carefully withdrawn from them, and thus they are deprived of everything necessary for the formation of blood—for the support of the vital processes, and, consequently, of that action which causes the formation of fat. By means of these cruel and wretched experiments these gentlemen believe they are able to prove that sugar, a non-nitrogenous substance, is incapable of being converted into fat, another non-nitrogenous substance. Such experiments prove nothing whatever, except the ignorance and total incapacity of the experimentalist to pursue these investigations.

Everywhere, and in all cases where we can succeed in ascertaining, from nature herself, the conditions of a phenomenon, our inferences possess a far higher value than they could ever acquire were they derived simply from experiments. No experiments can ever contradict truths derived from the observation of nature. The great difficulty under which we labour in our experiments is the immense sacrifice of time and exertion required to imitate the conditions under which the observed phenomena manifest themselves in nature.

With a knowledge of those conditions our labour is concluded. The safest and most direct way is invariably to study nature for a knowledge of those conditions, and when we have ascertained them, further experiments serve only to guard us against mistakes, and to suggest useful applications of our knowledge.

Let us not render our labours futile by creating imaginary difficulties ; those which exist already are quite enough for us to encounter.

Does the pathologist imagine that the chemist is desirous of seizing upon his territory ? Has he acquired a possession in it from whence he may be ejected? Is he anxious to leave the Augean stable uncleansed?

It has been discovered that benzoic acid becomes hippuric acid in the animal organism, that the elements of benzoic acid perform a part in the secretory process of the kidneys, that they take a definite and traceable share in a vital operation, and may be employed for a definite purpose. Benzoic acid is a non-nitrogenous compound which can only be produced in the living organism of plants.

Now, if we find further that animals which, to their aliments, partake of no benzoic acid, but of other non-nitrogenous substances, likewise secrete hippuric acid in their urine to a considerable amount, whilst the urine of carnivorous animals contains no hippuric acid, am I in error in concluding that other non-nitrogenous substances, differing from benzoic acid, may also be used for the production of hippuric acid, and that they likewise participate in the secretory processes?

Now, in hippuric acid I still find the elements of benzoic acid ; and I can by simply adding to benzoic acid another substance produced by the organism, form hippuric acid, whilst, *with other non-nitrogenous substances, this is possible only after they have undergone a series of transformations.* Does not this fact render it extremely probable, not to say certain, that vegetable medicinal substances,—themselves the products of the vital force,—may, in a manner exactly analogous, remove abnormal states of the animal body, if, by their composition, they are adapted for undertaking in the vital processes that part which the aliments can no longer perform because some part of the mechanism refuses its co-operation which is requisite to render these aliments fit for this purpose!

A lofty pillar may be saved from falling by a very small fragment of stone; the tooth of a wheel which has become loose in the works of a clock may be soldered, and thus the clock restored to its original correctness. Now, I ask, does not the fragment of stone so employed become part of the pillar? Does not the solder enter into the composition of the wheel? A watch may stop for want of oil; a platinum wire divided, may be connected with a piece of silver wire, and the electric current which had been interrupted restored. Does not the silver become part of the platina apparatus, so far as the desired effect is concerned? Does not the oil employed to lubricate the axes of the wheels form part of the watch?

When the chemist deduces inferences from his observations, surely he does not go beyond his own sphere. It is true we may not be able at present to solve the problem how morphine and quinine operate in the organism; but we are surely proceeding in the right direction for obtaining a knowledge of even those points. My opponents object that my inferences respecting the effects of vegetable remedies are only probabilities, but they altogether overlook the circumstance that I myself never attempted to pass them off for anything else. If you deprive the investigator of nature of the power to make suggestions, to take probabilities to guide his future aims, you deprive him of all support, of all reasons to proceed in his investigations. The chemist, as well as every other philosopher, must conceive some probable object toward which to direct his researches.

Would it not be exceedingly absurd to expect that plants would grow without seeds, to desire to engraft a noble tree upon an ignoble stock, whilst you reject the scion! How can we sow with the hope of a harvest without having a fertile soil at our disposal? Our desire is to winnow well the grain until all the chaff is cleared away.

If I were called upon to decide what right physiologists and pathologists have to form an opinion with respect to the inferences deduced from chemistry to aid physiology, and my judgment were guided by the facts and inferences cherished and fought for by these gentlemen, the amount of credit I could award to them would be represented by a very small figure.

When resting upon the fact of the transformation of benzoic acid into hippuric acid, a fact established in the most exact and decisive manner, I deduce a certain inference and catch a glimpse of a little more of the horizon of truth than my opponents, is it natural for them to desire to put out my eyes?

When, from the weight of the bile, which, according to the assertions of the physiologist, an ox secretes every day, and the weight of the blood-constituents which the same animal partakes of in its food in the course of twenty-four hours, I infer that the non-nitrogenous constituents of his food (gum, starch, sugar, &c.) must likewise participate in the formation of the bile, because the amount of carbon contained in the bile is greater than is contained in all the blood-constituents partaken of together, can this conclusion be called in question?

When, from not finding any bile in the fæces, I maintain that the bile must, in some manner, return into the circulation, to serve ultimately for the respiratory process, which means no more than that its carbon and hydrogen are eliminated from the organism in the form of carbonic acid and water; and further, when the physician finds that in cases where, by the administration of calomel, the bile, altered but little in its properties, is evacuated in the stools (known as calomel stools), the absence of the matter needed for respiration causes all the inspired oxygen to be directed towards the cause of the disease, and owing to this circumstance the disease is removed, can my inferences be doubted? Nevertheless, I do no more than desire my opponents to consider them as probable, and to submit them to the test of examination. But this has no weight with such people.

If some young author relates a tissue of marvellous tales to support an opinion that there exists certain states of disease in which the blood, which contains 80 per cent. of water, the flesh and tissues 75 per cent., and the bones 30 per cent. (thus altogether three-fourths water), may burn from within, in the absence of oxygen, these same physiologists will believe his assertions.* Our author has not, indeed, himself witnessed any case of this kind, he has never been in a situation to establish even a single one of the facts upon which the whole fabric of his tale rests; but it would require too much self-denial, a superhuman effort, to destroy such splendid tales, which render his book or his lectures so interesting!

* "What thing did you see? Speak boldly."

"I have seen a ship," said I, "going against a fierce wind with the same velocity as a horse, and that by the vapour of boiling water."

"Hajji," said the king (after a stare and a thought), "say no lies here. After all, we are a King. Although you are a traveller, and have been to the Franks, yet a lie is a lie, come from whence it may." * * * * "So you encountered great tempests?" said the Shah. "Say on Hajji, everything you have in your heart, say on."

"Yes, may it please your Majesty," said I, "one tempest we encountered, on our passage from England to Constantinople, was so great, that, venturing to look overboard to see how fast we were going for the good of your Majesty's service, and happening to leave my mouth open, a fierce wind entered, and blew three of your slave's teeth down his throat." Upon this I opened my mouth and showed the damage which my jaw had sustained from the kick of a Curdish horse.

"Are there such winds, indeed?" asked the Shah. "In truth they rush down with violence enough from the neighbouring heights of Albo."—*Hajji Baba in England.*

With the same easy credulity, people of this sort firmly believe that an individual suffering from diabetes emits more water as urine than he partakes of through the mouth. They, indeed, weigh the water which the patient drinks, but they take no account of the water in the milk partaken of (94 per cent.), in the bread (24 per cent.), in the meat (76 per cent.) Being either without the ability or the will to establish or refute the statement advanced, they assume it at once to be an indisputable truth.

If the public would take the trouble to test these marvellous stories (a task no one seems willing to undertake), it would soon be discovered that the evidence for them is precisely on a par with, and equally entitled to credit, as the certificates of the efficacy of *incomparable oils* for the cure of baldness, of *bear's grease*,† of vegetable pills, &c. On inquiry, it would be found that the bald heads, the ladies of quality who vouch for the marvellous cures, have just departed this life, or set out upon a journey,—they are never seen.

It is such people as these who believe the impregnation of the ovum without contact with the seminal principle not only possible but positively certain, and who bring forward, in proof of this assertion, instances which there cannot possibly be any opportunity of testing.

In criminal law, upon a charge of manslaughter or murder, the judge pronounces judgment only after the fact is well-established,—first, the *corpus delicti*, than the accusation, then the sentence, but these gentlemen care nothing about the establishment of the fact. If any rare morbid state, any reputed effect of a remedy, any pathological phenomenon, with which they are unacquainted, falls into the hands of this class of persons, all their egotism is aroused, truth is altogether disregarded. An imaginary criminal, as the cause, is created, whom they subject to the torture and the rack. Old women, fools, and children of all countries, are dragged forth to supply evidence, and the groans and sighs of the suspected innocent are interpreted as confessions in proof of their predetermined decision. Analogy is, with these people, converted into the bed of Procrustes, they stretch or cut off the limbs of facts and arguments, unscrupulously, and at their own sovereign pleasure.

In instances where a medical author advances such strange and imaginary opinions, the public seems to show an indulgence and kind forbearance which certainly is never exhibited towards writers upon other sciences. Too many established practitioners care less for the

† Original—*lion's grease*, which our German friends employ instead of bear's grease, but with equal effect ! !

advancement of science in their publications than for the extension of their own reputation for sagacity and penetration; whilst many a candidate for practice, pressed by his pecuniary necessities, writes a book as the best means of advertising himself; and to impose thus upon the public requires so very little labour or skill, that we may almost wonder that such works are not still more numerous.

In chemico-physiological works, physiology is threatened with danger, not from chemists, but from physiologists themselves and physicians.

It is not chemistry which asserts that peroxide of iron and protoxide of iron perform a part in the respiratory process; this assertion is made by physicians.

Chemistry knows but one organic compound, which invariably contains iron as a constituent. It is not a chemist who considers proteine the basis of blood and the tissues, but it is the iatro-chemist, who has introduced into the vital process the idea of the organic radicals. The chemist has not done so, because he knows that acetic acid may be derived from wood, and in its anhydrous state has the same composition as wood, and because he knows that acetic acid may be derived in the same manner from a thousand other substances, without being (on that account) the prototype of their constitution.

The iatro-chemist knows a proteine tritoxide, and deutoxide, he determines the atomic weights of fibrine, albumen, and caseine from their combinations with hydrochloric acid and peroxide of lead. It is he who wishes to establish the absolute number of atoms composing the elements of proteine, who disputes about the formula; this is the iatro-chemistry of the present time.

It is iatro-chemistry which proposes to make the addition of an atom of oxygen to *lung* tubercle render intelligible the formations of *liver* tubercle, which is just as clear as to suppose the addition of oxygen to ear-wax in an ear-spoon (cochlea), to make *spiritus cochlearia.*

I am perfectly aware that I bear the blame of many of these deductions, which I do not hesitate utterly to repudiate.

Iatro-chemistry, not chemistry, pretends to prove from the compositions of mould which forms in a solution of the sugar, that plants derive their nitrogen from the gaseous nitrogen of the atmosphere; for chemistry knows that pure solution of sugar does not admit the formation of any mould whatever. Chemistry knows that the so fabulously powerful vital principle is incapable of employing any element as the constituent of an organism. Chemistry knows that it is not *diamond* which nourishes the organism, but a carbon compound; not *hydrogen,* but a hydrogen compound; not *sulphur*, but a sulphur compound, and from this infers that nitrogen, also, cannot be assimilated as an element, but only in the form of a compound, which inference is moreover supported by the most direct and positive proofs.

In concluding these remarks, I cannot conceal from myself the little probability there is of their accomplishing any good, because those who have understood my works needed not a single line of explanation of this kind, and as for my opponents, they would choose to consider the most lucid explanation of mine as mere shadows and darkness. We need not alarm ourselves that the trees will grow into the skies, since nature and Providence alike forbid it; our own watchfulness, or an army of preventive police would be superarogatory.

I have pronounced my own opinions against the views of some individuals, who by the greatest and most transcendent merits have acquired my esteem, which will never diminish, but *they* must not forget that they have also their opinions, which do not offend me, because nothing can offend or disturb me on my way, since I shall ever maintain the courage to proceed right onward as long as my powers continue.

Note.—In the second volume of Berzelius's Manual, 5th edition, after describing my method of separating antimony from arsenic (by fusion of regulus of antimony with sulphuret of antimony and carbonate of soda), he says, "the antimony thus obtained is not so free from arsenic as that obtained by Wöhler's method."

If I understand this phrase aright, it means that antimony is not by my method obtained free from arsenic. Now, although I am always anxious to avoid discussions when my theoretical notions are assailed, I cannot remain silent, for science and the truth's sake, when facts are thus called in question. This method has been employed many hundred times in my laboratory, and has never failed. It has been repeated in other places also, and has invariably yielded antimony free from arsenic. Besides a few observations of Buchner's (Rep. new series 8, p. 266), no objections against my method have reached me in chemical literature, and the remarks of Buchner did not apply to the remaining presence of arsenic, but to loss of weight, &c., a subject discussed in the Annalen, bd. 22, p. 58. I cannot conceive what reason Berzelius has to condemn this method.

In his 23rd Annual Report, p. 177, Berzelius remarks upon my method of separating cobalt from nickel by means of cyanide of potassium. "He (Liebig) further states that he has applied cyanide of potassium as a means of separating metals from each other, and, for an instance, he gives a method for the separation of cobalt from nickel,

&c. An experienced eye perceives, immediately, that this method has not really been tested by analysis, which, moreover, would render necessary various methods, according to the varying relative proportions of the metals, and that it is fraught with more difficulties and sources of error than the common method of separating with ammonia and potass."

Altogether disregarding the circumstance that Berzelius gives an incorrect report of my method, this is not the first occasion on which he has deserted his formerly so stoutly-defended principle of allowing facts to speak and not opinions. I think it would have been better to have made an experiment than to have expressed an opinion based, as it is, upon an erroneous notion. Berzelius would then, probably, have satisfied himself, and this with the aid of my method, that the separation of cobalt from nickel by means of ammonia and potass is very incomplete and imperfect, since either the oxide of cobalt remains in solution, or the precipitated oxide of nickel contains oxide of cobalt.

I am, as is well-known, a teacher of chemistry in a university, and annually instruct above one hundred students in the art of analysing minerals, and, amongst others, in the separation of nickel from cobalt. My method, which Berzelius thinks exists only on paper, is, therefore, very often tried, and hitherto it has been found, invariably, that no better method can replace it; perhaps, because it depends upon a more correct principle of separation than other methods. I can only express my regret that Berzelius should have paid so little attention to the experiments of Fresenius and of Haidlen relating to the application of cyanide of potassium in chemical analysis, for these experiments constitute the most valuable contribution which mineral analysis has of late, received.

Manufacture of Epsom Salts.

The note, page 310 in our last number, relative to the process suggested in the paper of Lieut. Latter on the method of treating sulphurets of copper at Lyons, having attracted the notice of Messrs. Bathgate and Co., it was intimated to us, that sulphuric acid since the erection of their large chamber, has become so cheap as to be had for little or nothing. Conceiving the circumstance to be favourable for resuming the experiments in the manufacture of salts, referred to vol. 2, p. 244, we ascertained from Messrs. Bathgate and Co., that we might have the acid, specific gravity 1700, in quantities of not less than 100 maunds, at 6 Rs. per maund, for purposes of experiment.

We accordingly tried a maund of the acid on the magnesian limestone of Salem, an account of which mineral will also be found, vol. 2, p. 284 of this Journal. The result yielded 144 lbs. of Epsom salts from 38 lbs. of the calcined rock.

Taking the magnesite at Rs. 20 per ton, and the acid of the above specific gravity at 6 Rs. per maund, the Epsom salts afforded, which are very pure, costs 13 shillings and 3 pence per cwt. The imported salt from England costs, including freight and charges, 24 shillings. Having reported this result to the Medical Board, it was not deemed expedient to go on with the experiment to the extent proposed, with the view to supply public service. We would therefore recommend the subject to sulphuric acid manufacturers, as an useful way of employing their superfluous acid. The consumption of Epsom salts is becoming every year more general in proportion to the spread of European medical knowledge, the native sources and means of supply of all such articles, thus become proportionably more and more important.

There is however, another point of view in which this question becomes important; so long as we are depending in India on supplies of medicine from Apothecaries' Hall, our stock is liable to become exhausted. When the consumption exceeds the anticipated expenditure, which it almost always does, we are then obliged to make up the deficiency from such articles as we can collect in the bazars, sometimes at exorbitant rates. The cheap production of the common articles of medicine, such as Epsom salts, from the natural productions of the country, would prevent this, and also be the best check on the venders of adulterated drugs. Besides, it is the cheap and bulky articles of medicine which it becomes us most especially to prepare in India, since they are less worth their freight and the room they take up on board ship, than the more costly stores, such as quinine. The government are well aware of this, and in the paper above alluded to on this subject in a former number, it is stated in a note that the Governor General in Council was surprised to find no less than 18 tons of Epsom salts and other bulky articles of a similar nature included in our annual indents for medicines on Europe, calling at the same time on the Medical Board to institute enquiries as to the means of supplying such articles in India. Now that we have succeeded so well with regard to Epsom salts, we hope the Medical Board will be induced to re-consider the subject, and authorise the necessary supply to be furnished here, instead of occupying ships with such unnecessary importations to the neglect of the natural productions of this country. The production of Epsom salts from the Salem rock may be effected as above shewn at so cheap a rate, as altogether to secure the public against its adulteration in the bazars, with the numerous poisonous articles which, from its high price at present, are frequently mixed up with it. According to Lieut. Ouchterlony, of the Madras Engineers, the rock is abundant in Trichinopoly, Coimbatore and Mysore, its principal localities being in Salem.

Its sites are said by Lieut. Ouchterlony to be near enough to the banks of the Cavery, to allow of its being brought down that stream to Porto Novo on the coast, at a very low rate of not so much as 10 Rs. per ton, or probably a great deal less.

In the manufacture of sulphate of magnesia, from this rock, in the Laboratory of the H. Co's. Dispensary, which proved so satisfactory, it is first broken up into lumps of convenient size and thrown into the fires which are kept up for other purposes, and thus calcined. It is then pounded, mixed with water, and dissolved at once with acid, and filtered through cloth. The solution is then evaporated till a pellicle forms, and set aside to crystallize.

On a large scale the rock should be burnt in a kiln like limestone; but a quantity sufficient for the public expenditure at present might be made without this, and two or three coolies would be sufficient to conduct the whole process.

Coal from the Falls of the Jamuna, in Assam.

Results of the chemical examination of two specimens of Coal from near the Falls of the Jamuna, Nowgong district, Lower Assam.

Received from Major Jenkins, April 1844.

Sp. Gr. 1.2.

Bituminous volatile matter, ...	46.0
Carbon, ...	53.4
Light yellow White Ash, ...	0.6
in	100 parts.

Colour black and shining, with a resinous lustre, and temper-steel tarnish.

Quality, of the most superior description, better even than Cherra Ponji, or any other coal hitherto found in India.

J. M'Clelland,
Secretary Coal Committee.

Laboratory H. Co's Dispensary,
27th April, 1844.

THE

CALCUTTA JOURNAL

OF

NATURAL HISTORY.

The Palms of British East India. *By* W. Griffith, *Esq. F. L. S. Memb. Imp. Acad. Natur. Curios. Royal Ratisb. Botan. Soc. Corr. Memb. Hort. Soc. Royal Acad. Turin. Asst. Surgeon, Madras Establishment.*

[Continued from page 355.]

Sub-familia.—ARECINÆ. *Mart. Progr. p.* 7. *Palmæ. p.* 157. (ex. Endl.)

Flores mono-dioici vel polygami. *Spathae* plures incompletæ, vel una vel 2 completæ, rarissime nulla. *Stamina* 3-00 hypogyna. *Floris fæminei* perianthium convoluto-imbricatum, rarius corolla valvata. *Ovarium* 1-3-loculare, 1-3-ovulatum. *Fructus* baccatus vel tenuiter drupaceus, trilocularis, profunde trilobus, vel sæpius abortu unilocularis. *Semina* 1-3. *Albumen* corneum, ruminatum vel æquabile. *Embryo* sæpius basilaris.

Palmæ *perennantes vel monocarpicae, frutescentes vel arboreae.* Folia *pinnatim fissa* (*aliquando bifurca*) *vel pinnata, rarius bipinnata.* Inflorescentia *axillaris et terminalis, centripeta vel centrifuga.*

Sect. I.

Spathæ 1 vel 2, sæpissime completæ. *Perianthium* fæmineum convoluto-imbricatum. *Fructus* sæpe obliquus. *Folia* pinnatim fissa vel pinnata.

Areca.—Spathæ 1-2, *completae. Flores monoici in eodem spadice.* Stamina 3-00. Ovarium 1-3-loculare, 1-ovulatum. *Drupa,* rarius bacca obliqua. Folia pinnatim fissa vel pinnata.

Bentinckia.—Spathæ 2, *interior completa. Flores monoici in distinctis spadicibus, basi in foveolis immersi.* Stamina 6. Ovarium triloculare, 1-ovulatum. *Bacca? obliquissima.* Folia pinnata.

Slackia.—Spathæ 2, *incompletae,* vaginantes. *Flores monoici in eodem spadice, basi in foveolis immersi.* Stamina 6, filamentis basi coalitis. Ovarium triloculare. *Drupa obliquissima. Albumen ruminatum.* Folia pinnatim fissa.

Sect II.

Folia pinnata vel bipinnata, pinnis vel pinnulis erosis. *Inflorescentia* centrifuga. *Spathæ* plures incompletæ. *Corolla* fæminea valvata. Stamina sæpius indefinita.

* *Flores monoici in eodem spadice.*

Caryota.—*Folia bipinnata.* Stamina 00. Ovarium 1-2-loculare. Bacca 1, raro 2-sperma. *Albumen ruminatum.*

** *Flores monoici in diversis spadicibus, vel dioici.*

Arenga.—Folia pinnata, *pinnis linearibus, basi* 1-2 *auriculatis.* Stamina 00. Ovarium *triloculare.* Bacca *vertice depresso trigona, trisperma.* Albumen æquabile.

Wallichia.—Folia pinnata, *pinnis cuneatis. Flores interdum dioici. Stamina in quibusdam* 6. Ovarium *biloculare.* Bacca *disperma.* Albumen æquabile.

Sub-family.—ARECINÆ.

Flowers mono-dioicous or polygamous. Spathes several incomplete, or one or two complete, very rarely none. Stamina 3-00, hypogynous. Female perianth convoluto-imbricate, rarely valvate. Ovary 1-3-celled. Ovula 1-3. Fruit berried or slightly drupaceous, 3-celled, deeply 3-lobed, or generally by abortion 1-celled. Seeds 3 or generally 1. Albumen horny, ruminate or equal. Embryo generally basilar.

Shrubby or arboreous palms, perennial, or flowering only once. Leaves pinnate, rarely bipinnate. Inflorescence axillary and terminal, centripetal or centrifugal.

Sect. I.

Leaves pinnately-split or pinnate. Spathe (1 or 2) complete, in one incomplete. Female perianth convoluto-imbricate. Fruit often oblique.

Spathes 1-2, complete. Flowers monœcious on the same spadix. Stamina 3-00. Ovarium 1-3 celled. Fruit drupaceous, in some an oblique berry. Leaves pinnately split or pinnate, .. Areca.

Spathes 2, inner one complete. Flowers monœcious on distinct spadices, their bases immersed in niches. Stamina 6. Ovarium 3-celled. Berry? exceedingly oblique. Albumen solid. Leaves pinnate. .. .. Bentinckia.

Spathes 2, incomplete, sheathing. Flowers monœcious on the same spadix, their bases immersed in niches. Stamina 6, filaments united at the base. Ovarium 3-celled. Fruit drupaceous, exceedingly oblique. Albumen ruminate. Leaves pinnately split. .. .. Slackia.

Sect. II.

Leaves pinnate or bipinnate, divisions jagged. Inflorescence centrifugal. Spathes several incomplete, imbricate, sheathing. Female corolla valvate.

* *Flowers monoecious on the same spadix.*

Leaves bipinnate. Stamina 00. Ovarium 1-2-celled. Berry 1 or 2-seeded. Albumen ruminate. .. .. Caryota.

** *Flower monoecious on different spadices, or dioecious.*

Leaves pinnate; pinnæ linear, 1-2-auriculate at the base. Stamina 00. Ovarium 3-celled. Berry with a depressed triangular vertex, 3-seeded. Albumen equal. .. .. Arenga.

Leaves pinnate; pinnæ cuneate. Flowers sometimes diœcious. Stamina sometimes 6. Ovarium 2-celled. Berry 2-seeded. Albumen equal. .. Wallichia.

Sect. I.

Spathæ 1-2 completæ, rarius incompletæ, rarissime nullæ. *Flores* mono-dioici vel polygami. *Perianthium* fæmineum convoluto-imbricatum. *Stamina* 3-00, sæpius 6. *Ovarium* 1-3-loculare, sæpius 1-ovulatum. *Fructus* sub-drupaceus æquilateralis, vel subbaccatus inæquilateralis. *Semen* 1. *Albumen* ruminatum, interdum æquabile. *Embryo* sæpius basilaris.

Palmæ *elegantes, frutescentes vel arboreæ, sæpius graciles, sæpe arundinaceæ, in umbrosis vigentes.* Corona *sæpius ampla.* Folia *pinnatim fissa (imo aliquando bifurca) vel pinnata, pinnis reduplicatis, saepius oblique acuminatis.* Inflorescentia *universalis centripeta, partialis centrifuga.* Spadix *axillaris, paniculatim vel racemosim divisus, raro indivisus, saepe refractus, interdum coloratus.* Flores; *fæmineus sæpiusinter duos masculos, (superiores saepe tantum masculi,) binati, distichi, interdum suaveolentes.* Stigma *plerumque trilobum.*

Incolæ præsertim Asiæ archipelagicæ et oceanicæ; una cultissima prope mare, plures sylvicolæ, paucæ maritimæ. Limes borealis sp. indicarum 27-28. grad.

Usus.—Albumen astringens narcotica, inebrians Arecarum plurium Asiaticis cum calce et folio Piperis Betel manducatur. A. Catechu hanc ob causam præ palmas alias indicas (Cocos nucifera excepta) abunde colitur. Vaginæ foliorum (A. Catechu) consutæ haustrorum in usu adhibentur. Trunci A. tigillariæ asseres stabiliores præbent.

ARECA.

Linn. Gen. p. 516. *No.* 1225. (partim.) *ed. Schreber. p.* 776. *No.* 1696. (partim). *ed. Spreng. p.* 284. *No.* 1473. *Juss. Gen. p.* 38. *Gærtn.* 1. *p. t.* 7. *Lam. Ill. t.* 895. *Roxb. Icones.* 14. *t.* 75-77. *Suppl.* 5. *t.* 64-65. *Corom. Pl. t.* 75. (ex Endl.) *Fl. Indica* 3. *p.* 615. *Mart. Palmæ* 169. *t.* 102, 149, 158. *f.* 4, 5. (ex Endl.) *Endl. Gen. p.* 247. *No.* 1728.

Euterpe. *Gaertn. op. cit.* 1. *p.* 29. *t.* 9.
Pinanga. *Rumph. Hb. Amb.* 1. *t.* 4.
Caunga. *Rheede Hort. Mal.* 1. *t.* 5—8.

CHAR. GEN.—*Spathae* 1 vel 2, completæ. *Flores* monoici in eodem spadice, fœmineus inter duos masculos. *Stamina* 3-00. *Ovarium* 1-3 loculare. *Ovulum* 1. *Fructus* drupaceus vel sub-baccatus monospermus, interdum obliquus. *Albumen* ruminatum. *Embryo* basilaris.

HABITUS.—Palmæ *arboreæ vel frutescentes, sæpius inermes.* Truncus *annulatus.* Folia *pinnatim fissa, rarius bipartita vel pinnata;* vaginæ *coriaceæ, striatæ.* Spadices *axillares, paniculatim vel racemosim divisæ, rarius simplices, saepe refracti.* Flores *saepe distichi, plerumque evolutione centrifugi.* Antheræ *lineares.* Drupæ *ovatæ, saepius aurantiaceæ,* baccæ *globosæ, coerulescentes.*

SECT. I.—(PINANGA.) *Spathæ* 2-completæ, rarius 1. *Spadices* erecti, paniculatim ramosi. *Flores* inferiores 1 fæmineus inter duos masculos, superiores masculi binati. *Stamina* 3-12, sæpius 6. *Drupa.*

Frutices inermes, interdum soboliferæ, vel saepius arbores. Folia *pinnatim fissa, rarius pinnata.* Spadicis *rami dorso deficientes.* Fl. fæm. perianthii *foliola interiora longiora.*

SECT. II.—(ANACLASMUS.) *Spatha* 1, completa. *Spadices* refracti, racemosim 2-5-divisi, interdum simplices. *Flores;* 1 fœmineus inter duos masculos. *Stigma* discoideum, sæpe lobatum. *Drupa.*

Inermes, frutescentes. Folia *pinnata.* Fl. fæm. perianthii *foliola* 3 *interiora breviora.*

Seaforthia. *Martius.* (vix Brown). Pinanga. *Blume. Endl. Gen. p.* 1370. *No.* 1727/1.?

SECT. III.—(EUOPLUS.) *Spathæ 2,* completæ. *Spadices* racemosim divisi, ramis 00, fastigiatis, caudæformibus, pendulis. *Flores;* sæpius 1 fæmineus inter duos masculos. *Fructus* sub-baccatus, obliquus, cœrulescens.

Arboreæ vel arborescentes, soboliferae, armatae. Folia *pinnata.*

Oncosperma. *Blume. Endl. Gen. p.* 1371, *No* 1727/3. ?

Genus imperfecte cognitum, verisimiliter in posterum in plura dividendum.*

Seaforthia, Br.† differt habitu Caryotideo et floribus fæmineis inter duos hermaphrodito-masculos ; horumque stylo longo.

SECT. I.—PINANGA.

70. (1) A. *Catechu,* arborea, foliis pinnatis et pinnatim fissis, pinnis lineari-ensiformibus vel linearibus oblique acuminatis, spathis 2, fl. masculis solitariis distichis, petalis oblongis acutis, staminibus 6, fl. fæmineis solitariis ad vel versus basin ramulorum, drupa ovata mammillata magnitudine ovi gallinulæ.

Areca Catechu, *Willd. Sp. Pl.* 4. *p.* 524. *Roxb. Cor. Pl.* 1. *No.* 74. *Fl. Indica.* 3. *p.* 615. *Icones* 14. *t.* 75. (incompl.)

* The above disposition appears to be pointed out by the Indian species, of which alone I have any knowledge. I have no means of ascertaining the opinions of Botanists on the limits of the genus. The volume of Kunth's Synopsis, in which I understand Palmæ are to be found, has not yet found its way to this part of India. The Botanic Garden copy of Martius's Palmæ contains only a few figures without any accompanying letter-press. The copy of Blume's Rumphia likewise contains only two plates of Ptychostoma (Seaforthia, R. Br.). Martius (*in litt.*) seems indisposed to adopt Blume's divisions. As the habit however is distinct, it is probable that accurate examination of ample materials may lead to several sufficiently sound generic distinctions.

Blume's adoption of Pinanga for a section not including the genuine Pinangæ does not appear to me judicious. His Oncosperma is perhaps Areca tigillaria, Jack.

† Pr. Fl. Nov. Holl. ed. 2da. p. 123.

Areca Faufel. *Gaert. fr. et. sem.* 1. *p.* 19. *t.* 7. *f.* 2. Pinanga. *Rumph. Hb. Amb.* 1. *t.* 4. Caunga. *Rheede Hort. Mal.* 1. *t.* 5-8.

Habit.—Commonly cultivated, especially to the Eastward, where it attains a much larger size than in Bengal. Sanscrit, *Goovaka.* Bengallee, *Gooa.* Arabic, *Foolful.* Pers. and Hind. *Soopara.* Telingee, *Poka Chelloo.* Malayan, *Pinang.*

Perhaps the most elegant Indian Palm. It is too well known to need a detailed description. The male flowers are delightfully fragrant.

It is very extensively cultivated in most of the warmer and more humid parts of India, especially towards the sea, near which alone it comes to perfection. It thrives much more luxuriantly on the Tenasserim coast, and in the Straits of Malacca than in Bengal; it is also much more immoderately used by the Burmese and Malays than the Bengallees.

Several varieties with particular names exist among the Malays, and merit perhaps as much attention as do those of the Cocoa-nut.

71. (2) A. *triandra,* fruticosa, sobolifera, foliis pinnatim fissis, pinnis longe et oblique acuminatis, superioribus apice fissis, terminali furcata plurifissa fissuris bidentatis, spatha 1, fl. masculis binatis, petalis oblongis obtusis, staminibus 3, fæmineis ad basin ramulorum solitariis, drupa olivæformi mammillata.

A. triandra. *Roxb. Icones. Suppt.* 65, (incompl.) *Fl. Ind.* 3. *p.* 617. *Buch. Hamilt. Comm. Hb. Amb. in Mem. Wern. Soc.* 5. *p.* 310. *Mart. Palm. t.* 149.

Hab.—Woods; Chittagong, Rungpore. Bengallee *Bungooa, Ramgua, Runi Supari.* (*Buchanan Hamilton.*) Cultivated in the H. C. Botanic Gardens; in flower most of the year.

Descr.*—Shrubby, throwing out offsets at the base. *Stem* 5-7 feet high, green, distinctly annulate, $\frac{2}{3}$-1 inch in diameter. *Leaves* 4-5 feet long, *pinnæ* alternate, linear ensiform, 13-16 inches long, $1\frac{1}{2}$-2 inches broad, often falcate, much and obliquely acuminated, above 1-3-keeled according to the breadth which is variable, bright green, upper ones more or less split at the apex: terminal broadly cuneate, deeply bipartite, forked, lobes truncate, divided into as many narrow, bidentate lobes as there are keels on the under surface.

Spathe green, smooth, with a short blunt point, about a foot long, (*Roxb.*), in the Botanic Garden specimens generally 4-6 inches long, 2 broad: texture leathery. *Spadix* highly divided; peduncle and branches compressed; at the base of the lowermost branch a linear *bracte* $\frac{1}{2}$ inch long; branches spreading, ascending, much divided; secondary divisions stoutish towards the base, where they bear a female flower, close to which they branch into 2 slender flexuose spikes, (on which the male flowers are seated,) or more frequently are attenuated into one.

Male flowers angular, small, cream-coloured, in pairs pressed together and secund on the outer side of the spikes. *Sepals* 3, minute, ovate-oblong, unequal. *Petals* oblong, obtuse, valvate, 3-4 times longer than the sepals. *Stamens* 3, opposite the sepals; *filaments* stout, short, united at the base; *anthers* sagittate. *Rudiment* of the *Pistillum* conical subulate.

Female flowers rather large, generally between a pair of rudimentary males, suffulted by 2 broad, short, pointed *bractes*. *Sepals* roundish, green. *Petals* similar, but smaller and less tough. Six very small *rudimentary stamina*. *Ovarium* ovate, 1-celled, white. *Ovulum* 1, ascending. *Style* 0. *Stigma* of 2, or generally 3, erect, unequal, acute lobes.

Fruit oblong, of the form of an olive, but longer, distinctly mammillate, smooth, when ripe of a lively orange, at length becoming red. Pulp in small quantity, and mixed with many longitudinal strong, ligneous fibres. *Seed* conform. *Albumen* much ruminated. *Embryo* basilar.

72. (3) A. *laxa*, arborea, trunco sæpius incurvo nunquam stricto, foliis pinnatis, pinnis lanceolatis acutis integerrimis æquidistantibus, spatha 1-phylla, staminibus 3, rudimento pistilli nullo.

* From plants in the H. C. Botanic Gardens, fruit from Roxburgh and from Martius' figure.

A. laxa, *Buch. Hamilt. Comm. in Hb. Amb. in Mem. Wern. Soc.* 5. *p.* 30. Pinanga sylvestris glandiformis secunda, *Rumph Hb. Amb.* 1, *p.* 39 ?

HABT.—Andaman Islands. *Buchanan Hamilton.*

DESCR.*—*Trunk* 20-30 feet high, annulated, green, tumid, generally incurved, never straight as in A. Catechu. *Leaves* pinnate; *pinnæ* lanceolate acute, quite entire, æquidistant, two-nerved with 4-plaits; *petiole* pinniferous from the middle upwards?

Spathe 1-leaved, lanceolate, acute, margined. *Spadix* panicled, branches angular. *Male flowers* very many, minute, in pairs. *Sepals* three-rigid, lanceolate, acute. *Stamens* 3; *filaments* scarcely any; *anthers* oblong. *No rudiment* of a *Pistillum.*

Female flowers situated towards the bases of the spikes, solitary, few, much larger than the males. *Sepals* convolute, ovate, concave. *Petals* convolute, ovate, acuminate, longer than the calyx. *Ovarium* obsoletely trigonal, ovate, acuminate. *Style* 0. *Stigma* acute. *Fruit* ——

Buchanan Hamilton, from whose description the above is adapted, states, that it is closely allied to A. triandra, and that the nuts were used instead of the Betel-nut by the convicts confined on the island. Buchanan Hamilton makes no mention of the petals of the male flower. I have no knowledge of it.

73. (4) A. *nagensis*, (n. sp.) arborea, procera, foliis pinnatim fissis, pinnis linearibus obliquis acuminatissimis, spadice spithamæo, fl. fæmineis ramorum pluribus, fructibus angusto-ovatis utrinque attenuatis præsertim apice mammillato.

HABIT.—Assam? *Major Jenkins.* Naga Hills, up to an elevation of 800 feet above the level of the sea, affecting banks of rivers. Name of the tree in Naga, *Tál-pát;* Singpho, *Tong-tau;* of the nut, Naga, *Káve;* Assam, *Támul.* (*Mr. Owen.*)

* From that of Buchanan Hamilton, l. c.

Descr.*—"Trunk 30-40 feet high, attached to the soil by innumerable black fibrous roots." Naked part of the *petiole* about 3 feet long. *Lamina* 4-feet long : *pinnæ* sub-opposite or alternate, falcate, very acuminate, 19-20 inches long, about 1½ inch broad, above with 2-3 stout keels ; terminal deeply bilobed, variously partite, (laciniæ bidentate) ; the less divided, broader part obliquely truncate with irregular teeth.

Spadix about a foot long; peduncle compressed, branched from near the base, branches stout flexuose. A scale-shaped *bracte* under each *female flower*, several of which occur on the lower parts of the branches. *Fruit* oblong ovate, 1 inch long, 5 lines wide, attenuated to both ends, base surrounded by the *perianth*, (*sepals* round oblong, obtuse, *petals* larger sub-cordate with a short obtuse cuspis), apex rostrate mammillate, truncate, with a small mammilla in the centre: fibres numerous, stout, whitish. *Seed* erect, ovate, half an inch long, marked with many veins arising from the hilum, these are generally dichotomous, anastomosing reticulately on the dorsal face. *Albumen* cartilaginous, horny, ruminate, opaque white. *Embryo* basilar.

This appears distinct by its roots and fruit. It is according to Mr. Owen, used by the Nagas and Abors instead of the Betel-nut; the leaves are much like those of A. gracilis. Mr. Owen informs me, that it is very scarce, and courts high situations generally on river sides.

Both this and A. laxa require further examination.

74. (5) A. *cocoides*, (n. sp.) arborea, procera, foliis pinnatis pinnis linearibus acuminatis bipartitis, spathis ——— fl. masculis binatis polyandris, fæmineis paucis bases versus ramulorum undique insertis, stigmatibus 3-revolutis, drupa ovata magnitudine ovi gallini.

Habit.—Cultivated at Malacca, but not commonly. Occurs in a garden in Malacca towards the Dutch Redoubt; also in a Sawa, half way to Malim. Malayan name, *Pinang Punowur*.

* Specimens; imperfect leaves, and an imperfect spadix with immature fruit rom Major Jenkins; perfect fruit from Mr. Owen. The leaves may be open to doubt, from their resemblance to those of agracilis.

Descr.—A lofty palm. *Trunk* 40 feet high. *Crown* dark green, ample. *Leaves* pinnate; *petiole* scurfy, plano-convex: *lamina* 8-9 feet long, 4-4½ broad, in outline lanceolate acuminate; *pinnæ* 2 feet long, 1¼-1½ inch wide, linear, acuminate, unequally bipartite, shining, very smooth, uppermost inequilateral, sub-erose at the points: central vein and 5 others forming as many keels above, the central underneath bearing scales attached by the base.

Spadix ascending, altogether green; branches stiff, stout, above flexuoso-torulose owing to niches in which the flowers are lodged. *Spathes* not seen.

Lower *flowers* one female between two males, upper males in pairs. *Males* small; *sepals* imbricate, carinate, hard, much shorter than the corolla, margins sub-membranaceous, denticulate, inner rather the longest. *Corolla* valvate, hard, tripartite to the base; *petals* oblong-lanceolate, sub-obtuse. *Stamina* numerous; *anthers* linear-sagittate. No *rudiment* of a *Pistillum*. *Female* (in bud.) *Sepals* and *petals* scarcely distinguishable, imbricate, with very broad bases. No *rudiments* of *stamina*. *Ovarium* large, white, oblong, 1-celled, sub-compressed, divided at the apex into 3-cuneate sub-recurved lobes, each with a line of stigmatic tissue along the central line of the inner face. *Ovulum* one, attached nearly along its whole length; *foramen* inferior.

Spadix of the fruit spreading, presenting one or two annuli on its very stout base: branches angular, thickened at the base. *Fruit* pendulous from its weight, ovate, size of a large egg, surrounded at the base by the perianth, at the apex presenting the three styles: colour orange, smell unpleasant like spoiled sour fruit; outer substance thick, firm, of yellow cellular tissue and longitudinal fibres, which are more numerous towards the putamen. This is thin, hard, crustaceous. *Seed* one, erect; *tegument* thin, shining, light brown. *Albumen* densely horny, much ruminate. *Embryo* basilar.

The aspect of this Palm is very different from that of A. Catechu, the size being much greater, the crown blackish-green, the leaves stiffer and at a distance having a truncate appearance; the Malacca specimen when viewed closely has the appearance of a cocoa-nut tree. It is also to be known from A. Catechu by the round torulose branches of the spadix, the binary not solitary distichous polyandrous males, by the females not being secund, and by their greater number, by the recurved not connivent styles, and by the fruit.

I am not aware of the history of the plant, the fruit of which is, I believe, considered a medicinal kind of betel-nut, or its native place. Can it be Pinanga Calapparia of Rumph.?

Sect. II.—ANACLASMUS.

75. (6) A. *pumila*, arbuscula, foliis pinnatis, pinnis alternis 2½-pedalibus lineari-ensiformibus præ-acuminatis, spadicis ramis sub-4 undique florigeris, fl. masc. sepalis subulato-setaceis quam petala obliqua ovato-cuspidata paullo longioribus, staminibus 6, fl. fæm. stigmate obtuse-conico trisulcato, fructibus undique insertis ovatis (aurantiaceis.)

A pumila, *Mart. Palm. t.* 153. *f.* iv. v. (spadice inverso.)

Hab.—In a dense forest in a ravine near Ching, Malacca; one specimen only observed. Malayan name, *Pinang Jirong*.

Descr.—*Stems* 10-12 feet in height, 1¼-1½ inch in diameter, distinctly annulate. *Leaves* 8-9 feet long; *sheaths* subventricose, about 2 feet long, inside of a shining chesnut colour; *petiole* bearing pinnæ nearly to the base where it is channelled, elsewhere trigonal; *pinnæ* alternate, 2½ feet long, ½-1½ inch broad, sword-shaped, very acuminate, coriaceous, bright-green, above two-keeled with an obsolete intromarginal one on each side.

Inflorescence whitish-yellow. *Spadix* while included in the spathes shortly sword-shaped. *Spathe* about a foot long, linear, two-edged, flattish posticously, anticously ventricose, coriaceous, chesnut-coloured, obtuse and sometimes 3-fid at the point, here and there presenting spots of adpressed hairs.

Spadix peduncle about 1½ inch long, on the middle of the outer face a semi-circular scar of the attachment of the spathe, a little above this a membranous spathelle acuminate from a very broad base: a smaller one at the base of each lateral branch; *branches* about four, level-topped, pendulous, about a span or a foot long. *Flowers* about four-ranked, sessile, whitish-ochroleucre, throughout one female between two males. *Male flowers; sepals* nearly an inch long, triangular-subulate, canaliculate, and exceedingly acuminate. *Petals* oblong-ovate, oblique, valvate, long cuspidate, but shorter than the sepals. *Stamina* 6 ; *anthers* linear, those opposite the petals longest. *Pollen* ovate, 1-plicate, white. No *rudiment* of a *Pistillum ?*

Female flowers ; sepals roundish, imbricate. *Petals* similar, a good deal smaller. No *rudiments* of *stamina. Ovarium* white, roundish, 1-celled ; *ovulum* one, appense. *Style* wanting. *Stigma* obtusely conical, large, obscurely trisulcate, almost three-lobed.

Spadix of the fruit with about 4 simple, roundish, greenish-white branches. *Drupe* oblong ovate, 1 inch long, 5-6 lines broad, orange-coloured, mammillate at the apex, base surrounded by the perianth. *Seed* erect, oblong. *Albumen* horny, ruminate. *Embryo* basilar, rather oblique.

This species is closely allied to A. malaiana, but is at once distinguishable by the tetrastichous not distichous inflorescence, the sepals, number of stamina and the orange not sanguineous colour of the fruit.

Figure 11, 6, Plate Seaforthia Reinwardtiana, Mart. Palm. gives a tolerable idea of the fruit spadix of this species. Judging from Martius's figure, it varies a good deal in the size of the inflorescence and fruit.

76. (7) A. *malaiana,* arbuscula, foliis pinnatis, pinnis alternis 1-2-pedalibus linearibus valde acuminatis subtus glaucescentibus, spadice 3-5-ramoso, fl. masc. sepalis lanceolato-acuminatis quam petala obliqua acuta inæqualia multo minoribus, staminibus circiter 40, fl. fœminei nullis, stigmatibus discoideis, fructibus distichis ovatis (sanguineo-purpureis).

Seaforthia malaiana. *Mart. Palmae, p.* 184. *t.* 158, *f.* 3.

Hab.—In forests, Ayer Punnus, and Rhim, Malacca ; not uncommon. Malayan names, Malacca, *Pinang Booreng ;* Penang, *Kurdoo.*

Descr.—An elegant Palm, 8-12 feet in height. Habit of the preceding. *Stem* distinctly annulate, in diameter $\frac{2}{3}$-1 inch, internodes generally subclavate. *Crown* of 5-8 leaves, spreading. *Leaves* 5-8 feet long ; *sheaths*

1-1¼ foot long, leathery, striate; *petioles* (below the pinnæ) 1¼-1½ foot long, channelled, otherwise triangular; *pinnæ* alternate, linear, 1½-2 feet long, 8-10 lines broad, very much acuminate, above 2-keeled, underneath with 1-keel and a vein on either side, and whitish glaucescent: upper pinnæ cuneate, deeply bipartite, segments bilobed, lobes generally bifid; terminal portion deeply bipartite, obliquely præmorse, segments with several lobes, themselves obtusely bifid.

Spathe oblong, 10 inches long, 2½ broad, leathery-papery, with a broad obtuse cuspis, opening along the upper face. *Spadix* about 6 inches long; undivided part of the peduncle 1½ inch, compressed, with one oblong-linear bracte a little above the middle: *branches* 3-5, crowded with flowers, compressed, flexuose.

Male-flowers large, pressed, together, quite concealing the female, flat. *Sepals* three, membranaceous, lanceolate, acuminate. *Petals* much larger, unequal, one as large as both others, cordate, the others ½ cordate, all acute or acuminate, and of a hard texture. *Stamina* inserted on a convex torus, about 40; *filaments* very short; *anthers* linear, about twice as short as the petals.

Female flowers less advanced, occasionally two together, occupying the bends of the flat faces of the spikes, distichous: under each a broad, membranous, much acuminated *bracte*. *Perianth* urceolate. *Sepals* cordate, shortly cuspidate. *Petals* smaller and shorter with minutely fimbriated margins. No *rudiments* of *stamina*. *Ovarium* roundish. *Style* very thort. *Stigma* large, discoid, concave.

Spadix of the fruit of a bright sanguineous colour; *branches* 4-5, about a span long, compressed, flexuose. *Fruit* distichous; occupying the flat faces of the branches, ovate, at first sanguineous, afterwards blackish-purple, mammillate at the apex, surrounded at the base by the perianth; outer substance fleshy cellular, middle fibrous, inner hardened crustaceous. *Seed* one, erect; *tegument* very thin, membrano-cellular, veiny, brown, shining, generally adhering to the fruit. *Albumen* horny, deeply ruminate. *Enbryo* conical, basilar, obliquely situated.

This species is at once distinguishable by the colour of the spadices and fruit: its nearest affinities are with A. disticha and Dicksoni. It varies in the degree of compression of the spikes, and also somewhat in size.

77. (8) A. *Dicksoni*, arbuscula, frondibus pinnatis, pinnis linearibus 1-2-pedalibus apice præmorsis dentatis, spadicis

ramis 4-8, floribus distichis, masc. sepalis canaliculato-subulatis longitudine petalorum acuminatorum, staminibus 20-30, fæm. staminibus sterilibus 6 apice penicillatis, stigmate capitato trilobo, fructibus distichis oblongis.

A. Dicksoni, *Roxb. Fl. ind. 3. p.* 616. *Icones.* 14. *t.* 76. Seaforthia Dicksoni. *Mart. Palm. p.* 184.

HABT.—Mountains of Malabar. *Dr. Dickson, Wight;* in flower and ripe fruit in August.

DESCR.—" It grows to the height of about sixteen or eighteen feet, with a very straight, simple trunk, of about two inches in diameter. *Leaves* pinnate, about four feet long, with extremities bifurcate, like the tail of a swallow. *Leaflets* sessile, linear, ribbed, with numerous parallel veins, apices praemorse, dentate; from twelve to twenty-four inches long. *Spathe* simple. *Spadix* compound, retrofracted; *ramifications* from four to eight, alternate, simple, equal, distichous; from six to eight inches long. *Flowers* numerous, approximate, alternate in two exactly opposite rows, a single female in the centre, with a single male on each side. *Male flowers. Calyx* three-cleft, divisions subulate, nearly as long as the corol. *Corol, petals* three, cordate, with slender tapering apices. *Filaments* very short. *Anthers* from twenty to thirty, linear. *Female flowers. Calyx* of three reniform leaflets. *Corol* like the calyx. *Nectary,* six clavate, hairy-headed scales. *Germ* superior. *Style* short. *Stigma* three-lobed. *Berry* oblong, dry and fibrous, about an inch long, by half an inch in diameter. *Seed* of the shape of the berry, ruminated. *Embryo* lodged in the base." *(Roxb. l. c.)*

" Mr. Dickson, the Surgeon at Bedanore, who first brought the plant under my observation, observes that the nut is used by the poorer people, as a substitute for the common *Areca,* but no other part of the tree is turned to any useful purpose." *(Roxb.)*

78. (9) A. *gracilis,* fruticosa, foliis pinnatim fissis, pinnis sub-pedalibus falcatis oblique acuminatissimis, spadice simplici vel 2-3 ramoso undique florigero, spatha 1, fl. masc.

calyce minuto, petalis oblique cordatis acutis multoties majoribus, staminibus numerosis, fl. fæm. rudimentariis 0, stigmate infundibuliformi, fructibus ovatis acutis undique insertis.

A. gracilis, *Roxb. Icones. Suppt.* 5. *t.* 64. *Fl. Ind.* 3. *p.* 619. *Buch. Hamilt. Comm. in Hb. Amb. Mem. Wern. Soc.* 5. *p.* 311. Seaforthia gracilis. *Mart. Palm. p.* 185.

Habt.—Hills; Silhet, (where it is called *Gooa, Supari* and *Ramgoa*), Chittagong and the East border of Bengal. *Roxburgh.* Goalparah, Assam. *Buchanan Hamilton.* Assam, where it is called *Girgoa? Major Jenkins.* About Kujoodoo, and Ningrew, Upper Assam, in fruit January 1839; *Tea Deputation.* Himalayahs below Darjeeling, *Seharanpore Collectors.*

Descr.*—*Stem* slender, arundinaceous, about 8 feet high, 6-8 lines in diameter, distinctly and distantly annulate. *Crown* of about 5-6 *leaves,* which are about 3 feet long; *sheaths* ½ foot long; naked part of the *petiole* 3-4 inches long: *pinnæ* about a foot long, 2-3 inches broad, very and obliquely, acuminate, above 2-3-keeled: terminal obcuneate, about a foot long, 6 inches broad across the sinus, truncate, bipartite to the middle, about 8-cleft, divisions bidentate, emarginate, or entire and acute.

Spadices generally simple, sometimes twice or thrice branched, 6-9 inches long, compressed, bearing flowers on all sides. An annulate scar just above the base of the peduncle, and a second at the commencement of the pendulous part.

Male flowers; calyx minute, 3-cornered. *Petals* three, obliquely cordate, acute, many times longer than the calyx. *Stamina* numerous, shorter than the corolla.

Female flowers occupying large shallow niches with 3-toothed margins. *Sepals* broad, rounded. *Petals* like the sepals, but smaller. No *rudimentary stamina. Ovarium* ovate, 1-celled; *ovulum* 1, erect. *Style* very short, stout. *Stigma* large, infundibuliform, with ragged edges. *(Roxb.)*

* Chiefly from specimens communicated by Major Jenkins; spathes not seen.

Drupe reddish, ovate, with an attenuated base and a blunt point, 8 lines long, 3-4 broad. *Seed* ovate. *Albumen* highly ruminate. *Embryo* basilar.

I have some specimens communicated by Major Jenkins, and others collected by myself in Assam, and on the Khassya Hills,* of which I subjoin descriptions, as they either shew a tendency in this species to vary, or the existence of two other nearly allied species.

79. (10) A. *disticha,* fruticosa, foliis bipartitis vel pinnatis, pinnis oppositis acuminatis, spadice simplici vel 2-3-ties ramoso, fl. masc. petalis inæqualibus obliquis cuspidato-acuminatis calycem minutum multo excedentibus, staminibus circiter 15, fl. fæminei nullis, fructibus ovatis attenuatis distichis.

A. disticha, *Roxb. Icones.* 14. *t.* 77. *Fl. Ind.* 3. *p.* 620. Seaforthia disticha, *Mart. Palm. p.* 184.

Habit.—In dense forests, Ayer Punnus (Rhim), Malacca, not uncommon. Pinang. *Roxburgh.* Malayan name, *Pinang Booreng Paday.*

* Descr.—*Stem* apparently very slender. *Leaves* scarcely more than a span long; *petioles* 2-3 inches long, triangular, ferruginous scurfy; *sheaths* of the same length; *lamina* cuneate, bilobed to or beyond the middle, 7-8 inches long, 2 broad across the sinus, not coriaceous, lobes obliquely acuminate with twice as many acute teeth at the apex as there are keels.

Spadix with 4 sub-digitate branches, the lowest arising about 2 inches from the base of the peduncle, they are 3-5 inches in length, spreading and not compressed.

Fruits tetrastichous, ovate, attenuate at the base and surrounded by the cup-shaped *perianthium,* 6½ lines long, 3½ broad, distinctly mammillate at the apex; substance thin, fibres tolerably copious. *Seed* one, erect. *Albumen* horny, very much and deeply ruminate. *Embryo* basilar, rather obliquely situated.

This is also closely allied to A. disticha, but is distinguishable by the more branched stouter spadix, the tetrastichous fruit, its larger size, and distinctly mammillate apex. The stigma, judging from one abortive pistillum, is also 5-lobed. If the specimens of the leaves belong to the same plant as the spadix, it becomes probable that they are the mature form.

It would also appear to be allied to A. Dicksoni, from which it may be distinguished by the absence of sterile stamina, and the smaller and mammillate fruit.

Descr.*—*Stem* arundinaceous with distinct subclavate lengthened joints; varying in height from 1½ to 3-4 feet; parts lately exposed scurfy. *Leaves* rather distant, in the larger specimens, 4½ feet long, of which the naked base of the *petiole* is about 6 inches; *pinnæ* opposite, about a foot long, exceedingly and obliquely acuminate, above 3-4 keeled; terminal lobe deeply bipartite, many keeled, truncate and lobed at the apex: the bilobed leaves of the smaller specimens cuneate, forked, 12-14 inches long, 2½ inches across the sinus, apex obliquely præmorse, 4-5-fid, divisions obtuse, bifid.

Spadix 3-4 inches long, simple in the smaller specimens, 2-3 times branched in the larger; *branches* compressed, flexuose. *Spathe* oblong, about 4 inches long, 1 inch broad, acute. *Flowers* closely packed; one female between two males: the former distichous.

Male flowers rather large, angular. *Calyx* membranaceous, minute, three-toothed. *Petals* much larger, unequal, (one nearly as large as both others,) oblong, oblique, cuspidate-acuminate. *Stamens* about 15; *filaments* short; *anthers* linear. No *rudiment* of a *Pistillum.*

Female flowers with a broad short bracte at their base. *Perianth* of 6 coriaceo-scarious leaves, about equal in length; the inner (petals) the smallest. No *rudiments* of *stamina*. *Ovarium* oblong-ovate; *style* very short; *stigma* large, obliquely discoid.

Fruit spadices 3-6 inches long, branches slender, flexuose. *Fruit* orange-coloured or red, exactly distichous, one at each flexure, oblong, 6½ lines long, 3½ broad, mammillate-attenuate at the apex, surrounded at the base by the cup-shaped perianth. *Seed* of the same shape, covered by a chartaceous integument, marked with longitudinal lines along which the integument is inflected. *Albumen* horny, ruminate. *Embryo* minute, conical, basilar.

This plant varies much in size. Roxburgh describes the branches of the spadix as woolly: his drawing also represents the petals as acute, not cuspidato-acuminate.

The specimens from Malacca called *Pinang Boorang Paday*, from which the description of the male and female flowers is taken, are of a much larger stature in every respect, the spadices also are branched, the fruit much more elongated, and with a tendency to be curved. Further examination may show them to belong to a distinct species.

* Descr.—*Stem* and *leaves* much the same as in A. gracilis. *Spadices* slenderer, 3-4 times branched. *Female flowers* distichous, distant.

Habit.—Assam? Moosmai, near Churra Punjee, at an elevation of 4000 feet.

(ANACLASMUS ABERRANS.)

80. (11) A. *paradoxa,* (n. sp.) fruticosa, nana, foliis pinnatim fissis, pinnis inæqualibus oblique acuminatis, spadice simplici, fructu subulato curvato (albo) albumine æquabili.

HABIT.—Dense forests near the base of Goonoong Miring, Mount Ophir; in fruit February, 1841.

DESCR.—*Stem* slender, 5-7 feet high, 3-4 lines in diameter, annulate, upwards roughish with ferruginous down. *Crown* of 6-8 leaves. *Leaves* 1½ foot long, 8 inches broad; *petiole* with a long, coriaceous, striate, ferruginously downy *sheath,* above which it is channelled, lower naked part about 6 inches long; *lamina* pinnate, *pinnæ* 6-8 inches long, and very obliquely cuspidato-acuminate, very unequal, with 3 or 4 or many keels; terminal unequal at the base, bifurcate to the middle, irregularly toothed, teeth bifid sometimes split.

Spadix issuing from the stem below the crown, simple, 4-5 inches long, obtuse, pendulous, glaucescent. *Fruit* distichous, suffulted by a minute but broad bracte, and by a double cup, (calyx and corolla) of six round imbricate broad scales. They are of a white colour, obtusely subulate, 8 lines long, 1¼ diameter in the widest part or just above the base, curved in shape, and of a fibrous substance. *Seed* one, conform; *tegument* very thin, membrano-cellular; *raphe* of three fascicles, the central one reflexed near the apex of the seed, becoming confluent with the longer of the lateral vessels; the shorter one reflexed about the middle of the dorsum. *Albumen* solid, horny, slightly furrowed along the course of the vessels. *Embryo* minute, basilar, conical.

The specimen is scarcely distinguishable, except in the form and structure of the fruit and seeds, from A. disticha. That structure however is so different as to suggest the probability of its constituting a new genus.

SECT. III.—EUOPLUS.

81. (12) A. *tigillaria,* arborea, pinnis bipedalibus pendulis, spatha exteriore pedunculoque armatis, interiore subinermi, floribus distantibus, sæpe 1 fæmineo 1 masculo, petalis ovatis in setas subito attenuatis, fructibus globuli sclopeti minoris magnitudine.

A. tigillaria. *Jack. Mal. Misc.* (*Calc. Journn. Nat. Hist.* 4. *p.* 12.)

HABIT.—On the borders of Paddy swamps, Malacca, common. Malayan name, *Nibong*. In forests, Lainear, to the South of Mergui?

DESCR.—A very elegant Palm. *Trunk* 30-40 feet high, distinctly annulate, armed, surrounded with offsets at the base. *Crown* thick, graceful. *Leaves* pinnate, 10-12 feet in length; *petiole* roundish, armed, upwards very scurfy; *pinnæ* about 2 feet long, conduplicate at the base, very much acuminate, pendulous, coriaceous, many veined, principal keel above excentric, ferruginous scurfy, underneath bearing scales attached by their middle.

Spadices from the axillæ of lately fallen leaves; *peduncle* slightly armed; branches many, long, undulato-flexuose, lower ones divided, upper simple. A rudimentary *bractea* at the base of the lower ones. *Spathes* (complete) two, boat-shaped, bicarinate, of a stout texture, outer green, covered here and there with whitish-ferruginous scurf, armed on the dorsum especially about the carinæ; inner almost unarmed, more scurfy, velvety to the touch.

Flowers crowded, one female between two males, or in pairs, one male and one female, the former more advanced. *Male; sepals* subcordate, cuspidate, carinate, anticous one the largest. *Petals* 3, valvate, coriaceous, suddenly acuminate into subulate bristles, spreading. *Stamina* 6; *filaments* short, stout, cohering slightly with the petals; *anthers* large, sagittate, obtuse. Rudiment of a *Pistillum* rather large, white, of three carpel leaves distinct nearly from the base.

Female flowers suffulted by a broad inconspicuous bracte. *Sepals* imbricate, suborbicular, concave, fleshy, coriaceous. *Petals* larger, imbricate. *Rudimentary* stamina 3 or none. *Ovarium* roundish, of the size of a small pea, 1-celled. *Style* none. *Stigmata* 3, connivent. *Ovulum* appense pendulous.

Spadix of the fruit: branches 1-2 feet long, pendulous, purplish-sanguineous, with an articulated appearance. *Berry* globose, size of a carbine bullet, surrounded at the base by the perianth, marked towards the apex on one side with an areola, bearing in the centre the remains of the stigmata; *endocarp;* fibres few, thin. *Seed* appense just below the areola; funicle large, sub-intrant, so that the transverse section is sub-reniform. *Tegument* thin, scarcely separable from the endocarp. *Albumen* horny, deeply ruminate. *Embryo* oblong-conical, basilar.

The trunk of this palm is in much request for making posts. Jack (l. c.) says, that there is only one spathe, and that the flowers are one male to two females. He does not notice any obliquity of the fruit.

82. (13) A. *horrida*,* (n. sp.) arborea, pinnis 2-3 pedalibus patentibus, spathis pedunculoque spadicis armatissimis, floribus congestis, fæmineo inter duos masculos, petalis lanceolato-oblongis in setas attenuatis, fructibus globuli sclopeti majoris magnitudine.

A. Nibung.† *Mart. Palm. t.* 153, *f. V?*

Habit.—Common in densely wooded valleys and ravines, Ching. On wooded hills, Laydang Soobubi, but rare. In woods at the base of Battoo Bakar, Malacca. Malayan name, *Bhyass*.

Descr.‡—An elegant Palm, 30-40 feet in height, sending off offsets at the base. *Trunk* annulate, the spaces between the rings much armed. *Crown* rather thin. *Leaves* spreading in every direction, 14-16 feet long, 5 feet broad; *sheaths* leathery, much armed, 2 feet long; *petiole* bearing pinnæ nearly from the base, green, stout, flattened at the base, compressed at the apex, otherwise trigonal, covered with brown irregular scales, armed throughout, but especially underneath, with black-brown flat not very strong spines§; *pinnæ* alternate or sub-opposite, nearly linear, 2-3 feet long, subulate-acuminate, coriaceous, dark-green, above keeled along the centre, with two lateral plaits on either side, spreading or oblique, never pendulous, as in A. tigillaria; a few scales attached by the middle along the central vein underneath. *Threads* very fine, pendulous, at length deciduous.

Spadix axillary; *peduncle* stout, yellow, flattened at the base, much armed on the spaces between the insertion of the spathes, above these

* A third species of the section, with the habit of this species but smaller, is common on the cliffs of the sea-shore a little to the North of Koondoor, near Malacca. Its Malayan name is *Nibong Paday*. I have not seen it in flower or fruit.

† This name is scarcely tenable, the true Nibung being Areca tigillaria, Jack.

‡ Partly from dried specimens: perfect spadices at time of opening of the spathes not seen.

§ This is the general character of the armature.

unarmed; *branches* pendulous, flexuose, about equal, 2 or 3 times branched or simple, 1-2 feet long, each suffulted by a yellow bracte with a broad base, the upper of which degenerate into scales. *Spathes* two, complete, acutely margined, coriaceous, armed with rather weak brown-black spines, 1-1½ foot long, of a greenish colour outside when mature, yellow and polished inside: the inner one with a stout, unarmed cuspis; incomplete also two, cuspidate, armed, very unequally conduplicate. *Flowers* about 4 ranked, inserted just above a protuberance of the branch of the spadix; lower ones, one female between two males, upper males in pairs.

Male calyx of three imbricate, carinate, sub-membranaceous sepals. *Petals* 3, valvate, subulate or almost setaceo-acuminate. *Stamina* 6, sagittate. *Rudiment* of a *Pistillum* rather large, of three, sometimes two, imperfect carpel-leaves.

Female-calyx, sepals roundish-cordate, imbricated. *Corolla* conical in bud. No rudimentary *stamina? Ovarium* of one larger complete carpel, and two incomplete ones.* *Style* none. *Stigma* (of the perfect ovule bearing carpel) linear, running nearly half way to the base of the ovarium. *Ovulum* anatropous.

Spadix of the fruit; branches 2-4 feet long, pendulous, without spathes, each suffulted by a coriaceous acuminate broad-based bracte. *Fruit* sessile, size of a musket-ball, purplish-black, surrounded at the base by the perianth, oblique, the true apex pointed out by a conspicuous mamilla on one side near the middle; *epicarp* coriaceous; fibres very few; *endocarp* membranous. *Seed* round, appense-pendulous, attached by a broad base, whitish-brown, reticulate with white veiny lines; *hilum* large, with a tendency to have an entering process. *Albumen* horny, deeply ruminate. *Embryo* not observed.

This species is allied to A. *tigillaria*, but is very distinct in the spathes and fruit. The flowers also are much more crowded, and generally appear to have the usual arrangement; viz. one female between two males. The young spadices from the contrast in colour between the spathes and their spines and the waviness and adpression of these have the appearance of tortoise-shell.

* These are folded together, the margins united about the middle, above free, and evidently stigmatic.

BENTINCKIA.

Berry MSS. Roxb. Fl. Ind. 3. *p.* 621. *Mart. Palm. p.* 229. *t.* 139. *Endl. Gen. p.* 251. *No.* 1749. Keppleria. *Mart. Endl. Gen. l. c. No.* 1750. (e Martio.)

CHAR. GEN.—*Spathae* 2, vel plures, intima completa. *Flores* monoici in distinctis spadicibus, aut rarius polygami, e foveis tandem emergentes, masculi alternatim distichi, fæminei solitarii. *Masc. Stamina* 6. *Fœm. Ovarium* triloculare. *Ovulum* 1. *Bacca* obliquissima (stigmatibus basilaribus.) *Semen* sulcatum. *Albumen* solidum. *Embryo* basilaris.

HABITUS.—Truncus *tenuis, arundinaceus, annulatus.* Frondes *pinnatae.* Spadix *infra folia erumpens, paniculatim ramosus, rubescens.* Flores *parvuli, compage subglumacea, rubentes.* Baccæ *purpurascentes, parvulae.*

Bentinckia Coddapanna, *Berry MSS. in Roxb. Fl. Ind. l. c. Mart. Palm. l. c.*

HABIT.—In mountains, Travancore. *Roxburgh. Wight.* Flowers in June, seeds ripen eight or nine months afterwards. Telinga name, *Codda-panna.*

DESCR.*—An elegant, slender Palm, about 20 feet high. *Trunk* about an inch in diameter. *Pinnæ* linear, 2 feet or more in length, nearly an inch broad, much acuminate, rigid, closely inserted, generally split at the point into two exceedingly narrow triangular portions, 2 to 4 inches long, the fissure often bearing a thread; above about 3-keeled, the mid-keel below furnished with paleæ.

Spadices 1-1½ foot long. *Spathes* membranaceous; outer one or two short, truncate, incomplete; inner complete, longitudinally striate. *Common peduncle* 2-3 inches long, violet towards the base, *branches* few, each with a membranous broad semi-amplexicaul bracte, 3 or 4 times divided; of the female simple, generally only with two divisions. Colour of the male spadices scarlet, of the female pale lilac or violaceous. *Spikes* 6 inches to a span in length, subfastigiate.

* Chiefly from Martius, l. c. Dr. Wight communicated to me specimens of part of the leaves, and some immature spadices.

Male-flowers disposed in rather loose spires, immersed in niches, which are at first nearly closed, afterwards opening vertically. In each niche wo, three, or even four flowers, occasionally a female in those towards he base of the spikes, the upper ones opening first. An ovate-triangular *bracte* under the lowermost flower; a small *bracteole* bearded on the upper margin on the outer side of the upper ones. *Calyx* about a line long, *sepals* glumaceous, oblong, concave, rather obtuse. *Petals* nearly twice the length of the calyx, purplish, ovate, acutish, valvate. *Stamina* 6, included; *filaments* subulate; *anthers* ovate, subcordate. *Rudiment of the Pistillum* subtrigonal, nearly as long as the stamina.

Female flowers. *Perianth* subglumaceous, imbricate, striato-veiny. *Filaments* without anthers. *Ovarium* ovate, three-celled. *Style* almost wanting. *Stigmata* three, triangular.

Berry ovato-globose, rather compressed, 6-7 lines long, surrounded at the base by the perianth, bearing the stigmata near the base. *Seed* sub-globose, brown, with a rather deep complete furrow, and several other shorter ones. *Testa* obscurely chesnut-coloured, with veins arising from the groove near the embryo, and converging towards the base on the opposite face. *Albumen* solid, horny. *Embryo* basilar, conical, nearly a line long.

Martius describes the petals of the male flowers as equal in length to the sepals, and the perianthium of the female as similar to that of the male. This last, which attributes a valvate corolla to the female flower, I do not find to be correct, and in the plate quoted, the petals of the male are represented as I have described them.

This Palm was re-introduced during my superintendence of the Honorable Company's Botanic Garden, from Travancore, through Dr. Wight and Mr. Thomas, Collector of Tinnevelly. It appears like most of the other numerous cases to have been lost since Dr. Roxburgh left the Gardens.

SLACKIA.

CHAR. GEN.—*Spathæ 2,* incompletae, vaginantes. *Flores* monoici in eodem spadice, e foveis tandem emergentes; fæminei inferiores, solitarii vel masculo adjecto, masculi superiores, binati. *Stamina* 6, filamentis basi coalitis, (fl. fæm. castrata). *Ovarium* gibbum, 3-loculare, 1-ovulatum. *Stigmata 3. Drupa* obliquissima (stigmatibus basilaribus.) *Albumen* corneum, simpliciter ruminatum. *Embryo* basilaris.

Habitus.—Palma *malayana, arecæformis, fruticosa.* Folia *pinnatim fissa :* rete *O.* Spadices *axillares, nutantes, ramis* (spicis) *simplicibus, sæpius 2, aliquando pluribus.* Flores *subglumacei, albidi.* Drupæ *nigrescenti-purpureae, obovato-oblongæ.*

Genus Bentinckiæ proximum, discrepans spathis et albumine ruminato. Folia etiam pinnatim fissa. Habitus Geonomæ, quod genus differt filamentis in columnam connatis, antherarum loculis divaricatis, stylo (ovarii virginei) basilari et albumine æquabili.

Dicatum beato Henrico Slack, botanico magnæ spei, ætate iniente infelici casu abrepto.

S. geonomæformis.

Habit.—Forests, Ayer Punnus (Rhim), Malacca, rather common. In flower and fruit in July, 1842. Malayan name, *Pinang Rambeh.*

Descr.—*Stem* slender, 2-4 feet high, about ½ inch in diameter, distinctly annulate. *Leaves* pinnately split, 3-3½ feet long, 1-1½ broad, in outline linear-oblong: *sheaths* about a span long, striate ; naked base of *petiole* about a foot long, scurfy pubescent; *pinnæ* a foot or more in length, obliquely acuminate and nearly entire, or obliquely præmorse and eroso-dentate, varying in breadth from ½ an inch to 2 inches, with two or 2-more keels accordingly ; terminal bilobed, lobes broad, eroso-dentate; threads very fine.

Spathes about two, incomplete, leathery membranous, the lower one bicarinate; the upper twice as long, conduplicate, open interiorly to about its middle, like the spadix covered with brown pubescence. *Spadix* nodding, generally dichotomous, sometimes racemosely branched ; a scale-shaped, likewise scurfy pubescent, acute bracte at the base of the divisions. *Spikes* roundish, rather thick, of a spongy aspect 6-10 inches long.

Flowers partly immersed in niches with fimbriate membranaceous margins. *Males* in pairs, tribractreate. *Sepals* three, oblong-concave, striate, sub-coriaceous. *Petals* valvate, ovato-lanceolate, sub-acute, coriaceous. *Stamens* 6; *filaments* stoutish, united at the base, upper part inflexed in æstivation; *anthers* large, linear-oblong, 2-celled, versatile. *Pollen* 1-plicate. *Rudimentary Pistillum* angulato-sulcate, conico-cylindric, stout, with a discoid three-lobed apex.

Female flowers in the lower part of the spikes, tribracteate. *Sepals* as in the male. *Petals* broad, with a short broad point, imbricate. Six *rudimentary stamina. Ovarium* roundish, gibbous on one side, attenuated into a short stout style; with one cell on the gibbous side, containing one appense-pendulous ovulum. *Stigmata* 3, ovate, small, spreading or recurved.

Fruit spadix elongated, 1-1½ foot long, presenting at the base the remains of the spathes, nodding; *peduncle* compressed or sub-trigonal. *Fruit* sub-drupaceous, oblong, obovate, 5½-6 lines long, 4 wide, surrounded at the base by the perianth, very oblique, presenting on one side near the base the style. *Seed* erect, obovate roundish; *tegument* membranaceous, inflexed along simple lines, visible on the surface of the seed, converging towards the foramen. *Albumen* horny, simply ruminate. *Embryo* basilar.

It is scarcely distinguishable at first sight from Areca disticha, and like it, varies much in size and shape of the pinnæ.

I have placed both this and Bentinckia in Arecinæ, as the bulk of the affinities seems to me to indicate. I cannot perceive the necessary affinity between any of the genera arranged in Endlicher's Genera Plantarum as pinnate-leaved Borassinæ, and the true genera of that sub-family.

Sect. II.

Spathae plures, incompletæ. *Flores* monoici (vel interdum polygami ?) in uno vel distinctis spadicibus, vel dioici; masculi binati, cum vel absque fæmineo interjecto. *Corolla* fæminea valvata. *Stamina* sæpissime indefinita. *Ovarium* 2-3-triloculare, 2-3-ovulatum. *Bacca* 1-3-sperma. *Albumen* æquabile vel (in Caryota) ruminatum. *Embryo* dorsalis.

Palmæ *monocarpicae, interdum ope sobolum perennantes, frutescentes vel saepius arboreae.* Folia *pinnata vel bipinnata :*

rete *fibrosum:* pinnae *vel* pinnulae *varie erosae, lineares vel saepius cuneatae, saepius fasciculatae, subtus saepius albidae.* Spathæ *imbricatae, pedunculum vestientes.* Spadices *axillares et terminales,* (*in speciebus monoicis saltem*) *evolutione inversi,* spicis *saepius pendulis, fastigiatis.* Sepala 3, *imbricata.* Petala *totidem* (*vel* corolla *tripartita.*) Antheræ *lineares, adnatae.* Ovula *solitaria.* Succus *acris, urens.*

Palmæ monticolæ sylvicolæque, incolæ e maxima parte orbis veteris et præsertim Archipelagi orientalis. Limes borealis specierum indicarum 27°-28° grad., altit. supra mare 4,000 pedum.

Usus.—Trunci integri pro asseribus, excavati pro aquæductubus, fissi pro telis utuntur. E tela trunci centrali laxiori, farina, *Sagum* edita, paratur. Retis fibræ (*Ejoo*) in funes in aquam diutius stabiles torquentur. Succus recens (*Toddy,*) coctus Saccharum (*Cabong*) præbet et albumen immaturum cum saccharo conservatum condimenta. Denique tomentum vaginarum igniario est idoneum.

ARENGA.

(Areng.) *La Billardiere Mem. l'Instit.* 4. *p.* 209. (Martius). *Mart. Progr. p.* 23. *Palm. p.* 193. *t.* 208. *Endl. Gen. Pl.* 248. *No.* 1734.

Saguerus (vel Gomutus). *Rumph. Hb. Amb.* 1. *p.* 57. *t.* 13. *Roxb. Icones.* 14. *t.* 81. *Fl. Ind.* 3. *p.* 626.

Borassus. *Lour. Fl. Cochin. p.* 617. ex. pte.

Gomutus. *Spreng. Gen. Pl. p.* 450. *No.* 2222.

Char. Gen.—*Flores* monoici in diversis spadicibus (vix semper). *Stamina* indefinita. *Ovarium* triloculare. *Bacca* vertice depresso-trigona, sub-triloba, trisperma. *Albumen* æquabile. *Embryo* dorsalis.

Habitus.—Palmæ *spectabiles, arboreae, monocarpicae, raro soboliferae.* Truncus *annulatus, apicem versus petiolorum basibus saepius quasi squamatus.* Folia *pinnata;* rete *copiosum fibris rigidis nigris intermixtum:* petiolus *interdum aculeatus*; pinnæ *lineares, fasciculatae et plurifariae, vel solitariae bifariae, subtus albidae, basi uno vel utroque latere lobato-auriculatae, apice eroso-dentatae truncatae vel dentatae, vel bilobae.* Spadices *nutanti-pendulae;* spicis *pendulis, saepius fastigiatis caudae equinae in modum dispositis.* Flores *majusculi.* Antheræ *mucronato-apiculatae.* Baccæ *viridescentes, rotundatae, majusculae.* Semen (*endocarpio cohaerente?*) *saepius baccatum, saepius evenium.* Succus *acris.*

85. (1) A. *saccharifera,* elata, petiolis inermibus, pinnis fasciculatis 4-5 fariis lineari-ensiformibus basi utrinque auriculatis (auricula inferiore longe producta) apice bilobis et varie dentatis.

A. saccharifera. *Labill. Mem. l'Inst.* *Lam. Enc. Suppt.* 1. *p.* 441. *Mart. Palm. p.* 191. *t.* 108. Saguerus s. Gomutus. *Rumph. Hb. Amb.* 1. *p.* 57. *t.* 13. Saguerus Rumphii. *Roxb.* 3. *p.* 626. Borassus Gomutus. *Lour. fl. coch. p.* 648. Gomutus saccharifer. *Spreng. Syst.* 2. *p.* 624.

Habit.—Malacca Province, generally cultivated, but less common in the littoral districts. *Anowe* of the Malays. Succeeds sufficiently well in the H. C. Botanic Gardens, flowering throughout the year.

Descr.—A handsome palm, reaching to the height of 30-40 feet, *Crown* oblong, very dense, of a sombre aspect. *Leaves* very large, 20 feet (or more) long, 10 broad, outline oblong-ovate; *petiole* very stout, channelled at the base, sprinkled with blackish scurf; *pinnæ* generally fasciculate, 4-5 farious, the middle ones 5 feet long, 4-4½ inches broad, linear-ensiform, coriaceous, dark green above, underneath white, margins with distant spinescent teeth, towards the apex becoming more frequent; apex itself bilobed or bifid, eroso-dentate; base with one, or generally two unequal auricles, of which the lowermost is much the longer.

Male spadix 4-5 feet long. *Spikes* attenuate at the apex, and there furnished with a few rudimentary or abortive flowers. *Flowers* very numerous, oblong club-shaped, of a rich purple black colour, and a disagreeable smell, of considerable size, often an inch long. *Sepals* three, rounded, broad. *Petals* nearly three times longer, oblong obovate. *Stamina* 00; *filaments* short, slender; *anthers* nearly as long as the petals, aristato-mucronate.

Female-flowers solitary, large, about an inch across. *Sepals* 3, very broad. *Petals* three, cordato-ovate, coriaceous. *No sterile stamina. Ovarium* shortly obturbinate, 3-celled, apex 3-lobed, concave in the centre, whence arise 3 tooth-shaped, triangular, erect *stigmata;* substance thick, fleshy. Down the back of the lobes which are opposite the sepals runs a slight keel. *Ovula* erect.

Fruit oblong-round, 2-2¼ inches long, surrounded at the base by the perianth; apex flat or nearly concave marked with three lines, running from the backs of the persistent stigmata to the now nearly obsolete lobes; substance (outer) coriaceous, thick, inner berried-cellular, gelatinous, adhering for the most part to the seeds, abounding in raphides. *Seeds* dull black, convex on the outer, bifacial on the inner face, attenuate at the base. *Albumen* horny, cartilaginous. *Embryo* so eccentric as to point almost to the junction of the bifacial side.

This is one of the handsomest and most useful Malayan Palms. It is very commonly cultivated in the interior, the lines of trees recalling to mind gothic arches. The parts chiefly used are the black fibres forming the rete, the juice, and the young albumen; the former are twisted into ropes or cordage, renowned for its power of resisting wet; the juice is either drunk as toddy or made into sugar, which appears to be in great demand. The young albumen preserved in syrup forms one of the well-known preserves of the Straits. Mr. Lewes informs me, that trees that have died after the ripening of the whole crop of fruit, which is the natural course, are almost hollow, and particularly adapted for making troughs, spouts or channels for water, and that they last extremely well under ground.

In short it is so valuable a palm, that it early attracted Dr. Roxburgh's attention,* who introduced it largely. The

* With respect to the various and important uses of this most elegant palm, I have nothing to offer myself, but refer to what Rumphius and Marsden have written on the subject. At the same time, I cannot avoid recommending

natives however have never taken to it, prefering the coir of the cocoa-nut, and the toddy and sugar of Phœnix sylvestris.

86. (2) A. *Westerhoutii,* (n. sp.) petiolis inermibus, pinnis alternis bifariis linearibus basi uni vel ex-auriculatis apice exattenuato truncatis sæpius bilobis et varie dentatis.

HABIT.—Naning, Malacca Peninsula, *Mr. Westerhout.* Penang. *Mr. Lewes.* Malayan names, *Anowe kutaree,* (Malacca); *Langkup* (Penang.)

DESCR.*—A palm of about the size of the preceding. *Leaves* ample, linear-oblong in outline, 20 feet long, 10 feet across in the broadest part ; *rete* as in A. saccharifera ; *pinnæ* sessile, about 5 feet in length, 3 inches broad, alternate or sub-opposite, solitary, bifarious, very spreading with deflexed points, attenuate towards the base, the upper ones alone auriculate at the lower side, coriaceous, bright green above, white underneath and (with the petiole) scurfy towards the base ; margins with irregular spinescent teeth ; apex præmorse, dentate and erose, sometimes bilobed.

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to every one who possesses lands, particularly such as are low, and near the coasts of India, to extend the cultivation thereof as much as possible. The palm wine itself and the sugar it yields, the black fibres for cables and cordage, and the pith for sago, independent of many other uses, are objects of very great importance, particularly to the first maritime power in the world, which is in a great measure dependent on foreign states for hemp, the chief material of which cordage is made in Europe.

From observations made in the Botanic Garden, well grown, thriving trees produce about six leaves annually, and each leaf yields from eight to sixteen ounces of the clean fibres.

In the same garden are now (1810) many thousand plants, and young trees, some of them above twenty years growth, with trunks as thick as a stout man's body, and from twenty to thirty feet high, exclusive of the foliage. They are in blossom all the year ; one of them was lately cut down, and yielded about 150 pounds of good sago meal. *(Roxb. op. cit.)*

* From an entire specimen of a young palm, procured from Naning by Mr. Westerhout, two male spadices, and several specimens of female flowers and fruits.

Spadix curved-pendulous. *Spathes* fibrous, coriaceous, often split. *Spikes* about level topped. *Male flowers* in pairs, without an interposed rudimentary female, or solitary, with a rudimentary female. *Calyx* cup-shaped. *Petals* oblong, fuscous-purple. *Stamina* numerous; *filaments* short, subulate; *anthers* with mucronate or aristate ends. *Pollen* hispid, with a longitudinal fold.

Female flowers solitary, sessile. *Sepals* broad. *Petals* three, cordate, concave, obtusely carinate. *Ovarium* roundish, trigonal, (angles opposite the sepals,) depressed at the apex, and there marked with three lines running from the angles to the stigmata, which are three, tooth-shaped, and connivent, so as to form a cone.

Fruit roundish, about the size of a small apple, with a depressed three-lobed trigonal vertex, terminated by the sphacelated stigmata, surrounded at the base by the perianth, 2-3 celled; outer substance thick, fibrous-fleshy. *Seed* separating with the thick gelatinous-cellular, endocarp, black; when three convex-bifacial. *Embryo* oblique about the centre of the dorsal face of the horny *albumen*.

Not having seen this palm growing, I am unable to say any thing regarding its habit. The chief difference from A. saccharifera is in the leaves. A obtusifolia, Bl., has the petioles furnished with marginal aculei.

The *Langkup* of Penang may probably be distinct, the pinnæ being smaller and more truncate, the branches of the fruit spadix spreading, short, and the fruit larger and more oblong.

I am not aware of its being applied to any use. I have Mr. Westerhout's authority for stating it to be quite local, being only found in one place, although there abundant.

87. (3) A. *Wightii*, (n. sp.) sobolifera, trunco humili 3-8 pedali, petiolis inermibus, pinnis alternis linearibus basi bi-auriculatis (auricula inferiore maxima) apice attenuato erosis inæqualiter bilobis, spadicis ramis subfastigiatis, fl. fæm. staminibus sterilibus pluribus, semine venoso, embryone supra medium.

Habit.—Dense forests, Hills about Coimbatore, *Dr. Wight*.

Descr.*—A monoicous palm forming by means of suckers dense clumps. *Trunk* stout, as thick as a man's thigh, generally 3-5 feet, rarely 8 feet high. *Leaves* 18-28 feet in length; lower naked part of the *petiole* 6-8 feet long; *pinnæ* alternate, crowded, linear ensiform, 3-3½ feet long, 1½-2 inches broad, white underneath, with two large auriculæ at the base, (the lower very large indeed, 1½-2 inches long, overlaying obliquely the petiole,) with a few distant teeth from the middle upwards; apex attenuate, unequally bi-lobed, erose; terminal lobe narrow cuneate, 2-3-lobed, base shortly bi-auriculate, apex truncate, lobulose, and jagged-dentate.

Spadices decurved pendulous, about 4 feet long: *peduncle* before branching about 2 feet long, quite concealed by the sheathing imbricate lacerate spathes. *Male; branches* (spikes) about 2 feet long, sub-fastigiate, slender. A scale-shaped *bracte* at the base of each. *Flowers* in pairs rather distant, (altogether forming a rather thin mass of inflorescence,) rather large, in pairs, with a vertical scale interposed. *Calyx* of three roundish imbricate sepals with thick bases. *Petals* 3, oblong, very thick and coriaceous. *Stamina* 00; *filaments* short; *anthers* linear, adnate, terminated by a longish subulate point. No *rudiment* of a *pistillum.*

Branches of the *female spadix* attenuate towards the ends, where they bear rudimentary flowers. *Flowers* solitary, under each a shallow entire or bi-lobed cup. *Sepals* broadly cordate, small. *Petals* roundish-cordate, acute or cuspidate. *Abortive stamina* several.† *Ovarium* roundish, 3-celled. *Styles* three, short, recurved. *Ovula* solitary.

Fruit crowded on the lower halves of the stout spikes (the upper halves naked,) about the size of a crab apple. *Seed* convex on one face, unequally bifacial on the other, separating easily except at the base from the black papery endocarp, brown, surface conspicuously marked with slightly branched veins, converging at the apex of the seed. *Albumen* horny. *Embryo* on one edge of the convex face, above the middle.

This species approaches in its inflorescence closely to A. Westerhoutii. Its main differences from it seem to regard the pinnæ, which are attenuate and bi-lobed at the apex, (not as in that species undiminished or even wider and more

* Specimens: portions of a leaf; an entire male, female, and fruit spadix, communicated by Dr. Wight, with a letter describing the habit, and a drawing of the male spadix, male and female flowers, and a fruit-bearing branch.

† In flowers shortly after fecundation, however, I find none.

or less truncate, and ex-auriculate at the base), and the seeds. It also disagrees in stature, in which respect it differs importantly also from A. saccharifera, as it also does in the solitary pinnæ and veiny seeds.

I believe it is the first species hitherto found on the continent of British India; it is dedicated to Dr. Wight its discoverer, to whom Indian Botany is so deeply indebted.*

CARYOTA.

Linn. (*Mus. Cliff. p.* 12.) *Gen. Pl. ed.* 6*ta. p.* 517. *No.* 1228. *ed. Schreb. p.* 779. *No.* 1701. *ed. Spreng. p.* 449. *No.* 2218. *Juss. Gen. p.* 38. *Gaert. Sem. et. Fruct.* 1, *p.* 20. *t.* 7. *Roxb. Icones.* 14. *t.* 80. *Fl. Ind.* 3. *p.* 624. *Jacq. Frag. Bot. p.* 20, *t.* 12, *f.* 1. *Lam. Illustr.* (*t.* 897.) *Mart. Progr. p.* 18. *Palmae. p.* 193. *t.* 107. 108, (bad.) *t.* 162, (bad.) (*Tab.* 5, *f.* 1, *tab.* Y, *f.* 1, 2.) *Endl. Gen. p.* 248. *No.* 1735.

Seguaster Major, *Rumph. Hb. Amb.* 1. *p.* 64. *t.* 14.

Schunda-pana, *Rheede Hort. Mal.* 1. *p.* 15. *t.* 11.

Char. Gen.—*Flores* monoici, fæmineus inter duos masculos. *Stamina* indefinita. *Bacca* sub-exsucca, sæpius monosperma. *Albumen* ruminatum. *Embryo* dorsalis.

Habitus.—Palmæ *elegantes, saepius procerae, monti-sylvicolae, monocarpicae, interdum ope sobolum perennantes.* Trunco *concinne annulatus.* Folia *bipinnata, amplissima;* rete

* I subjoin a short description of another species observed in the second Kiouk-dweng, or mountain defile of the Irawaddy.

Stem stout, 10-15 feet high, covered with the bases of the petioles. *Leaves* 10 feet long; *rete* scanty, stout, with very long, black twig-like processes; *pinnæ* ensiform, 2-2½ feet long, 1½ inch broad, white underneath, bi-auriculately lobed at the base, the lower lobe very large and decurrent. *Spadices* ample, nodding, pendulous.

Habt.—In densely shaded places of the second (from Mogam) Kiouk-dweng, or rocky defile of the Irawaddy, 7th May, 1837.

This is the most northerly species of the genus. In the same locality Orophea, Dillenia, Hæmatospermum, Campanula, Æsculus, were noticed.

tenue, fibrillosum ; pinnulæ *cuneatae, oblique praemorsae, erosae, pagina utraque concolori.* Spadices *nutanti-penduli.* Spicæ *pendulae, saepius fastigiatae, caudae equinae in modo dispositae. Fl. fœm.* stamina rudimentaria *tria.* Baccæ *subglobosae, rubescentes.* Succus *acerrimus.*

Specierum octo tres tantum satis bene cognitæ; aliæ recognoscendæ, tum fusius tum accuratius definiendæ.

C. *urens,* arborea, pinnulis coriaceis spinuloso-dentato-lobatis et erosis, lateralibus obliquissimis margine exteriori producto caudato-acuminatissimis, staminibus sub-38, antheris sæpius emarginatis, baccis depresso-globosis 1-2-spermis globuli sclopeti magnitudine.

88. (1) C. urens. *Linn. fl. zeyl. p.* 187. *No.* 396. *Willd. sp. Pl.* 4. *p.* 493. *Gaert. fruct. et. sem.* 1. *p.* 20. *t.* 7. *Roxb. Icones.* 14. *t.* 80. *Fl. Ind.* 3. *p.* 625. *Mart. Palm. p.* 193. *t.* 107, *t.* 108, (indifferent,) *t.* 162, (very bad.)
Schunda-pana. *Rheede. Hort. Mal.* 1. *p.* 15. *t.* 11.

Habit.—In sandy places, Malabar. (*Rheede.*) On Hills Cavila-Cutty, with Teak and wild Mango trees. Velater, Malabar, where it is called *Evim-pannah.* Dinagepore, *Buch. Hamilton.** A native of the various mountainous parts of India, flowering time the hot and rainy season. *Roxb.* Assam. Telinga, *Jeroogoo.* Dinapore. *Ramguoah, Bon-khejur.* Assam, *Bura Sawar.*

Descr.†—A lofty, extremely elegant palm. *Trunk* a foot in diameter, 35-40 feet high, with distinct distant annuli. *Crown* rather thin, of several ascending gracefully curved leaves, of great size, 18-20 feet long, 10-12 broad. *Petiole* very stout, at the base about 3 inches across; the lower foot naked, the margins of the sheath continued up on it as an elevated confluent line. *Rete* moderate, coarsely fibrous. *Pinnæ* fascicled or generally alternate, inserted on large knobs, 5-6 feet long, curved or even drooping. The lowest *pinnules* attached to the petiole

* Journ. Mysore. etc. 3. p. 64.—Ditto 2. p. 454.

† From specimens in the Botanic Gardens.

itself, crowded, broad cuneate, less obliquely præmorse, and generally not produced on the outer side; but the upper ones gradually assume the form of the other *pinnules*, which is narrow cuneate, with the outer edge caudato-acuminate; there are about 22-24 to each pinna, 12-15 inches long, 1½-2 inches broad, those of the uppermost pinnæ very narrow, even so as to be almost equilateral. All are sharply toothed, lobed and erose, coriaceous, plicate, green. *Terminal pinnules* broadly cuneate, two-lobed, or perhaps generally three-lobed.

Spadices very large and long (10-12 feet): upper ones flowering first, and so on, till that next the ground has flowered, when the tree dies. *Peduncle* curved, stout, entirely covered with large, greyish, coriaceous, leathery, 1-1½ foot long, closely imbricated *spathes*. *Spikes* very long, pendulous, level-topped, resembling a huge docked tail. *Flowers* immensely numerous, in threes, the central and lowermost later in development, female. *Male sepals* three, roundish, cordate, ciliate, imbricated. *Petals* oblong, reddish. *Stamens* about 38; *filaments* short, white; *anthers* about as long as the petals, linear, generally with bifid or emarginate points. No *rudiment* of a *Pistillum*.

Female flowers much the same, but the *sepals* are broader, more ciliate, the *corolla* shorter, greenish. *Sterile stamina* three, opposite the sepals and angles of ovarium, resembling young anthers. *Ovarium* subtrigonal, roundish, bilocular, cells fore and aft. *Ovules* solitary, erect. *Stigmata* 2, cordate, white. *Berry* reddish, "about the size of a nutmeg, covered with a thin, yellow, acrid bark, but nothing that deserves the name of pulp. *Seed* generally solitary," (Roxb.) "*Albumen* horny. *Embryo* conical, centric." (Martius.)

This and the Phœnix sylvestris when allowed to reach its full size unmutilated, are the handsomest and most useful palms of the Peninsula of India.

"This tree is highly valuable to the natives of the countries where it grows in plenty. It yields them, during the hot season, an immense quantity of toddy or palm wine. I have been informed that the best trees will yield at the rate of one hundred pints in the twenty-four hours. The pith or farinaceous part of the trunk of old trees, is said to be equal to the best Sago; the natives make it into bread, and boil it into thick gruel; these form a great part of the diet of those people; and during the late famine, they suffered little while those trees lasted. I have reason to believe this substance to be highly nutritious. I have eaten the gruel, and think it fully as palatable as that made of the Sago we get from the Malay countries." *Roxb. op. cit.*

89. (2) Caryota *obtusa,* (n. sp.) arborea, pinnulis valde inæquilateralibus erosis dentibus brevibus obtusissimis, floribus masculis distantibus, antheris mucronulatis.

HABIT.—Mishmee Mountains in woods about Yen. Altitude above the sea 3-4000 feet.

DESCR.*—A very large *palm ;* diameter of the *trunk* 1½-2 feet. *Leaves* very large; *pinnules* cuneate, very unequal sided, coriaceous, when dry remarkably striato-plicate; the outer side scarcely at all produced; the teeth short, very obtuse.

Branches of the male spadix long, flexuose, scurfy. *Flowers* distant, three together, the central (female) later in development. *Males* about 5 lines long. *Sepals* rounded, scurfy and ciliate. *Petals* 2½ times longer than the sepals. *Stamina* indefinite. *Anthers* linear, mucronulate. *Female flower* (in bud.) *Calyx* as in the male. *Petals* much smaller, valvate. *Sterile stamina* 3, opposite to the sepals. *Ovarium* subturbinate with a trigonal vertex, 1-2 celled. *Ovula* solitary, erect. *Stigmata* 2, oblong, cordate-subreflexed.

I met with this palm in 1837, during a hurried journey to the Mishmee Mountains. Its habit is that of C. urens, from which the obtusely toothed pinnules at once distinguish it. The Assamese coolies who were with me called it Bura Suwar, their name for C. urens. The Mishmees make use of the central soft portion of the trunk as food.

The pinnulæ are not unlike those of Seguaster major, Rumph. Hb. Am. 1. t. 14 ; but my specimens do not contain an entire pinna, with the attaching part of the petiole.

I find in my notes mention made of a second species inhabiting the Mishmee Mountains, with the inflorescence of an

* Partly from notes made on the spot, from dried specimens of a portion of a leaf and a spadix.

orange yellow colour. Attention should also be directed to the "Semoong-koong"* of Sikkim, which is probably a species of Caryota.

90. (3) C. *sobolifera*, arbuscula, sobolifera, pinnulis subobtuse erosis et dentatis latere exteriori cuspidato-acuminatis, staminibus circiter 17, antheris mucronulatis, baccis sæpius monospermis depresso-globosis magnitudine globuli sclopetarii minoris.

C. sobolifera. *Mart. Palm. p.* 194.

HABIT.—About Malacca and on Pulo Bissar in woody places. Malayan name, *Tookkus*. *Doodoor* of Penang, *Mr. Lewes*. Introduced into the Botanic gardens in 1816 from the Mauritius, flowers duing the greater part of the year.

DESCR.†—A very elegant *Palm*, forming by its offsets very thick compact tufts. *Stems* 12-15 feet high, 4-5 inches in diameter, greenish, distinctly annulate. *Leaves* 8-9 feet long, spreading, nodding towards the apex, glaucescent greenish; *petioles* and *sheaths* scurfy downy; *pinnulæ* (basilar) sub-opposite, (the rest alternate,) obcuneato-deltoid, obliquely præmorse, the outer margin acuminate, regularly and rather obtusely jagged.

Spathes concealing the whole peduncle, almost boat-shaped, at length deciduous. *Spikes* very numerous about a foot long, altogether resembling a docked tail, axis or rachis green, sulcate. *Male flowers* very numerous, oblong, flesh-coloured, with reddish points. *Calyx* cup-shaped, sepals broad, imbricate. *Corolla* of three, coriaceous, striate, almost distinct, petals. *Stamina* about 17; *filaments* united at the base, very short; *anthers* linear, adnate, generally slightly mucronulate. *Pollen* ovato-lanceolate, 1-3 plicate.

Female flowers at the time of expansion of the males minute, rudimentary, not developed until after the males of the same spadix have fallen off. They are smaller than the males, not always solitary, but sometimes in pairs or threes, or solitary with a scar of one male only. *Bracteolæ* two, right and left. *Sepals* rounded, with a brown intromarginal line, and ciliate edges. *Corolla* twice as long, tripartite to a little below the

* See Journal of the Agricultural Society of India, vol. 2. p. 323.

† Description, excepting the female flowers, from the Malacca Plant.

middle, coriaceous, brown, valvate. *Barren stamina* 3, united to the corolla as far as the sinuses of its segments, ends thickened, glandular, yellowish. *Ovarium* roundish-ovate, with three obtuse angles, 1 or sometimes 2-celled. *Stigma* 1, or sometimes 2, cordate, channelled down the middle. *Ovules* 1, or sometimes 2, according to the stigmata and cells of the ovary.

Fruit surrounded at the base by the perianth, depressed, roundish, about the size of a carbine bullet, greenish red, or red, presenting (generally) at the apex an oblique cordate stigma; *epicarpium* brittle, subfibrous. *Seed* one. *Albumen* horny, ruminated. *Embryo* situated obliquely above the middle of the albumen.

I can find no distinction between the Malacca and the Botanic Garden specimens, the former, however, were not noted to be soboliferous.

The substance of the ovarium, the buds and the outer surface of the albumen abound with raphides.

Martius* mentions his having only met with one ovulum and a simple stigma. I find however, often two stigmata, when the ovarium is two-celled; in the other case the stigma is oblique, and the ovarium smaller.

Dr. Martius is to be considered the authority for the species.

WALLICHIA.

Roxb. Corom. Pl. 3. *t.* 295. (1819 Sprengel.) *Mart. Progr. p.* 17. *Reichenb. Consp. Reg. Veg. p.* 72. *No.* 1647. *Bartl. Ord. Nat. p.* 65. *Spreng. Gen. pl. p.* 285. *No.* 1476. *Lindl. Int. Nat. Ord. p.* 346—non D. C. nec Reinwdt.

Harina. *Ham. Mem. Wern.* 5. *p.* 317. *Spreng. Gen. pl. p.* 792. *No.* 4110. *Mart. Palm. p.* 188. *t.* 136. (part. mala.) *Endl. Gen. pl. p.* 248. *No.* 1732.

Wrightea. *Roxb. Icones.* 14. *t.* 78. *Fl. ind.* 3. *p.* 621. non R. Br.

Orania. *Blume. Mart. Palm. p.* 186. *t.* 157. *Endl. Gen. pl. p.* 248. *No.* 1731. *Bl. Rumphia. t.* 85.

Seguaster minor. *Rumph. Hb. Amb.* 1. *t.* 15.

* Palmae. l. c.

CHAR. GEN.—*Flores* mono-dioici. *Masculi* binati. *Stamina* 6 vel indefinita. *Fœminei* solitarii vel masculo utrinque stipati. *Bacca* sub-exsucca, 1-2-sperma. *Albumen* æquabile. *Embryo* dorsalis.

HABITUS.—Palmæ *cæspitosae, humiles, frutescentes, soboliferae* (an semper?), *aliquando arundinaceae, truncis monocarpicis.* Folia *pinnata;* rete *fibrosum;* pinnæ *infimae saepius fasciculatae, superiores solitariae, e basi cuneata integerrima varie lobatae dentataeve* (*lobis dentibusque spinuloso-erosis*), *striato-veniae, subtus albidae et nigro punctulatae.* Flores *mono-dioici, vel polygami in diversis spadicibus, vel monoici in eodem spadice?* Spadices *masculi, vel axillares inversa ordine evoluti, nutanti-penduli, ramosissimi spicis fastigiatis e maxima parte spathis inclusis; vel* (Oraniæ) *terminales, parce ramosi, spicis exsertis.* Flores *inferiores per paria dispositi cum vel absque fœminei rudimento; superiores solitarii.* Spadices *faeminei terminales, ramis paucis exsertis, interdum simplices.* Spicae *apice attenuatae, polygamae?* Flores *solitarii, bi-tribracteolati.* Fructus *oblongi, interdum obliqui, rubri vel albi.* Succus *causticus.*

The genus Wallichia was first established by Dr. Roxburgh in 1819.*

In 1826, it appeared as Harina of Buchanan Hamilton.†

In 1832, it re-appeared under the name Wrightea in the Flora Indica‡ of Dr. Roxburgh. And this was the original MSS. name, which it became necessary to change, owing to the prior appearance of the Wrightia§ of Mr. Brown.

The synonymy became very confused by the appearance in 1823, four years after the publication of the Coromandel plants, of the Wallichia of De Candolle,|| a plant belonging to the family of Byttneriaceæ.

* Cor. Pl. 3. t. 295. This date is taken from Sprengel's Genera, there being no complete copy of the Coromandel Plants in the H. C. Botanic Gardens.

† Mem. Wern. Soc. 5. p. 317.

‡ Op. Cit. 3. p. 621.

§ Mem. Wern. Soc. 1. p. 73.

|| Mem. Mus. 10. p. 104. t. 6.

These are the synonyms which are the most concerned, but the name Wallichia has also been applied to a Rubiaceous genus, the Axanthes of Blume; also Dr. Wallich* states by Roxburgh himself in his MSS. to another Rubiaceous genus, the Urophyllum of Jack.

Both Harina of Hamilton and Wallichia of De Candolle, appear to have been adopted without remark by the generality of Botanists, except by Reichenbach,† Bartling,‡ and Lindley,§ none of whom, however, take any notice of Harina. Harina may, still, through Dr. Martius|| be now considered as quite current, although in favour of Wallichia there is claim of priority of seven years. And as for the Wallichia of De Candolle, it is so far from being so distinct as that Botanist considered it, that it has already merged into Microchlæna, which again is considered by that very competent authority, Dr. Wight, as not distinct from Eriochlæna.

It is I think singular, and not less consoling to colonial Botanists, that a genus belonging to so notable a family as Palms, and published in such an enormous, conspicuous, and well-known work as the Coromandel Plants, should have been overlooked by two Botanists, one writing at Geneva, the other in Edinburgh. For the appearance of Wrightea in the Flora Indica, twenty-one years after that of Wrightea of Mr. Brown, Dr. Wallich may be considered responsible, because from his office, professed friendship, and reiterated veneration for Dr. Roxburgh, he ought to have been the Editor of the second edition of that work, which from want of proper supervision is so much disfigured by obscurities and typographical errors.

* Flor. ind. ed. Carey. 2. p. 674.

† Consp. Regn. Veg. p. 72.

‡ Ord. Natur. Pl. p. 65.

§ Introd. Nat. Ord. p. 346.

|| Palm. p. 188, where no remark is made on the change of name from Wallichia, under which it appeared in his Programma, p. 17.

* *Flores monoici. Stamina sex.*

91. (1) *W. caryotoides,* pinnis inferioribus 3-4-natim fasciculatis cuneatis panduriformi-lobatis apice ambitu triangularibus, floribus faemineis distantibus tribracteatis, alabastris rotundo-conicis, petalis tribus acutis erectis ovario subduplo longioribus.

W. caryotoides. *Roxb. Corom. pl. 3. t. 295.* Wrightea caryotoides. *Roxb. Icon.* 14. *t.* 78. *Fl. Ind. 3. p.* 621. Harina caryotoides. *Ham. in Mem. Wern. Soc. p.* 317. *Mart. Palm. p.* 188, (excl. syn. Hamilt.) *t.* 136, (mal.)

Habit.—Chittagong, where it is called *Chilputta* or *Belputta,* (Roxb.) Cultivated in the H. C. Botanic Gardens.

Descr.—An elegant tufted *Palm,* each tuft consisting of several very short stems. *Leaves* ascending curved, 8-9 feet long, 2½ feet broad, oblong in outline; *petiole* naked and roundish throughout the lower 4 feet, among the pinnæ bifacial on the upper side, sprinkled with brown and grey scurf; *pinnæ* lowermost in threes, sometimes fours, intermediate in pairs, uppermost solitary, cuneate, 12-18 inches long, 6-7 broad, coriaceous, with a deep notch corresponding on either side towards the middle, and a shallower one at the apex on either side of the midvein: the margins of these lobed, and erose: teeth close set, almost spinous; the *terminal* pinna cuneate, bilobed at the apex, sides above the middle lobed, and similarly erose-dentate.

Male spadix not seen.*

Female spadix terminal, shorter than the leaves, erect, or almost nodding. *Spathes* closely imbricated, concealing the peduncle. *Spikes* spreading, stout, marked under each flower with a distinct areola, with attenuate points, bearing *neuter* flowers, which are cylindrical with 6 barren stamina and no Pistillum.

Next to these occur some, nearly if not quite *hermaphrodite,* with generally three full sized stamina, and a seemingly well developed Pistillum. The other flowers are *female,* and are in bud roundish-conical. *Sepals* three, short, rounded. *Petals* three, ovate-cordate, erect, acute,

* Roxburgh's drawing represents the spadix terminal, nodding, the flower bearing part pendulous. The spathes acuminate, not entirely appressed to the peduncle, those next the flowers distichous, and rather shorter than the spikes, all being of a grey-green tint. The leaves next the inflorescence have the pinnae almost truncate, with one or two notches above the middle, the lowermost being in pairs.

almost spinous pointed, about twice as long as the calyx and ovarium, greenish. No rudiments of *Stamina*. *Ovarium* roundish-turbinate, 2-celled, with a very short conical *style* and an emarginate *stigma*. *Ovules* solitary, ascending.

Fruit oblong, about ½ an inch long, reddish, with a thin flesh. *Seeds* generally two, about the size of a coffee-seed, plano-convex, with an indistinctly reticulate-veined surface; *tegument* adhering to the *albumen*, which is horny and solid. *Embryo* conical, a little above the centre of the convex or dorsal face.

This I believe is Roxburgh's plant, the pinnae agreeing in shape with the outline figure of one in his original drawing. Still, however, there are many discrepancies, Roxburgh representing the spadix as terminal, with both male and female flowers, and resembling in most respects the male spadix of the succeeding, whereas the garden plants are as I have described them, their spadices evidently corresponding to the female spadices of the succeeding.

Hamilton's plant, which he considered the same as Roxburgh's, appears to me from his description distinct. I have therefore quoted his synonym doubtfully.

92. (2) W. *oblongifolia*, (n. sp.) pinnis imis binatim fasciculatis (reliquis solitariis) lineari-oblongis basi breviter cuneatis integerrimis caeterum sinuoso-lobatis dentatisque ut plurimum eroso-serratis obtuse acuminatis, spathis (spad. masculi) ventricosis spadicem e maxima parte obcludentibus, floribus faemineis densis bibracteatis, corolla tridentata quam ovarium breviore segmentis depressis.

Harina caryotoides. *H. B. C.* non Roxb. H. densiflora, *Mart. Palm. p.* 189. *in annot?*

Habit.—Assam. *Major Jenkins, Mr. Masters.* Sub-Himalayan range. Darjeeling. *Seharunpore collectors.* Cultivated in the H. C. Botanic Gardens, flowering in May and June.

Descr.—A very elegant Palm forming thicker tufts than the preceding. *Leaves* rather larger, the lower ones spreading; *petiole* much the same as that of the preceding; *pinnæ* alternate or often sub-opposite, the lowermost only in pairs, linear oblong, 18-20 inches long and 4 broad, from a short entire cuneate base sinuato-lobate and dentate, undulated, eroso-dentate almost throughout, white beneath, with a brown midrib; terminal pinna broad cuneate, three-lobed, central lobe bi-lobed, similarly eroso-dentate.

Male spadices axillary, curved, often nutant or pendulous; the ends of the lowermost touching the ground, scarcely more than 1½ foot in length. *Spathes* densely imbricated, the innermost almost membranous, striate, tinged with dark purple, equalling the flower-bearing part of the spadix, and often disposed round it in an urceolate form. *Spikes* slender, very numerous, level topped, pendulous, their points projecting beyond the opening of the spathes.

Flowers very numerous, ochroleucous, the lower ones in pairs, with a rudimentary female between, the upper ones solitary. *Calyx* cylindrical, nearly entire. *Corolla* as long as the calyx, tripartite nearly to the base, segments reflexed. *Stamina* 6; *filaments* cohering rather high up to the petals. No *rudiment* of a *Pistillum.*

Female spadix much like that of the preceding; *spathes* brown, conduplicate, the outer one sometimes very long, and acuminate. *Branches* very stout, green, variously ascending, tapered at the ends, where they are caudiform and notched, the notches bearing rudimentary flowers. *Bractes* 2, right and left. *Flowers* purplish, closer than in the preceding, sometimes (especially in the wild specimens) quite crowded, occupying the lower part of a flattish areola, bases somewhat immersed; in bud almost globose. *Calyx* very short, divided to the middle into three broad rounded teeth. *Corolla* shorter than the ovarium, trifid, segments broadly half ovate, obtuse, depressed. No rudiments of *stamina. Ovarium* round ovate, two-celled. *Stigma* an indistinctly emarginate point. *Ovula* solitary.

Fruit crowded, oblong, surrounded at the base by the perianth, on the apex presenting a brown spot (the stigma); *epicarp* tough, rather thin; flesh scanty, with a mucilaginous acrid juice. *Seeds* two, plano-convex; *tegument* greenish, veiny. *Albumen* horny, solid. *Embryo* about the centre of the convex face.

This species is quite distinct from the first, though at first sight they are scarcely distinguishable. The main differences are the linear-oblong, sinuate-lobed or toothed, obtusely acuminate pinnæ, the lowermost only occurring in pairs, the male spadices, which are judging from Roxburgh's figure, quite different, the shape of the flower bud, and the trifid corolla with depressed segments and shorter than the ovarium.

It is more common in the Gardens than the other, for which it has been so strangely mistaken.

* * *Flores dioici, Stamina indefinita.*

Orania. Blume.

93. (3) W. *nana*, (n. sp.) pinnis subquinis oppositis basi cuneatis ceterum obliquis irregulariter lobatis vel dentatis, spathis vaginantibus distichis conduplicatis, fl. fæmineis tripetalis ferrugineo-furfuraceis, spadicibus (fæm.) simplicibus vel 2-3 ramosis, fructibus oblongis 1-spermis (albis.)

Hab.—Lower Assam, in woods about Gowahatty. *Assam Deputation. Major Jenkins.* Flowers in July, August.

Descr.*—A small erect palm from 3 to 5 feet in height. *Trunk* slender, throwing out roots from the base, covered with sheaths of the leaves. *Leaves* about 2 feet long; *petiole* short, roundish, obliquely sheathing at the base, with a thin *rete*, above produced into a bipartite liguliform body; *pinnæ* alternate or subopposite, cuneate towards the base, above this oblique, variously lobed, toothed and spinuloso-serrate: terminal one irregular in shape, generally bilobed, striate-veined, above green, underneath glaucous white.

Spadices axillary. *Spathes* several, distichously imbricate, ferrugineo-furfuraceous, conduplicate, entirely concealing the peduncle.

Spadix simple, or with two or three divisions, densely ferrugineo-furfuraceous, flower-bearing part exserted, about the length of a finger. *Flowers* densely spiked, small, white, with (at least in the female) an inverted order of expansion. *Male Calyx* of three rounded, sub-membranous sepals. *Petals* three, oblong, with almost introflexed points, furrowed inside from the pressure of the stamina. *Stamens* about 14, inserted on a small prominent torus, rather shorter than the petals; *filaments* very short; *anthers* linear, adnate. No rudiment of a *Pistillum*.

Female flowers also white, crowded on a generally simple spadix attenuate at the apex and probably there bearing neuter or hermaphro-

* From fresh entire specimens communicated by Major Jenkins.

dite flowers. *Calyx* tripartite nearly to the base, segments very spreading, greenish. *Corolla* of 3 broad, ovate, sub-connivent, striate, coriaceous petals. No rudiments of *Stamina.* *Ovarium* white or reddish, a little shorter than the corolla, triangular-conical, the angles alternating with the petals, 2-celled, of a thick coriaceous substance. *Style* 0. *Stigma* emarginate. *Ovules* solitary, erect.

Fruit sub-baccate, white, obliquely oblong, straight on the upper side, convex on the other, 7 lines long, 4¼ broad; base surrounded by the perianth, apex presenting a bi-dentate sphacelated stigma, 1-seeded, 2-celled, 1-cell almost obliterated. *Seed* 1, of the same shape, whitish; *tegument* adhering to the albumen; *raphe* on the straight face, palmately divided, branches often dichotomous. *Albumen* solid, radiating from a central line. *Embryo* about the centre of the convex (dorsal) face.

This species appears allied to Orania regalis, Blume, Rumphia, t. 85. and O. porphyrocarpa, Mart. Palm. t. 157. It differs from both in the number and the irregular shape of the pinnæ, the crowded flowers, and three petalled females. In the shape of the fruit it is nearly intermediate.

Besides these three species, I have bits of three others, collected on the N. E. frontier, (one from Yen in the Mishmee Mountains.) If to these Buchanan's Harina caryotoides be added, the total number of our Indian species will be seven, of which increase, the most unexpected part is the finding an undescribed species* in the H. C. Botanic Gardens, in which it has existed at least 25 years.

MACROCLADUS.

CHAR. GEN.—*Flores* monoici, fæminei utrinque masculo stipati. *Spatha* duplex, interior completa, clavato-fusiformis, lignosa. *Corollae* valvatæ. *Stamina* 6. *Ovarium* triloculare, loculis 1-ovulatis. *Fructus* subsiccus. *Albumen* cartilagineum, æquabile. *Embryo* lateralis.

HABITUS.—Palma *malayana, spectabilis, inermis.* Corona *haemisphaerica, densa.* Folia *pinnata, pinnis linearibus,*

* This makes the second undescribed Palm in the Gardens, see p. 36.

apice irregulariter dentatis vel lobatis, subtus albidis. Spadix *axillaris, paniculatim ramosus.* Flores *albi, minuti.* Fructus *globosus, albidus.*

Folia et flores fæminei quodammodo Arengæ, spathæ Cocos, fructus Coryphæ.

Locus naturalis mihi ignotus: ad calcem Arecinarum interim posui. Affinis Euterpe montanæ, Graham, Bot. Mag. t. 3874, quæ cum charactere generico citato saltem quoad spathas minime convenit.

94. (1.) M. sylvicola.

HABT.—In forests, Ching, Malacca. Malayan name, *Ebool.*

DESCR.—A handsome palm, about 40 feet in height, with somewhat the habit of Cocos nucifera. *Crown* sub-hemisphærical, dense. *Leaves* pinnate, ample, 12-15 feet long, spreading in every direction; *petiole* with the margins of the hardened leathery half stem clasping base lacerate-fibrous, lower naked part about 5 feet long; *lamina* sub-obovate in outline; *pinnæ* sub-linear, 2½-3 feet long, 2 inches broad, oblique at the points where they are irregularly toothed or lobed, underneath whitish-scurfy: above 1-keeled, underneath with 5 small keels.

Spathes 2, outer one very small, incomplete, 2-edged, perforated at the apex, leathery; inner complete, almost woody, before dehiscence fusiform-clavate with a subulate cuspis, striate or sulcate, ferruginously scurfy, roughish, opening longitudinally, the margins becoming reflexed.

Spadix paniculately branched, spreading, nodding towards the point, here and there ferruginously scurfy; *branches* sub-secund, the primary ones suffulted by a broad short greenish *bracte*; the secondary *(spikes)* nodding, slender, gradually attenuated to the apex, the lower ones bearing female flowers towards the base, the upper male flowers throughout.

Flowers distichous, white. *Male flowers* either one on either side of the female or in pairs alone, oblong, sub-angular. *Calyx* small, tripartite to the middle; divisions tooth-shaped, erect, fleshy, membranous. *Petals* 3, oblong, coriaceous, boat-shaped, valvate. *Stamina* 6, shorter than the petals; *filaments* stout, subulate; *anthers* linear-oblong, adnate, extrorse attached near the base. *Pollen* lanceolate, 1-plicate, whitish. *Rudiment* of the *Pistillum* simple, conical.

Female flowers shorter and broader than the male. *Calyx* as in the male. *Petals* broadly ovate, obtuse, spreading, valvate. *Rudimentary stamina* 6; those opposite the petals quite abortive and falling off with the petals. *Ovarium* obtusely trigonal, 3-lobed longitudinally, to each lobe 1-cell, with one appense pendulous *ovulum*. *Style* none; *stigmata* 3, papillose, recurved, channelled down the centre.

Fruit spadix with the branches more nodding, and without spathes. *Fruit* surrounded at the base by the perianth, nearly dry, globose, about the size of a small lime, oblique, bi-gibbous at the base (from the 2 abortive cells of the ovarium near which the stigmata will be found,) 1-seeded, with a smooth cartilaginous aspect; *epicarp* rather thick, fleshy cellular; *endocarp* moderate, hardened, rather brittle. *Seed* large, globose; *tegument* cellular coriaceous, brown, adhering to the endocarp. *Albumen* opaque, white, cartilaginous. *Embryo* large, conical, situated about half way between the middle and base of the albumen.*

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* I have since, through the kindness of Dr. Wight, seen the third vol. of M. Kunth's Enumeratio Plantarum, containing Palmae, taken from Martius and Endlicher. From it I extract a part relating to the varieties of Areca Catechu, and the characters of A. Nibung, (which is probably A. tigillaria, Jack, quoted by M. Kunth as a doubtful species, from the description not having been sufficiently attended to) and A. Wallichiana, a species of which I have no knowledge.

"Pro-varietatibus cultura ortis habendae sunt sequentes: *a*) oxycarpa: drupa ovata, acutiuscula; *b*) elliptica: drupa oblonga, utrinque rotundata; *c*) sphaerocarpa: drupa subglobosa; *d*) gonocarpa: drupa angulosa; *e*) ceratocarpa: drupa vertice sublobata et *f*) ocarpa: drupa ovali, albida. Aliae varietates minoris momenti non a forma et magnitudine, sed a compage fructus ejusque carnositate, fragilitate et sic porro dependent." *Mart.*

"A. Nibung *Mart. Palm.* 173, *t.* 150, *et* 153, *f.* 4 *et* 5. Caudice elato, aculeato: petiolo rhachique fusco-squamulosis aculeatisque; pinnis linearibus, acuminatis, interdum apice bifido filiferis, subtus ad costam squamulosis; spadice ramoso, basi aculeato; florum masculorum hexandrorum petalis ovato-cuspidatis; fructibus globosis, stigmate excentrico. *Mart.* Euterpe filamentosa *Blume in ed.* Areca spinosa *Van Hasselt MSS.* Nibung *Javanensium.* In littore australi Insulae Javae. Caudex gracilis, annulatus. Flores masculi ochroleuci. Drupae violaceo-fuscescentes; carne tenui, grumosa. *Albumen* lacteum, corneum, ruminatum. *Embryo* basilaris." (*Mart.*)

"A. Wallichiana, *Mart. Palm.* 178. Inermis; caudice humili; pinnis connexis, inferioribus falcatis, extus repandis et denticulatis, superioribus truncatis et denticulato-praemorsis, inferne in nervis rhachique paleaceo-villosulis; spadicibus simpliciter valde ramosis; calycum masculorum hexandrorum foliolis lato-orbicularibus, quam petala ovata duplo brevioribus; drupsis . . . . . *Mart.*—Insula Pulo-Pinang Archipelagi Indici.—Frondes 4-5-pedalis."

(*To be continued.*)

Geology and Magnetism.

The connexion of Geology with terrestrial Magnetism shewing the general polarity of matter, the meridional structure of the crystalline rocks, their transitions, movements, and dislocations, including the sedimentary rocks, the laws relating to the distribution of metalliferous deposits and other magnetic phenomena, by Evan Hopkins, Civil Engineer and Fellow of the Geological Society, is the title of an octavo work of about 130 closely printed pages and numerous illustrations, which we propose to notice in the following remarks:—

The only thing we regret in the perusal of this work is the levity with which the author seems to treat all previous information, "in which we search in vain for any useful fundamental rules to guide us in subterraneous operations, even in treatises professedly *practical*, much less in those of a more theoretical character." "If we refer to the descriptions of the primary rocks, we find them so imperfect, and so inapplicable," says Mr. Hopkins, "to their general structure, and mixed so much with hypothetical ideas, that those who derive their knowledge from books, must imagine these rocks to be confused masses void of all order." Now it is generally known to every one that primary rocks are stratified and many of them crystalline, and therefore that more or less of order and harmony must belong to them, particularly in the great scale. It is allowed, however, that the study of the primary rocks is a subject of very great difficulty, from the manner in which their masses have become deranged and altered in almost every conceivable situation in which they have been examined. The observations contained in the present work, may assist in removing some of the difficulties with which the examination of the primitive rocks is beset, but until the magnetic theory is more advanced in its application to this subject, we cannot allow it to be more practical or useful than 'Fossil Geology,' a knowledge of which Mr. Hopkins supposes to be of little consequence in mining operations, with regard to Fossil Geology, and its practical applications to mining operations. A good deal will, however, depend on the object of those operations, whether they are directed for the recovery of earthy, or of metallic minerals. Fossil Geology would be of little use in directing the search for the precious metals, which are generally found either in recent alluvium or in the unstratified rocks in which no fossils occur. With regard to coal, the case is very different, and in estimating the value of indications of this mineral, we have no other rule to guide us than fossil geology, and if this be not always successful, the fault is attributable rather to its being imperfectly employed than to its being too much trusted to, and it has the advantage over magnetic and economic geologies, in as much as it is not to be counterfeited.

After describing the Mariner's compass, its use and importance, Mr. Hopkins remarks, that there is no substance, but which under suitable circumstances, is capable of exhibiting signs of magnetic virtue. The crystalline rocks forming the solid surface of the globe are more or less magnetic, and cause great variations in the magnetic needle, which is never free from such influence. *Loadstone*, a rock impregnated with oxide of iron itself forms a magnet, and all primary crystalline rocks containing iron and manganese, will, with due accuracy, point north and south like steel needles, *i. e.* in the exact direction in which they are found in *situ*, when fresh cut from the place in which they were formed. Even the atmosphere is affected by the same influence, as when the aurora borealis makes its appearance. The disturbance of the magnetical equilibrium of the atmosphere occasions what Humboldt terms magnetical storms, commonly observed it is said, before and during earthquakes in equatorial America.

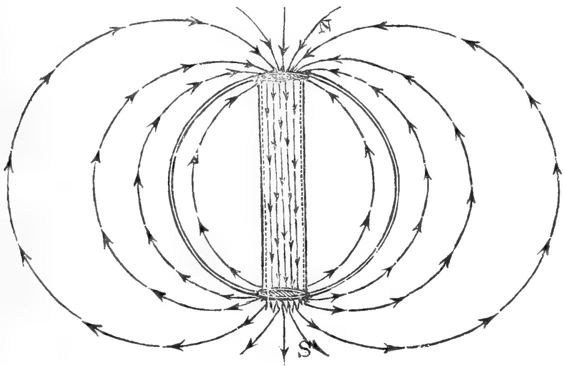
The general direction of magnetic curves and meridians converge at the poles of the earth, preserving notwithstanding their deflections and undulations from various local causes, a remarkable degree of regularity.

" Numerous fruitless investigations have been made with the view of ascertaining the position of the magnetic pole, as if that must be a *mathematical point.*

Any person who has had some experience with the action of fluids, whether water, air, or electric, converging towards or diverging from a central passage, must know that they cannot be forced into a *mathematical point,* there must be a limit to their compression or density ; nor can it be expected that every individual current should retain its exact radial course towards the focus, and much less when diverging from it. Hence, from analogy and observations, the narrowest limits that we can assign to the polar axis to which the magnetic currents converge and diverge are, perhaps, the areas bounded by the arctic and antarctic circles.

Numerous observations have been made in the equatorial regions, indicating both east and west variations in the *same meridian* of only a few leagues in extent ; and numerous other experiments and observations may be quoted to prove that the direction of the needle does not necessarily point towards the centre of convergence of the individual current which moves it, but in the direction of the resultant, viz. the compound of the primary and local currents—the diagonal of the parallelogram of the two actions. The local disturbing force being a variable quantity subject to perpetual fluctuations, it follows as a consequence that the *variations* of the direction must be uncertain, and therefore not within the power of any formulæ to know their periodical amount.

In the above, our observations have been principally confined to the magnetic needle ; but as it is proved that all matter is more or less affected by the magnetic fluid or current, and since we cannot withhold our conviction, after tracing the curves which the needles form within, on, and above the earth, that the globe is a magnet, *i. e.* that its axis is magnetic ; and according to the law of magnetism founded by direct experiment, the *North* end is the attractive and the *South* end is the repulsive, or in plainer language, that the magnetic fluid or currents move towards the north, enter into the axis, through which they pass, then issue out from the south pole and encircle the globe to complete their circuit (as indicated by the direction of the needles, and illustrated by the arrows in the following sketch);—we ought to be able to trace their effects on all substances within the limits of our observations.



If the earth be a magnet, as we have endeavoured to prove, it must produce the effects observed; if it be not a magnet, it possesses a property identical in its results to one; therefore all we require in our investigations is the knowledge of the law of these actions, as the *name* of the primary cause of the action cannot have a material influence on our researches. If we continue to call it *gravitation*, we must add to it a property which was not applied to it before, viz. polarity,—call it *magnetism*, and the term embraces all we require in astronomy as well as in geology.

Let us suppose a bar, having been made magnetic, to be placed in the axis of an artificial globe, if iron filings be strewed carefully over it, the filings would become magnetic, and arrange themselves in curves like the magnetic needles on our globe, as shown in Plate I.* The small magnetic ingredients do not converge to one mathematical point at each end of the bar, but to a space equal to the transverse section of the axis; and if this effect is produced by a current of subtile fluid, which may be conceived to emanate from one pole and to enter in at the other, penetrating

* As above.—Ed.

the substance of the bar, and again to issue from its former outlet, as exhibited by the arrows in the above diagram, it is reasonable to suppose that the fluid will not be compressed more than the transverse size of the bar will require. Taking this simple principle of action as a guide, with its various consequnces under different circumstances, we shall soon perceive that we not only account for the various phenomena of geology, but, in a word, *all* phenomena connected with terrestrial physics; and that we are enabled also to reason from the known to the unknown, and actually to predict facts before trial, not merely to satisfy curiosity, but questions of practical utility, especially in mining. Indeed, theories are not worthy of attention unless they can be fairly demonstrated and rendered practically useful."

The phenomena of terrestrial magnetism is then exemplified by Mr. Hopkins, by supposing an iron bar magnet to be placed in a wooden globe, the poles of the magnet corresponding with those of the earth.

"In placing needles round this globe, we find them arranging themselves in the exact order which they keep on the terrestrial globe, both as to dip and direction; and as there is nothing to disturb them on the wooden globe, their positions in the curves of convergence are uniform; their focus of convergence being equal to the transverse area of the magnetic axis at both ends.

We find in measuring the force along the magnetic curves, that it varies inversely as the distance; allowing for the influence of the earth's magnetism and tracing the effects in a horizontal plane, we obtain the following law, viz. *that the force varies inversely as the square of the distance from the surface of the ball in the equatorial plane, and also in the meridian from the poles towards the equator;* being the necessary consequences of the expansion and compression of the magnetic fluid surrounding it, as shown in the sketches. This is precisely the law of what is called gravitation, but the meridional variation towards the poles of the earth has been ascribed to the effect of a centrifugal force produced by the earth's rotation. The assumed centrifugal effect of the earth's rotation is also considered as the cause of the earth being an oblate spheroid. In the first place, a globe constituted and placed under similar conditions as our earth is, with its enveloping fluids, placed under the influence of centripetal and centrifugal forces *alone*, according to the well-known laws of physics, would not, nor could not, produce the observed figure, much less the observed variation of attraction towards the poles. Its magnetism alone, without rotation, must necessarily compress the poles, and also cause the inverse law of intensity in the enveloping fluids."

Passing over the proof Mr. Hopkins affords of magnetism alone being sufficient to account for the oblate spheroidal figure of the earth, and of its universal agency, we arrive at the following evidence of the polarity of the atmosphere.

"If the globe be a magnet, we ought to observe at the poles some indications of the convergence of the air towards the poles, *i. e.* something similar to the inverted conical appearances which we observe in the ingredients at the poles of an artificial magnet, Plate I. It is true that the air is an invisible substance, yet, as it occasionally becomes saturated with visible fluids, it would, under such condition, with the advantage of reflected light, which may also be expected to vary according to the curves formed by the currents, show the phenomena of convergences. This fact we have in the aurora borealis and australis. These are the luminous appearances seen in the atmosphere connected with the poles of our earth, the general appearances of which correspond to the curves of convergence towards the poles. When these luminous phenomena display unusual brightness and activity, the magnetic needle is also found very fluctuating, both in dip and direction; and also the mercury in the barometer is subject to similar action; this coincidence of the variable movements indicates that they are produced by the same cause, viz. the disturbance of the equilibrium of the magnetic curves, or tension of the fluid.

The aurora is not the *cause* of the needle being disturbed, nor are its luminous rays required to produce a rise or fall of the mercury in the barometer; on the contrary, the whole phenomena appear to be the *effects* of the oscillating movements of the magnetic currents.

The mercury in the barometer, like the magnetic needle, fluctuates without being accompanied with a visible aurora. Probably the light is produced by a change in the constituent elements; but the light is not essential to prove the existence of the currents; nor is visibility necessary to produce undulations in such currents: such variations can only be ascertained by their effects.

That the barometer is subject to perpetual oscillation is a phenomenon so well known as not to require comment; but that the magnetic needle should be also subject to similar oscillations appears to those who have not paid attention to the subject somewhat strange. However, the fact is, that the former is the effect of the rise and fall, and the latter the horizontal movement of the same fluid; the former is governed by the curves of equal density, the latter by the meridional direction of the currents.

That there is a daily oscillation of the needle has been placed beyond a doubt by observations made with the most accurate instruments in almost every part of the world: the mean daily change amounts to about ten minutes. When the diurnal variation of the needle was first discovered, it was supposed to have only two changes in its movements during the day. About 7 A.M. its north end began to deviate to the west, and about 2 P.M. it reached its maximum westerly deviation. It then returned to the eastward to its first position, and remained stationary till it again resumed its westerly course in the following morning.

When magnetic observations became more accurate, it was found that the diurnal movement of the needle commences much earlier than 7 A.M.; but its motion is to the east. At half-past 7 A.M. in England it reaches its greatest easterly deviation, and then begins its movement to the west till 2 P.M. It then returns to the eastward till the evening, when it has again a slight westerly motion; and in the course of the night, or early in the morning, it reaches the point from which it set out twenty-four hours before*.

Within the tropics the variations in the height of the mercury in the barometer are very uniform, subsiding about half an inch

* See Brewster's Treatise on Magnetism.

during the day, and rising again to its former height in the night. In the northern regions, such as Denmark, Iceland and Greenland, the diurnal variations, are greater and less regular, in the height of the mercury as well as the direction and dip of the needle; but in advancing from the north to the equator the diurnal variations diminish. In the southern hemisphere the daily variation of the needle is in an opposite direction, the north end of the needle moving to the east at the same hours that it does to the west in the northern hemisphere.

To give an occular illustration, we may conceive the magnetic current as a string from pole to pole: if the string be drawn from its meridional position at the equator, its relative direction or the angle formed between it and the meridian will be the same; but if we compare the direction on each side by looking towards the north alone, we shall observe that the bend of the string will be—say north-west in the southern hemisphere and north-east in the northern. That such should be the natural consequences of such disturbances is too evident to require further explanation.

Besides these regular changes to which the needle and the mercury in the barometer are subject, they are often affected with sudden and extraordinary movements, to which Baron Humboldt has given the name of *magnetic hurricanes,* during which the needle often oscillates several degrees on each side of its mean position. The vibrating action of the needle during the appearance of the aurora is well known. It is also known that the luminous beams of the aurora are more or less parallel, or rather corresponding to the convergence of the dipping-needle; that the rainbow-like arches are seen on either side of the meridian; and that the beams perpendicular to the horizon are only those on the meridian. It has been found that on the days when the southern auroræ take place, the same phenomenon is observed also in the north: the one appears to be the cause of the other, and is therefore simultaneously produced, similar to the electric sparks seen at the poles of an artificial globe.

Although the aurora lights are generally accompanied with oscillations of the magnetic currents, it is not necessary that they should always be so affected, because the light may arise from a change in the density or property of the currents, and not from any changes in their directions. That there is magnetic matter in the atmosphere is indubitable, and that this matter is constantly acted upon by the currents cannot be doubted. However, it must not be expected that the variations are alike at all places, because the disturbances in the equilibrium of the magnetic currents are influenced by various causes of a local nature. Resembling the weather in this respect, these variations may differ at different places at the same instant of time.

The next point to be considered is the direction in which the magnetic currents move. If the currents, as we have previously stated, emanate from the south pole of the earth and enter into the north pole, we should expect somewhat different appearances in the south aurora compared with the north; because from the former they rise from an aqueous element, which must produce a visible portion of vapour; and if so, the aurora will have the appearance of steam; whereas in the latter, as the currents descend from an aerial element, and are exposed to the effects of the sun, they must be drier. This difference has been observed by several navigators.

The southern aurora consists of long columns of clear white light, shooting up from the horizon, and gradually spreading over the whole sky. These columns are bent sideways at their upper extremities, and are in every respect similar to the northern lights, except in being always of *a whitish colour*, whereas the northern lights assume various tints, especially those of fiery and purple hue. The figure is identical—indeed exactly such as would be produced by the convergence, or *vice versâ,* of the magnetic currents: and the difference in the colours is precisely what we should have been led to expect from the different nature of each pole. The saturated or hydrogenous nature of the currents coming from the south pole towards the north, will account for the observed peculiarity of the southern hemisphere in its general temperature, moisture, rains, the growth of vegetation, &c., as compared with that of the northern.

The great ocean of air which envelopes the planet we inhabit, and to which we are every instant beholden for supplying us with the elements of vitality, is governed by the magnetic currents. Whatever substances may be decomposed and converted into gases and rise in the atmosphere, are again returned into the earth by means of the currents. Nothing can be destroyed; on the contrary whatever substances we may consume, reduce, or decompose, become again, by means of the enveloping magnetic fluid, what they were before they existed in form of vegetable, stone or water, active agents in the business of the world, and main supports of vegetable and animal life, and are still susceptible of running again and again the same round, as circumstances may determine."

Mr. Hopkins next explains the identity of magnetic and galvanic currents, rejecting the commonly received opinion that they move at right angles, which is at variance with the analogy of all other physical forces, which act in a line extended between two points, the point from which the force emanates and that against which it is exerted. When a magnet is exposed to electrical action by means of two conducting wires bent into helices, a spiral current is produced. This Mr. Hopkins refers to a general law of all fluids, which when forced through tubes, have a tendency to a spiral direction, as commonly observed in a funnel. The funnel however, we think an unfortunate instance, for we are disposed to refer the spirial direction of the fluid passing through it a good deal to its shape, and we doubt much if fluids forced through square tubes, would indicate any tendency to a spiral direction. We do not know how far Mr. Hopkins' views may depend upon such a law. With regard to electro-magnetic action, Mr. Hopkins remarks, the mean direction of the spiral corresponds with the direction of the wire: "therefore we may safely consider the magnetic needle, enveloped as it is in the great terrestrial magnetic fluid, indicates the direction of the currents."

" We have now to prove that the currents move through the magnetic needle from south to north. In the battery we find that the currents of hydrogen move from the zinc to the silver plate, along or through the connecting wire. We find by experiments that the south pole of a magnet has a greater affinity for oxygen than the north pole. The difference in the oxidation of the south pole, compared with the north, is easily proved by various simple methods. All that is required is to place the ends of a magnet in water, and allow it to remain undisturbed for several days, and the fact is soon proved. A very powerful horse-shoe magnet will decompose water, and the oxidation will be observed to go on at the south pole, and the evolution of the hydrogen at the north pole: hence it is manifest that the currents move from the south pole to the north of the needle: the magnet possesses the property of *filtering*, as it were, *the oxygen from the stream,* be that stream what it may, such is the effect and such the direction of the current."

Mr. Hopkins next refers to the reduction of metals by electro-galvanic currents, by which he accounts for some phenomena of metalliferous veins. Where metals are found in the metallic state, it has been usual to ascribe their presence under such circumstances to the action of heat, although we frequently find them, particularly copper and silver, the ores of which resist a very high temperature in a native state, deposited on timber and decayed leaves in old mines, proving the ordinary process of fusion to be incapable of accounting for their reduction. Besides, it is found impossible for castings to take the exact impression of the mould, owing to the great heat required to give metals, even the most fusible, a perfectly homogeneous consistence, as well from the lodgment of air as other causes. In veins, however, we find the native metals deposited in every crevice, presenting an exact form of the mould, whether this consists of solid quartz rock or soft clay, or substances more fusible than the metal itself.

We must therefore look for some other agency than that of fire for such effects. Electro-magnetic currents are adduced by Mr. Hopkins, and he reconciles many of the conditions in which metals occur in veins, with effects produced on metallic solutions by the galvanic battery.

" In order to ascertain experimentally what are the circumstances which tend to produce these conditions, we have only to procure a galvanic battery and connect it with two platinum poles, which we place in a vessel to serve as the precipitating trough.* In this trough we place a saturated solution of a metallic salt—for instance, copper—when on examination, if the battery possess but feeble power, we shall find that crystalline copper will be deposited ; if, however, we dilute this solution with twice, thrice, or four times its bulk of water, the metallic deposit will assume a very different aspect : it will then be aggregated in a flexible state, or a reguline deposit. If we now dilute this same solution to an infinitely greater extent, the metal will still be reduced, but in the form of a very fine black powder.

" Almost all metallic solutions may be substituted for that of the sulphate of copper, and the experiment will show nearly the same result, namely, that the strength of the metallic solution influences the nature of the deposit.

" If we examine the converse of the experiment, and take a solution of sulphate of copper, and use successively, first, one very small battery, then two or three batteries arranged in a series, and lastly, a very intense battery, we shall find that with this self-same solution we can obtain by these means, first, a crystalline, then a reguline, and subsequently a black deposit.

" The above variable state in which minerals are deposited by the battery is of very common occurrence in mineral veins ; and even the same vein presents large and small crystals, and often of variable composition, within a very small compass."

Mr. Hopkins concludes this portion of the subject by the following remark, and allusion to the result obtained by Mr. Fox, in his experiments in the mines of Cornwall :—

" Comparing these facts with those observed in metalliferous deposits, we find a very striking coincidence ; and when we apply similar laws and orders of deposition to mineral veins, the problem

* See Smee's excellent work on this subject, second edition, p. 113.

of their formation is easily solved without having recourse to the igneous theory.

Mr. Fox has obtained an electro-type copper plate by the agency of these subterranean currents. He found their natural direction to be from south to north in Pennance mine. After a few days crystals were formed in the negative plate, but two months had nearly elapsed before the apparatus was removed from the circuit."

Mr. Hopkins next enters into a consideration of the heat produced by magnetic and galvanic currents, which he thinks sufficiently powerful to account for all the phenomena, usually but erroneously ascribed to the action of fire in terrestrial physics. Mr. Hopkins objects to the igneous theory, that if the increased heat experienced in deep mines proceeded from an incandescent nucleus, as some profound geologists supposed, it would be found uniform and constant in proportion to the depth we descend from the surface. On the contrary Mr. Hopkins states, that in South America, where a great many experiments have been made, the variations in the degree of temperature were irregular, and confined to particular patches; and in some instances the temperature was even found lower at great depth than at the surface. On the other hand, parts of rocks were sometimes found intensely hot in deep mines at one time, and at another of very low temperature, conditions which though incompatible with the igneous theories of the earth, are strictly conformable with the chemical actions which are going on in rocks.

Mr. Hopkins here explains the heating phenomena displayed by metallic solutions in a galvanic battery. The heat developed, and the power of fusion exercised over the most refractory substances, such as platinum, palladium, gold, copper, iron and steel, is in proportion to the amount of the electro-magnetic currents, or in other words, to the power of the battery.

"Conducting liquids may be heated in a similar manner. This fact may be seen in a great variety of ways: dilute sulphuric acid may be made to boil in a siphon connecting two vessels, in which the poles of an extensive series of batteries are placed. Another mode of showing the same fact is to take a piece of string and moisten it with acid, connecting the extremities with the poles of a series of galvanic batteries, when it will begin to smoke, and become charred from the heat produced.

"The next property which a battery displays is its power of igniting metallic or charcoal points when joined to the two ends of the battery, and held so that they barely touch; a light is then exhibited equal in brilliancy to that of a little sun. The spark seems to depend principally upon a combustion of fine particles of metal, and, when charcoal or hard gas coke is used, upon little points of it flying from one pole to the other; so that one pole wastes away and the other increases, till the flame becomes quite encased in a mass of carbonaceous matter. This flame is singularly repelled or attracted by a magnet held in its vicinity. Heat is, indeed, one of the effects of chemical action; and though we might by a fallacious reasoning be led to assert that chemical action is the effect of heat, a very slight examination will show the absolute futility of such reasoning. In fact, we have no heat of which the cause is known, but that which is derived from, and proportionate to chemical action."

Mr. Hopkins applies this to terrestrial phenomena further on, and remarks.

"If we admit the existence of subterranean currents, and that these exert a slow decomposing power, like that of the voltaic battery, we have a sufficient power for our purpose. In the first place, we have a mechanical tension on the consolidated parts of the rocks, by the linear action of the currents passing through them; and should the intensity of the currents be very great, fractures would ensue, more or less at right angles to the direction of the force. These fractures would admit air and water, and thus produce intense heat, by the avidity with which the metallic nature of the bases of the earths and alkalies combines with the oxygen.

"That nearly all the substances which constitute the crust of the globe are found *in solution* as well as solid, saturated throughout the rocks, and to such a degree sometimes as to issue out and form springs, is well known; therefore, judging from the violent effects on a small scale which we are able to produce by experiments, a heat would be engendered quite adequate to occasion all that takes place in volcanic eruptions. It is a fact, that nearly all active volcanic groups are within a short distance of the sea; and even those that are situated at a distance from it may be connected with subterraneous channels of water. It is also a well-known fact in South America that fish are commonly thrown out of the crater, and some of the eruptions consist entirely of mud or muddy water, thus giving a still greater proof of their origin. The sudden fracture, as well as the sudden expansion of the gases, would produce a vibratory jar, which being propagated in undulations through the rocks or external crust, would give rise to superficial oscillations, and thus cause earthquakes.

"We shall note here a singular fact connected with the earthquakes of South America, viz. during nine years' observations made by the writer, the oscillations were from *east to west*, whilst the directions of their disturbances, and the rumbling noise which generally accompanies them, were from *south to north*. The former were generally confined to comparatively narrow limits, whilst the latter extended often from Chili to central America.

"This meridional action of the subterranean currents from south to north is not confined to South America, but extends to the northern hemisphere. And it appears from numerous observations made on the magnetic currents, that the power which governs earthquakes and magnetic currents is the same. The mean direction of the latter in South America corresponds to the average direction of the subterranean disturbances."

We do not see that we can well curtail the following remarks which constitute the 5th chapter of Mr. Hopkins' work, which we give entire.

"From a consideration of the general facts that have been stated with respect to the effects of the galvanic current and its identity with magnetism, it will be sufficiently evident that the earth acts upon magnetized bodies in the same way as if it were itself a magnetic battery; or rather, as if it contained within itself a powerful magnet or battery lying in a position coinciding with its axis of rotation.

"In order to make the above to agree with the facts as indicated by the needle and other bodies possessing the property of polarity, we must assume that the north pole of the earth is the positive one, as the currents are moving towards it, therefore the pole of decomposition, and the south the negative pole, *i. e.* the pole of recomposition. Provided these poles be connected by a conducting fluid an action would ensue; and in consequence of the oxidation going on at the north pole there would be a tendency in the conducting element to move towards it.

"The ocean may be considered as the conducting element, its compostion being peculiarly applicable for the purpose. The most general component parts of the sea, in addition to pure water, are muriatic acid, sulphuric acid, fixed mineral alkali, magnesia, sulphate of lime, and various other substances. We also know that the ocean reaches from pole to pole.

"On reference to the observations made on the general currents of the ocean, we find the following:—

"The principal currents of the Pacific, Atlantic and Indian oceans proceed from the south pole in a north-westerly direction towards the north. These currents are subject to numerous modifications, in consequence of the obstacles presented by the land to its free passage. The eastern coast of South America, and the western coast of Africa form the boundary to the Atlantic ocean, and the general movement of the ocean between the above is in a north-west direction, until it enters amongst the West India Islands and the Gulf of Mexico; from which point it turns towards the north and north-east near Newfoundland. In the Pacific ocean there is a similar northward current.

"Another interesting question connected with these general northward currents is the fact, that within the Polar region the fruit of trees which belong to the American torrid zone is every year deposited on the western coasts of Ireland and Norway; and on the shores of the Hebrides are collected seeds of several plants the growth of Jamaica, Cuba, and the neighbouring continent. The most striking circumstance, perhaps, is that of the wreck of an English vessel, burnt near Jamaica, having been found on the coast of Scotland. From the account of Captain Parry, it appears that there is also a great quantity of timber cast by the sea upon the northern coast of Spitzbergen. Timber is found floating in large quantities in the north polar seas, and much of which is thrown ashore on the northern side of Iceland; some of which appear to be of the growth of Mexico and Brazil. This question has engaged a good deal of attention, and has been considered difficult to explain; but by admitting the general northward tendency of the ocean the question is easily solved.

"Ice is fallen in with much sooner in sailing towards the south than it is in approaching the north pole. The dry lands or the large continents are more or less pointed towards the south, whereas the northern parts are more or less ragged and crowded about the northern pole; in a word, all observed facts tend to prove that the ocean moves from the south pole towards the north. (Plate V.)

"If, then, such an action is actually going on in the great terrestrial battery, its effects will not be confined to that of the ocean, but will also produce corresponding effects on the solid and semi-fluid part of the earth. Such an effect is apparent in the meridional lamination of the crystalline rocks, as shown in Plates IV. and V.

"In South America we find the whole region laminated in a north and south direction, subject of course to great contortions from various local disturbances. This lamination forms those kind of rocks known by the name of gneiss and schistose, being in fact a modification of the granitic base, produced by the polar laminating action, and not, as it is erroneously considered, the result of a mechanical sedimentary action. The planes of these meridional laminations are generally more or less vertical, and are often seen cutting through sedimentary beds at right angles to the seams of deposition, and thus showing their independent and subsequent origin. Nor is this meridional structure confined to South America, but extends to the north, subject of course to great bends from numerous mechanical resistances.

It may be considered strange that such an universal structure has escaped attention, and that it has not ere this been discovered. The isolated facts have been long known, but not properly used, and the laminated structure has been, and continues to be, confounded with those planes resulting from mechanical deposition. As we have already noted, the granitic gneiss and the schistose, which are commonly represented in geological sections as sedimentary beds resting on one another, are the result of a crystalline action modifying the granitic mass in the direction of the lamination, which structure is generally formed in a more or less vertical position as commonly seen when not disturbed.

"Since the year 1792," says Humboldt in his treatise on Rocks, "I have been attentive to the parallelism of beds. Residing on mountains of stratified rocks, where this phenomenon is constant, examining the direction and dip of primitive and transition beds, from the coast of Genoa across the chain of the Bochetta, the plains of Lombardy, the Alps of St. Gothard, the table-land of Suabia, the mountains of Baireuth, and the plains of Northern Germany, I have been struck, if not with the constancy, at least with the extreme frequency of the directions from south-west to north-east. This inquiry, which I thought would lead naturalists to the discovery of a great law of nature, at that time interested me so much, that it became one of the principal reasons for my voyage to the equator. When I arrived on the coast of Venezuela and passed over the lofty littoral chain and the mountains of granite-gneiss that stretch from the Lower Oronoco to the basin of the Rio Negro and the Amazon, I recognized again the most surprising parallelism in the direction of the beds; that direction was still north-east."

Unfortunately, in consequence of Werner's theory, Humboldt wrote the above under the impression that the gneiss and schistose rocks were similar to sedimentary beds; hence he confounds the lamination of the former with the divisional planes of the latter.

"When we examine," says M. Boué, "with a compass the position of mineral masses in Scotland, and endeavour to stop at general facts, we perceive that the direction of the beds is *constant*, and corresponds with that of the chains from south-west to north-east, but that the dip varies according to local circumstances."

According to Von Buch and other continental geologists, the directions of the lamination of the crystalline rocks in Sweden and Finland are from south to north, varying occasionlly towards the east. In Mexico the laminated structure is principally towards the north-west; but in the plains it is frequently found due north and north-east. In the United States its general direction is similar to that of South America, *i.e.* from south to north, but presenting numerous contortions, and thus causing local variations in the direction, either towards the east or west, according to the nature of the local resistance.

"The direction of primitive and transition beds" (gneiss and schist), says Humboldt, "is not a trifling phenomenon of the locality, but, on the contrary, a phenomenon independent of the direction of secondary chains, their branchings, and the sinuosity of their valleys; a phenomenon of which the cause has acted, at immense distances, in a uniform manner, for instance in the ancient continent, between the 43° and 57° of latitude, from Scotland as far as the confines of Asia."

Hence it will be observed that the universality of this structure has not escaped attention.

Dr. M'Culloch, in his description of the Western Islands of Scotland, remarks on the striking uniformity of the beds of gneiss and schist being more or less in a north-east direction. In cutting any of these beds, as they are called, in an east and west direction, *i. e.* from the eastern to the western coast of Scotland, the lamina would be intersected transversely, and on examination the planes would be found more or less vertical, sometimes leaning to the east and sometimes to the west : any east and west section of considerable length would be found the same. It must be understood, however, that the above remark is confined to the average, because numerous bends and contortions of very considerable extent are frequent in this fundamental structure, and are susceptible of constant changes from the effects of chemical action going on in it.

On the eastern coast, between Waterford and Dublin, the more ancient lamination presents a mean average direction towards the north-east, but is also intersected at various points by a comparatively recent lamination in a north-west direction. It is at these intersections of the old and new lamina, that the metalliferous deposits of Ireland are principally found. In the Barony of Bantry the old laminated structure is much contorted and dislocated.

In North Wales and the northern part of England similar oblique intersections of the old and new lamina are observed. The most recent lamination of Cornwall is nearly in the direction of the magnetic needle, and corresponding to that of Wicklow.

The above observations are not founded merely on a superficial survey of these districts, but on a laborious investigation under ground, as well as on the surface. Indeed, without studying the structure of rocks *beneath the surface*, where chemical actions are observed in operation, and various crystals constantly forming, it is not possible to arrive at any thing like a correct knowledge of the law which governs the superficies of our globe.

In Auvergne the laminæ of the gneiss and schist run nearly in a direction from south to north, and dip to the west, that is, when viewed on a great scale, for when examined more partially the ordinary exceptions occur. In short, the continent of Europe exhibits the uniformity of structure throughout.

In the United States of America we find the same meridional structure. In Virginia the gneiss, talcose and chlorite slates run north and south, leaning from the perpendicular towards the west. The Boston railway exhibits, by its numerous cuttings in an east and west direction, the general verticality and meridional structure of the schistose rocks for several miles in length.

Along the north coast of South America, in the Caribbean Sea and the West India Islands, the same structure prevails; and was minutely examined by the author, from east to west across the three great branches of the Cordilleras, between the latitudes of 4 and 6 degrees north.

In an admirable essay published on this subject by Professor Sedgwick, we find the following observations :—

" In that variety of slate which is used for roofing, the structure of the rock has been so modified, that the traces of its original deposition are quite obliterated; and this remark does not apply merely to single quarries, but sometimes to whole mountains. In the Welsh slate-rocks we see the cleavage planes preserving an almost geometrical parallelism, while they pass through contorted strata of hard slate, obviously of sedimentary origin. Crystalline forces have re-arranged whole mountain masses of them, producing a beautiful crystalline cleavage, passing alike through all the strata. And again, through all this region, whatever be the contortions of the rocks, the planes of cleavage pass on, generally without deviation, running in parallel lines from one end to the other, and inclining at a great angle to the west. Without considering the crystalline flakes along the planes of cleavage, which prove that crystalline action has modified the whole mass, we may affirm that no retreat of parts, no contraction in dimensions, in passing to a solid state, can explain such phenomena as these. They appear to me only resolvable on the supposition that crystalline or *polar forces* acted on the whole mass in given directions and with adequate power."

In the Geological Report of Cornwall and Devon, Sir H. de la Beche remarks:—

"When we regard the prevalence of the great divisional planes in particular directions crossed by other nearly at right angles to them, producing solids to a certain extent symmetrical, and consider the mineral modifications which the sedimentary beds have generally undergone since they were deposited, we are led to suspect not only that the lamination planes, commonly termed cleavage, are, as has been supposed by some authors, due to *polar forces*, but also that the great divisional planes have been equally caused by them, as has been considered probable by others." "Although the direction of the present magnetic meridian in the district may be merely temporary, and the proximation of so many great divisional planes to it therefore accidental, still their great prevalence, both in the igneous (crystalline) rocks and sedimentary deposits, in that direction, leads us to suppose that *polar forces* may have considerably governed the arangements of the component matter of the rocks they traverse during consolidation. If we require a constant tendency of such *polar forces* to arrange the component matter of rocks during consolidation in given areas, we can the more readily account for the frequency of nearly similar directions in the great divisional planes of rocks of different ages."

These observations are quoted here merely to show the striking coincidence of independent investigations with which the writer was totally unacquainted during his researches in America; but they clearly prove the universality of the *polar lamination.*

During the recent examination of the metalliferous deposits and primary rocks of England and Ireland, we found the old lamination of the United Kingdom, on an average, a few degrees east of north, and the new lamination intersecting it obliquely, in a direction approaching the present magnetic meridian. (See Plate IX.) The same kind of polar structure has been observed in coal beds in all countries.

The meridional lamination has been observed from Morocco, in the north of Africa, to the most northern parts of Europe; therefore the crystalline crust of the earth does not consist of confused shapeless masses, resulting from igneous eruptions, but possesses a structure and arrangement of parts as regular and uniform as any other natural production. It has but one general grain, by which any of the masses will split, and that is from pole to pole, as represented in Plates IV. and V. This meridional grain is produced by the arrangement of the crystals in the granitic base, causing more or less vertical sheets or plates of mica, talc, chlorite, &c., the influence of which, together with the constant circulation of the polar currents in the direction of the planes, extends to the sedimentary beds, and thus the whole of the surface becomes uniformly cleaved."

Passing over certain preliminary remarks and criticisms on the prevailing theories of the earth in the sixth chapter entitled 'general character of the crystalline rocks, called primary,' Mr. Hopkins offers his own view of the case, which may be termed, a magnetic theory of the earth.

"We shall consider the ocean as the primary menstruum from pole to pole,—a compound of the elements in solution through which the magnetic currents circulate. From analogy and by experiment, crystallization would commence at the negative pole, and would continue to form until its growth would extend to the positive pole in meridional lines, thus producing the polar grain or lamination explained in the previous chapter. In the primary rocks we recognise in every crystal the action of the constant and undeviating laws of the polar force and chemical affinity, giving to the mass a regular grain, and to every crystal a definite form and composition. Hence the above may be considered an experimental and natural truth.

The elementary substances entering into the composition of the primary rocks, may on an average be considered the following :—

Silica,	Iron,
Aluminum,	Manganese,
Magnesia,	Fluoric acid,
Potash,	Carbonic acid,
Soda,	Water.
Lime,	

These are united with variable proportions of the gases, hydrogen, oxygen, chlorine, &c. The compound consists of the above in a state of fluids, semifluids and solids, being an aggregation of the separate elements in different states of crystallization.

Silica forms	Quartz.
Silica, alumina, lime and potash, ...	Felspar.
Silica, alumina, potash and iron, ...	Mica.
Silica, magnesia and potash, ...	Talc.
Silica, alumina, magnesia and iron, ...	Chlorite.
Silica, alumina, magnesia, lime and iron, ..	Hornblende.
Silica, alumina, magnesia, potash and iron, ...	Schorl.
Lime and carbonic acid, ...	Carbonate of lime.

Besides the above compound ingredients, there are also disseminated in the primary mass all the known mineral substances; these may likewise be compounds, of which hydrogen forms a part.

Granite may be considered as the fundamental crystalline base, a compound of the above ingredients in variable proportions. Numerous appellations have been from time to time suggested for the different kinds of granites, but it is very evident that such distinctions cannot be established, inasmuch as the variety of crystals constituting the granitic masses are very irregularly disseminated, and possess no distinct lines of demarcation. However, in order to have some idea of their variable character, the following may be enumerated as very common compounds in Europe and America :—

Micaceous granite, ...	Mica predominating.
Chloritic ,, ...	Chlorite ,,
Talcose ,, ...	Talc ,,
Hornblendic ,, ...	Hornblende ,,
Quartzose ,, ...	Quartz ,,
Felspathic ,, ...	Felspar ,,
Porphyritic ,, ...	Felspar in excess with crystals of Felspar in a base.

Felspar in general constitutes by far the largest part of granite: it is often in a soft and fluid state, and in small and large grains.

The following varieties of granitic rocks are often associated in the same mountain mass, and may be regarded as contemporaneously formed, accidentally modified by an admixture of different ingredients :—

Common granite; the felspar white or red, composed of quartz, felspar and mica.

Chloritic granite; quartz, felspar and chlorite.

Felspathic granite; in which felspar is the principal ingredient, and the quartz, and particularly the mica, very rare, with large crystals of felspar.

In these masses are veins of the predominating substances of the enclosing rocks.

The granite being the fundamental base, or the crystalline shell of the globe, its thickness is not known. It has a polar structure, and when the quantity of mica is considerable, granite divides into parallel plates, or in other words becomes laminated, and exhibits the meridionally structure explained above.

Gneiss is the laminated part of the granitic base, the same identical mass; the distinction being produced by the ingredients tending to arrange themselves in parallel plates; quartz follows quartz, felspar follows felspar, and mica follows mica. (See Plate VI.)

As this crystalline arrangement and lamination of the fundamental base is produced by the continual circulating action of the magnetic currents through the semifluid mass, the transition of the crystalline aggregation to the laminated structure is necessarily insensible; the action being like a simultaneous growth of the granite northward. Hence a micaceous granite produces micaceous gneiss, chloritic granite chloritic gneiss, &c.

Schist, or Crystalline Slate.—This variety forms the termination of the granitic base, the branches and leaves, as it were, of the great granitic trunks. The mica granite passes first into gneiss, and the latter into mica schist by an almost imperceptible gradation. This rock has been represented as stratified by a mistake in confounding the stratified with the laminated structure. (See Plate XVI.) It is the final decomposition of the felspar that distinguishes slate or schist from gneiss. (Plate VI.)*

It will therefore be observed that the primary crystalline, from the granite to the schist, belongs to one formation, and is essentially composed of the same minerals, variously modified by the polar force, and passes by insensible gradation from the base to the final slaty structure in a more or less vertical and meridional direction; but subject to constant changes and disturbances from local causes.

These rocks are very extensively developed in South America, and may be traced from Chili to the Caribbean Sea. A section was taken across the three Cordilleras, where the rocks were seen cut by ravines upwards of 2000 feet deep, thus exhibiting natural sections, and showing the nature of their transition vertically as well as horizontally; the minute, and very laborious investigation of which is the foundation of the present observations. The crystalline series in Europe falls into insignificance when compared with those of America, and it is in such extensive areas that the real character of the crystalline base can be clearly ascertained.

Besides the regular transition of the crystalline base into slate, there are also veins formed, interlaminated in the mass. Should the base contain a large proportion of magnesia and talc, veins of serpentine rocks will be formed; should the granite predominate in silica, quartz veins will be found very abundant.

* We have been unable to give the plates referred to, but the structure represented is so well described by Mr. Hopkins, that the reader can be at little loss.—Ed.

The felspathic granite never produces slate for the want of mica, therefore it is generally covered by a massive rock which is erroneously called clay-slate. Should hornblende and lime be disseminated in a felspathic base, hornblende, basaltic, trap, and greenstone veins are formed; and as carbonic acid is generally combined with the ingredients, this compound base produces great disturbances in the superincumbent masses; it is the most restless base of the whole of the above compounds. However, we must always bear in mind that there is no granitic base *in situ* actually dormant; these are constantly acted upon by the polar current, with variable degrees of intensity. The porphyritic granite is the richest base for producing minerals in Chili, Peru, Quito, New Granada, Mexico, England and Germany. The quartzose granite is the most unproductive.

When the granite forms a moist massive base, it is seldom deficient in mineral salts, but when comparatively dry, with a distinct crystalline grain, it is generally poor in mineral. These are the primary points to be first considered in making a survey of a mineral district.

The metalliferous parts of Crownwall have a porphyritic granite, which on the surface is partilly decomposed, forming patches of dark masses of the same substance; the intermediate part (forming the transition) is called "elvan," being a fine grain porphyry.

The transition of the granite into the slate is very irregular, owing to the excess of felspar and the want of mica: this is also the cause of the series not possessing the uniform cleavage structure seen in America and other places. However, there are a few meridional channels intersecting Cornwall, presenting the usual phenomena of the vertical polar cleavage, and cleaving the superincumbent beds, which may be seen at the United Hills, St. Agnes, and various other parts of the northern coast. The interlamination of the granite, porphyry, and slate, and the common northward transition, may be seen at Dolcoath, and along the whole range of the Carn Brea granite, on the north side.

The gradation of granite into gneiss, and gneiss into mica and clay-slates, may be seen in Wicklow, and also in the western part of Scotland. The Irish crystalline series may be considered as the southern extremity of those of Scotland. It has been conjectured that the slates of the western part of North Wales formed the eastern edges of those seen in Wicklow; this idea originated from the mistaken notion that primary schist were sedimentary beds. The Wicklow and North Wales crystalline slates are two independent meridional series.*

A variety of talcose, micaceous and chloritic schists may be seen near Holyhead and on the south-west coast of Carnarvon, possessing that fibrous structure and silky striated and shining lustre in the planes of the laminæ or meridional cleavage, so peculiar to all the crystalline rocks.

To enumerate the localities of the primary series would be an endless task; therefore we must refer to other works, and confine ourselves to the mode of their formation and general structure. As the action in the primary base is constant, like a series of channels growing northward, with their pores and cleavages full of mineral solutions, subject to variable tensions, fractures, &c., the structure of the compound becomes occasionally very complicated, by which cause the phenomena of heaves, splits, veins, &c. are produced.

Metalliferous rocks.—These are channels of rocks in which minerals are so abundantly disseminated that the whole masses are worked like quarries. In the silver mines of Mariquita native silver is commonly found in flakes, like mica in the laminæ of the schist, in channels of ground of about twenty-four feet wide, of course in the meridian, like the formation of the rock itself; and these metalliferous channels are quarried for silver. In the same neighbourhood the argentiferous channels are very numerous.

At Ibague, copper is found under similar circumstances in a clay-slate formation; also lead and iron pyrites, disseminated in porphyritic rocks in the same locality.

Gold is principally found as a superficial efflorescence on the face of rocks and in cavities, seldom or never in a close grain or compact

* This and other similar appearances referred to, are illustrated in the original work; but except plate XXVII, exhibiting the polar currents as corresponding with the direction and variation of the magnetic needle, we have not thought the other illustrations essential to this notice.—Ed.

rock. It is found in the Brazils, Chili and New Granada, in the tender part of porphyry and clay-slate. It is the destruction or waste of these friable rocks that produces the rich alluvial soil of America.

The porphyry of Cornwall contains nests of yellow copper ore, varying from a few ounces to several tons' weight. In North Wales and Cumberland similar metalliferous rocks are common; they are also very abundant in Ireland.

Moss copper is well known to miners; it is the produce of a metalliferous rock, out of which it vegetates like common moss. Gold, silver, pyrites, lead, and indeed all metals, may be seen occasionally growing out of rocks where the situation and circumstances are favourable for their formation.

The minerals are found in the rocks in solution as common as in the solid, indeed it is the state in which we consider them to be previous to their crystallization. All rocks are more or less impregnated with mineral solvents. The cupreous springs are very abundant in Chili, Peru, New Granada, Cuba and New Brunswick: they are to be seen also in Ireland, Anglesea, Spain and Hungary. The copper in solution is obtained by precipitating it by means of iron. The bog-iron ore is of similar origin, and is formed precisely in the same manner as the calcareous and siliceous tuffa."

According to Mr. Hopkins, there are two great series of splits and fractures in primary rocks, the one extending in a meridional direction from pole, to pole, more or less interrupted, and depending on the polar forces. The other series extend from east to west, and are occasioned by the contraction of the rocks in the direction of the grain. It is to these last, that the peculiar rents and dislocations called faults, are referred.

"We have already shown that the polar grain is universally observed; the east and west fractures intersecting this structure are seen in the Brazils and Chili, forming immense veins of quartz. In Peru and Quito they are very abundant. In New Granada, on the western Cordillera, which is principally formed of porphyritic granite, the east and west fractures are very numerous, and are generally filled with quartz and auriferous pyrites, being the principal metalliferous solvents of this chain.

The central Cordillera is very schistose, thus possessing great tenacity, and capable of being elongated; consequently the transverse fractures are but few, and confined to subordinate granular channels: the longitudinal and diagonal splits are of ordinary occurrence, the sides are commonly grooved and highly polished by friction caused by the meridional movements of the parallel masses. The hornblendic, calcareous and talco-magnesian varieties are found extremely active in the above series. The eastern Cordillera is very quartzose, therefore the east and west fractures are very numerous, and are intersected by a few polar splits, with striated and polished sides. In Mexico the porphyritic variety predominates, and the meridional splits are consequently intersected by a great number of fractures. In Cuba and the other large islands of the West Indies the same phenomena are observed. In the southern departments of the United States, and especially at Virginia, the polar splits predominate. These splits have cleaved the coal beds of Blackheath into longitudinal fragments, causing great disorder in their position. In Cornwall they are very numerous; the splits are known by the names of *fluccan* and *cross courses,* and the transverse fractures are called *lodes.* It is in the fractures that the mineral wealth of this country is found.

The great polar splits of Cornwall and Devon extend across the Bristol Channel to Wales, and have cut the coal fields and all the sedimentary rocks of the province into meridional strips. The same kinds of splits and fractures are seen throughout England, Scotland and Ireland, and have broken the great sedimentary beds into various fragments of a somewhat rhomboidal form, according to the oblique angles of the splits.

On the continent of Europe similar series have been observed, especially in Tangiers, Spain, France, Germany, Hungary and Sweden; we need not detail them, but beg reference to works describing each district.

These splits and fractures, and their being in continual motion by the constant action of the polar force, produce great disorder in the general structure, and cause dislocations in the order of the masses (called *heaves* by the miners). These are the effects of the horizontal or diagonal motion of the individual strips of rocks between the splits from their original position. The great *heaves* are produced by the northward action of the rocks between the polar splits; the *slides* observed in the east and west fractures are few, and generally insignificant; they are the effect of wedges of rocks squeezed between great splits.

These dislocations have created great discussions, and have caused very opposite opinions, owing principally to the impossibility of restoring the continuity of *all* the fractures on both sides of the splits. A very little reflection must show that such an agreement in *all* the fractures could not be expected. In the first place, the ruptures across the splits would necessarily take place in the direction of the least resistance, be that in a direct line or not; it does not follow that it should be straight across the split. If, again, we consider that the rocks are exposed to the continual action of the polar current, and therefore subject to a slow movement northward, there would necessarily be fractures taking place periodically in the same masses, *i. e.* when the "heaves" are only 1, 10, 20, 30, 50 feet; how then would it be possible to restore the continuity of the whole series of fractures? It is well known, and can be proved that the fractures have occurred at different periods. It is like attempting to refit pieces of ice, after having been broken and subjected to repeated movements and reunited again by repeated freezing, as to try to restore dislocated masses of rocks in the primary base.

When we consider the semifluid nature of the masses, and their permitting a continual molecular action through their pores in the meridian direction, like the current of sap in a living tree, we need not be surprised that the wall of the fractures, cannot always be refitted; their ruptured sides are altered by the chemical action in a very short time; the southern parts of which are often seen penetrating into the northern by a new cleavage formed subsequently to the filling of the cracks, as represented in Plate XI.*

Miners are well aware that the sides of veins often bulge out in defiance of all mechanical resistance: it requires a considerable practical knowledge to keep them open to extract the mineral, particularly in very wet ground. When the *splits* happen to be in

* See Note, p. 518.

a *north-west direction*, the masses of rocks on the *western side* are generally forced *northward* more than those on the eastern side: if the *splits* be towards the *north-east*, the *contrary effect* takes place; that is, in real *heaves*, because a great number are called "heaves" that are only apparent. In Cornwall the majority of the *splits* are north-west, as described in Plate VIII.:* consequently all the principal "*heaves*" of the country are to the right, the western masses having shifted northward more than the eastern. The red sandstone and carbonaceous series, intersected by a split near Tiverton in Devon, has been shifted northward on the western side nearly half a mile. In the vicinity of Tavistock and Callington similar northward movements are observed. There is another great northward "heave" near Redruth, produced by the great cross course traversing the North Downs. The direction of the "heaves" is generally expressed by *right* and *left*, because the same expression serves on approaching them on either side. Some suppose that the nature of "heaves" depends on the direction and inclination of the mineral veins or transverse fractures; but this is a mistake: the movements of the masses are quite independent of the cracks, and would be the same had they not existed. Nor does it follow that the dislocated veins should be always "heaved" on the side of the obtuse angle, as generally supposed, because this depends on the angle of the fracture itself.

The cause of the above order in the dislocated masses is made manifest when we examine the nature of the mechanical disturbance. Admitting the magnetic force to act in the meridian, the direction of the *oblique splits* destroys the parallelism or uniformity of the polar forces; consequently the masses presenting the largest transverse bases to the south will be propelled northward at a greater rate than the others. (Plate XII.*)

Having lately made a very extensive investigation of the principal mines of Cornwall, Wales and Ireland, with a view of instituting a comparison between them and those of America, this part of our subject was carefully attended to, and the result has fully confirmed our previous opinion that the greater number of the veins on the large scale have been "heaved" and filled simultaneously. The

* See Note, p. 518.

splits, generally speaking, are older than the transverse fractures. The mines of Flintshire are referred to as one instance out of hundreds which may be mentioned, where the transverse cracks are confined within the limits of the meridional strips. The cause of the meridonal splits intersecting the east and west cracks is not from their being of a more recent origin, but owing to one series being subject to perpetual longitudinal movements, and the other to transverse actions."

We give the following observations on veins entire from the practical importance of the subject, no less than the interesting view taken of it by Mr. Hopkins.

"Besides the conflicting opinions respecting the origin of mineral veins, much confusion has also arisen from the very loose signification which is given by miners to the term *vein* or *lode*, which they apply, in fact, to almost any species of mineral deposit which affords a foundation for mining operations, however widely it may differ from the definition of these terms in a mechanical sense. To avoid this confusion, and to render the opinion which is here maintained respecting their origin more clear, we shall distinguish them by *veins of fractures* and *split veins;* the former being more or less east and west, and the latter north and south: transverse fractures and meridional splits are to be considered as identical. We must always bear in mind the fact, that the rocks are more or less strongly saturated with minerals in solution, in a state favourable to chemical action, and having a free motion through the pores of the rocks in obedience to the polar force. Those who may wish to know whether this is a known fact in England, may consult the numerous experiments of Mr. Fox, who has proved the existence of the subterranean currents and mineral salts in Corwall by repeated experiments. Indeed, to doubt this is equal to doubting the meridional action of the magnetic needle; the latter is the effect of the same power.

We have already observed that the meridional channels of rocks contain different kinds of minerals, the fractures intersecting which form what are called lodes or mineral veins; we shall now consider the nature of their contents.

The Filling of Veins.

Agreeably to the preceding observations, we should naturally conclude, that if fissures be formed in a rock of any given chemical composition, the pores of such a rock being filled with solvents, the fissures traversing it would contain the predominating mineral substance: hence we should find in limestone, veins filled with carbonate of lime; in siliceous rocks, veins of quartz; in hornblendic granite or slate, veins of hornblende, &c.: consequently those veins which may intersect a series of rocks varying in their chemical composition, would be filled with a corresponding variety of minerals. Should the laminæ or pores of any given channel of rock be more strongly saturated with mineral salts than another, the traversing crack, or a series of cracks, would be found to contain rich deposits opposite to, and within the limits of such a channel. This variation in the contents of the bounding rocks produces a corresponding variation in the fissure: hence the cause why the minerals are formed in isolated masses (called "bunches"), a well-known fact in every mining district. The reality of the dependence of the masses of metallic ores in a continuous vein upon the qualities of the bounding rocks, is very perfectly demonstrated by facts long known in England.

Some veins of fracture change so much in their horizontal direction as to be considered in one part a *tin* lode and in another a *copper* lode. This is particularly the case with Chasewater lode, which at Wheal Daniel is called a tin lode, at Chasewater mine a tin and copper lode, and at Treskerby a copper lode. The nature of the minerals and the accompanying matrix changes with the changes of the rocks intersected by the fracture. In South America the veins of fractures are also often found,—in one part auriferous, in another argentiferous, again cupriferous, according to the metalliferous character of the bounding rocks. (Pamplona, Ibague.)

The changes in the contents of fissures, when traversing sedimentary rocks, are equally striking. The mining districts of Aldstone Moor, Teesdale, &c., consist of sedimentary beds of swaledale grits and limestones, traversed by fractures; the minerals in the fissures are chiefly found opposite the limestone beds, which in the above district are the most metalliferous. (Plate XV.* fig. 3.) The ore is more abundant in the limestone than in the gritstone, and in the shale ore seldom occurs. The matrix of the vein as it passes through the gritstone is often sulphate of barytes; but when it enters the limestone it changes to carbonate of barytes. When the rock on one side of a vein is thrown up or down considerably, so as to bring a stratum of limestone opposite a stratum of sandstone, or when the walls of the vein are of two different kinds of stone, the vein is never so productive in ore as when both sides of the vein are of the same kind. The connexion of the opposite beds of limestone appears essential to keep up the crystallising action, and consequently the accumulations of the useful metals from side to side within the fracture. When the strata are but slightly shifted, the component parts, or the elements of each stratum, connect the opposite walls obliquely: sometimes the shales cut through the veins from side to side; thus the transverse section of the contents of the fracture exhibits the order of the sedimentary demarcations of the bounding rocks, as shown in Plate XV. This important fact alone is sufficient to invalidate the idea of veins having been filled from above or below; and proves very clearly that the veins of fractures have been forced open and filled gradually by a lateral crystallization from the bounding rocks.

In Derbyshire the beds of metalliferous limestone are interstratified by hornblendic rocks, called toadstones. When a vein of lead is worked through the first limestone down to the toadstone, it ceases to contain any ore, and often entirely disappears: on sinking through the toadstone to the second limestone, the ore is found again, but is cut off by a lower bed of toadstone, under which it appears again in the third limestone. In some situations, where the beds of limestone are divided by seams of clay, they cut off the contents of the veins as effectually as the toadstone. (Plate XV.)

With regard to the metalliferous beds or channels of rocks, it matters not of what variety they are, provided they be good conductors and well charged with metallic solutions. The changes in the contents of veins intersecting the more or less vertical channels

* For this and similar references to plates, see note, p. 518.

of the crystalline rocks are similar to those observed in the sedimentary rocks.

The mining districts of Gwenap, Redruth and Cambrone (Plate VIII.), consists of crystalline channels of clay-slate, porphyry, greenstone, granite &c. When the lodes intersect the pale-blue massive clay-slate, they are generally productive in copper, and tin in the chloritic variety. When the channels dip towards the east or the west, the bunches of ore dip in the same direction. If the channels of ground be very dry and of a close crystalline grain, they seldom produce minerals. The metalliferous character of the channels depends principally on a primary prophyritic and moist base; this kind of rock appears to be the richest soil, as it were, for the production of minerals. These crystalline channels of rocks being more or less in the meridian, as we have already explained in a previous chapter, and the fractures called lodes intersecting them from east to west (Plates VII. and VIII.), each fracture will contain similar deposits of mineral in the same meridian, or in a line approaching to it, as illustrated in Plate XV.: hence the miner's old rule in Cornwall, *parallel lodes produce parallel bunches.* This is an established fact in all mining districts; but it must be remembered that the rule cannot hold good in split veins. The east and west cracks being across the meridional grain, are exposed to the whole crystallising action of the series, whereas split veins between the channels can only receive such solvents as may pass longitudinally through them: this is also the cause of the contents of the two classes of veins exhibiting a different structure; viz. the east and west from side to side, and the splits in longitudinal plates. (Plate X.)

In order to exhibit the mode of filling, and the formation of different crystals in the same fracture, place a mass of clay-slate between the poles of a battery, immersed in a metallic solution; it will be seen that the currents pass *only* in the direction of the *cleavage*: if the slate be broken across, so as to represent veins of fractures, crystals will be observed to grow in each fracture transversely, *i. e.* in the direction of the cleavage planes*. If two or

* We have already insisted that cleavage planes are formed *in the direction of the currents from pole to pole.* Experiments have been made with the view of imitating these crystalline planes, by placing a mass of clay between the poles of a

more metals be combined in the solution, and the current be very feeble, only one of the metals will be formed in each crack at a time: should the current be increased beyond that required for the decomposition of one of the metallic salts, the others will be reduced proportionably and accordingly to their relative ease of decomposition. The intensity of the current and the proportion of the metallic salts may vary periodically, which may account for the variety of crystals irregularly grouped together in the same vein and at the very same spot. When the intensity of the currents is very feeble the crystals are large, and when greater than sufficient to reduce the metallic salts, hydrogen will evolve and the metals will be precipitated in a massive powder. Hence, when minerals are found in their metallic state and in large crystals, they indicate feeble currents, and consequently unfavourable for the production of large quantities in such veins. The most favourable indications for rich deposits are strong solutions of minerals, dammed by fluccans or clayey veins, so that the excess may ooze out on the surface, forming hydrous oxides and sulphates. The amount of deposition in each fracture depends on the mechanical positions, as illustrated in Plate XIV. The most favourable position of a fracture for the accumulation of minerals is at right angles to the grain of the district, and slightly dipping northward; the unfavourable fracture is, that dipping southward at a first angle under a heavy hill. In a series of parallel fractures the bunches of mineral will be found in a more or less meridional direction (Plates VII. and VIII.), on the south somewhat deep, and on the north shallow deposits. This rise of the metalliferous currents varies in South America from 10° to 20° from the horizon. In Mexico the richer bunches of minerals are found in the parts where the fissures intersect the moist porphyritic varieties of clay-slates. (Plate VII.) In

battery, and it has been supposed that the small transverse *fissures* produced by the tension represent the phenomenon of cleavage. A very slight examination will shew the distinction between them. Those who may feel disposed to imitate rea polar laminæ must furnish each pole with a piece of laminated rock; without this preparation cleavage planes cannot be produced by artificial means. A mass of clay jammed between the walls in a vein of fracture will be cleaved across by the natural magnetic currents in a very few years. It is this constant cleaving action which is the cause of veins becoming obliterated.

New Grenada, Peru, Chili and the Brazils, similar channels of rocks are equally productive. In a word, every mining district has its conducting metalliferous channels, and the whole accumulated evidence obtained in all parts of the world clearly proves the fact, that the contents of the veins of fractures depend on the character of the rocks they traverse, as represented in the sketches.

It is of great importance to bear this fact in mind, because veins which have been particularly rich at one place have led persons to suppose that the continuation of the same fracture must lead to more riches, although such a fracture may intersect barren rocks. Every mining establishment ought to be in possession of the general bearing and undulations of their respective metalliferous channels, without which the work must be attended with great risks: guess work, "*where it is there it is*," is an extremely bad principle to go by, even with a good practical miner; but when exposed to the changes of agents, inexperience, &c., the consequence may be easily conceived. After great expense has been incurred in carrying on works through unproductive rocks, mines have frequently been abandoned, when within a few feet of rewarding our search, for the want of knowing the width and positions of the barren and rich channels of ground. On the other hand, in prosecuting works of discovery in a direction where no metalliferous channels exist, mines have been carried on at a considerable loss, simply because the vein happens to be in the same direction as another more productive. Of all speculative employments, mining has been, and continues to be, for the want of a well-founded principle, the most uncertain; experience and ingenuity being frequently and completely defeated, although the miner has been continually led to suppose himself on the point of meeting a good course of ore; while from veins, which men of equal ability have abandoned, large profits have afterwards been realized. Therefore the theory of the formation of mineral veins, and the rules which lead to the discovery of the richer deposits, are objects of much greater national importance than is generally supposed. It is essential to the interest of every mining proprietor to know the general character of the local dissemination of the minerals in the district, and indispensable to his forming a correct judgment on the mode of working adopted by the practical miner.

The metalliferous deposits are subject to be decomposed and recompounded periodically, according to the nature of the local changes. In some situations it is possible that veins may change their character in a comparatively short period, so as to be rich at one time and poor at another, especially if kept full of water.

Numerous instances may be mentioned where old workings have been partially filled with a fresh crop of minerals, and also where minerals have been decomposed and disappeared. After the production of some crystals these are again decomposed by new elements; and thus we find crystals have disappeared after having once served as nuclei for others to be deposited upon.

A kind of efflorescence of gold, blende and pyrites have been found formed on the walls in old workings in the mines of Marmato in New Grenada. Gold washings are often abandoned, and the very same sand becomes again sufficiently rich to be rewashed, if situated immediately on a primary rock. Capillary gold, silver and copper have been found formed in old workings near Ibague, subsequently to the mines having been worked by the Aborigines. Native copper has been found formed on the timber in the Wicklow mines.

Mr. W. Forster states, that at Wolfclough mine, in the county of Durham, which was closed for more than twenty years, and opened again, needles of white lead ore were observed projecting from the *sides* of the veins, more than two inches in length, being equal to a vein two inches wide.

D'Aubuisson observes, that in the mines near Pontgibaud, ferruginous and calcareous deposits are now effective in the open spaces left in the mines; so that if after working out the lode the galleries be left shut, and filled with the solutions of the bounding rocks during a long series of years, new workings could be carried on upon the new deposits. The rubbish left in old workings becomes often cemented by mineral salts, which sometimes crystallize in the crevices, so as to render it worth working over again in the course of a very few years. In the mines of Hanover a leather thong suspended from the roof of a mine was found coated with silver ore, and also native silver and vitreous ore coating the wooden supports of a mine which had been under water for several years.

These chemical actions, governed by the subterranean polar currents, continue to fill every fissure or vacuity with crystals, the growth of which swells open the cracks, and thus causes new fractures and dislocations, according to the variable nature of the containing rocks, and the amount of resistance. This gradual opening of the veins with the growth of the crystals from the *sides* accounts for the isolated masses of the bounding rocks found in veins (Plate XIII.), which could not possibly occur had they been open fractures. Indeed the hypotheses supposing mineral veins to have been *filled by solution from above*, or that of the *injection of ingneous matter into an open fissure from below*, are so crude and irreconcilable with the nature of their contents, that they do not deserve our attention: the facts brought forward fully justify the conclusion that *all* veins, whether they be mineral or not, have been formed and filled on the same principle of polar action as above described. In the east and west, or transverse fissures, the crystals are formed from side to side, and in the splits, longitudinally, in parallel plates, as shown in Plate X. The bunches of minerals in the splits are in diagonal and longitudinal shoots. (Plate XV.)

Roots and Branches of Mineral Veins.

The meeting of a number of small veins either in depth or in a horizontal direction is favourable for the accumulation of minerals. Plate XVIII. represents a plan of a split vein in New Grenada containing silver ores; the *feeders* or *roots*, and the *northern branches*, are laid down according to the manner in which the mineral concentrated and dispersed northward. Many are called feeders by miners which in reality have had the contrary effect.

The feeders of the east and west veins, like those of the splits, are on the south side; the branches seen on the opposite side have, generally speaking, allowed the mineral to escape from the veins. An oblique fissure on the south side, called a *caunter*, formed contemporaneously with an east and west vein, produces the same effect as the small oblique branches, viz. enriching one part of the east and west fracture at the expense of another; the lode north of the oblique vein would be found comparatively poor. These facts may be observed in Cornwall in various parts, and particularly in the mines of Dolcoath, Tin Croft, and North Roskear.

The feeders or roots of the split veins may be seen in the mines of St. Just, the bunches of mineral depending entirely upon them ; the principal being those coming in from the granite in a S.S.E. direction, and forming diagonal shoots of ore from their junction northward, as represented in Plate XV. The tin formation in the St. Ives consols may be described as a number of large roots coming in from the South-east, converging into one grand trunk, and growing northward at an angle of about eight degrees from the horizon, surrounded by the granite. A similar split vein may be also seen on the banks of the Tarmar, having the principal feeding veins or roots on the south-east side, in tender ground under the bed of the river. Split veins, cross courses, &c. are not productive without the feeders, the latter being the only means by which the contents of the bordering rocks can be brought into them.

The split veins of all mining districts are of the same nature ; therefore as these effects are matters of fact, and easily referred to, we shall not enter into further details. All split veins, be they quartz, carbonate of lime, hornblende, or any other, have been formed in the same manner, and consequently the contents are arranged in longitudinal plates.

The influence of the impermeable Splits on the accumulation of the Minerals in the Transverse Fractures.

Independent of the " bunches" of minerals being found corresponding to certain channels, the amount of the deposit in the fissures is considerably influenced according to the position of the intersecting splits. (Plate XVII.)

That veins of fractures are enriched near their intersection by cross-courses, fluccans, faults, &c., is a fact well known in Cornwall, North Wales, and the North of England ; the same fact is also observed in Germany, in Mexico and South America : the evidence for which is very clear, inasmuch as the bunches of mineral are sometimes found confined to one side of the splits, as represented in the Plate. This well-known fact is another proof of the east and west fractures having been filled *subsequently* to, or *contemporaneously* with, the formation of the splits.

These accumulations of minerals appear to have been produced by the splits having been filled with substances impervious to water, the metallic solutions being thus retained entirely on their respective sides; and when one side happens to be more strongly impregnated than the other, the quantity of minerals formed in the transverse fissures will be found in the same relative proportion. The sketches in Plate XVII., illustrating these kinds of accumulations, have been taken from mines in America and Europe; therefore they may be considered as real sections, to which we beg reference for a more clear idea of this interesting part of our inquiry.

The *impermeable* porphyritic channels have the same influences on the deposits of minerals as the cross-course, or meridional split, *i. e.* they dam of and retain the metalliferous solutions on one side, and thus produce large accumulations. In South Roskear, Tin Croft, and some other mines in Cornwall, the mineral is found almost entirely confined to one side of their intersecting cross-courses and hornblende veins One of the most noted examples of this fact, mentioned in the Geological Report of Cornwall, is that of Wheal Alfread, near Guinear. The elvan vein, Plate XVII, fig. 1, runs from south west to north-east; the lode intersects it obliquely; while in the slate, on the eastern side, it contained mineral; but on approaching the elvan it became much richer, and yielded sufficient ore to afford a profit of £140,000. After quitting the elvan on the western side the lode became poor, and eventually the mine was abandoned as unproductive. The arrows in the sketch represent the nature of the accumulation on one side of the elvan, and the apparent cause of the poverty on the other. Viewing the subject on a large scale, the accumulations produced by impermeable veins will be found according to the following order:—

When the splits or veins run from south-west to north-east the "bunches" will be found principally on the *eastern side:* if the splits run from south-east to north-west the deposits will be found on the *western-side,* being the natural consequences of the oblique mechanical interruptions of the solvents transmitted through the grain of the rocks by means of the magnetic currents. Numerous minor variations must necessarily occur from the effects of local causes; but we need not describe them, as we hope that the principle here laid down will be found sufficient for the guidance of the practical miner."

Reduction of the Meteorological Register, kept at the Surveyor General's Office, Calcutta, for the year commencing on the 1*st November* 1843, *and terminating* 31*st October* 1844. *By* J. M'CLELLAND.

Meteorological Registers are intended to afford materials for the investigation of climate, and if held available in the places where they are kept to persons engaged in researches of this nature, publication may be well dispensed with. They are bulky if given in detail, and useless if too much abridged, while in any case they are seldom referred to.

For these reasons, I discontinued the publication of the usual abstracts from the very copious register kept at the Surveyor General's Office, by Mr. Rees, since October 1843. I now propose to give the general results to be deduced from these records since the latter period.

The prevalence of small-pox and of cholera in March and April last, and of a peculiar form of brain fever which set in the early part of the rains, may render the subject more interesting as accounting for those complaints by the unusually early setting in of the hot season, its violence and protracted length. The late and irregular appearance of the rains, while the heavy falls of rain in August and September, and the consequent diminished temperature of those months, will account no less satisfactorily for the unusual healthiness of that part of the season.

The observations were made at sunrise, 9h. 40m., noon, 2h. 40m., 4h., and at sunset; in all at six different periods. The lowest daily temperature is at sunrise, the highest at 2h. 40m., and this holds good throughout the year. The lowest temperature observed was on the 19th January, when the thermometer stood at 51.7; the highest was on the 10th of April, when the thermometer stood in the shade at 104. The mean temperature of December, the coolest month of the year, was 72.02; and of April, the hottest month of the year, 89.6; the mean temperature of the whole year founded on six daily observations at the hours above stated is 82.35.* The mean minimum is 81.15, and the mean maximum is 93.67.

* The mean of a fractional difference between Tab. I and Tab. XIX the results being in the first case obtained from the sums of the columns for each month, and, in the second from the daily average.

The greatest extremes were in the months of February and March, when there was a difference of 38° between the maximum and minimum temperature observed. The months of August and October afford the nearest approximation to the mean temperature of the whole year.

The following Table exhibits these results for the several months :—

TABLE I.

Thermometric Results for the year commencing 1*st November* 1843, *and terminating* 31*st October* 1844.

	Months.	Minimum.	Mean.	Maximum.	Months variation from the annual mean.	Epochs.		Difference of extremes monthly.
						Of Min.	Of Max.	
		°	°	°				
1843,	November, ...	60·	78·49	86·2	— 3·91	29th	6th	26·2
	December, ...	53·	72·02	84·5	—10·37	17th	4th	34·1
1844,	January, ...	51·7	72·32	84·2	—10·01	19th	25th	32·5
	February, ...	56·	78·14	94·	— 4·32	1st	26th	38·
	March, ...	63·	86·85	101·	+ 4·44	1st	28th	38·
	April, ...	71·9	89·63	104·	+ 7·21	29th	10th	32·1
	May, ...	76·	87·76	98·6	+ 5.34	14th	6th	22·6
	June, ...	76·	86·88	95·	+ 4·46	13th	20th	19·
	July,... ...	77·	84·03	93·2	+ 1·61	1st	24th	16·2
	August, ...	76·9	83·73	90·5	+ 1·31	14th	25th	13·6
	September, ...	77·	85·58	96.	+ 3·16	9th	27th	19·
	October, ...	73·	83·68	94·	+ 1·26	31st	6th	21·
	Means.	81·15	82·42	93·67				31.23

The mean height of the barometer during the year was 29.707. The lowest mean monthly height was 29.484 in June. The highest mean monthly is 29.951 in December; the lowest extreme, 29.196, was on the 21st August, and the highest, 30.153, on the 17th of January. September affords the nearest approximation to the mean annual. The maximum pressure occurs about 10 A. M. The minimum at 4 P. M., except on the 26th of January, 27th of February and 29th of May, when the minimum pressure was observed at 6 P. M. The following Table exhibits these results :—

TABLE II.

Barometric Results of the year 1843-44.

	Months.	Extreme Min.	Mean Monthly.	Extreme Max.	Monthly difference from the Annual Mean.	Epochs. Of Min.	Epochs. Of Max.
1843	November, ...	29.785	29.867	30.042	+.160	17th	2nd
	December, ...	29.830	29.951	30.094	+.244	1st	19th
1844	January, ...	*29.772	29.937	30.152	+.230	26th	17th
	February, ...	*29.770	29.915	30.062	+.208	27th	5th
	March, ...	29.606	29.793	29.978	+.086	29th	1st
	April, ...	29.458	29.656	29.834	—.051	2nd	16th
	May, ...	*29.385	29.563	29.734	—.144	29th	1st
	June, ...	29.271	29.184	29.694	—.220	29th	18th
	July, ...	29.326	29.517	29.713	—.190	28th	21st
	August, ...	29.196	22.516	29·740	—.191	21st	30th
	September, ...	29.394	29.662	29.865	—.045	8th	29th
	October, ...	29.572	29.633	29.937	—.074	12th	28th
	Means.	29.530	29.707	29.903			

Rain fell on 101 days during the year to the amount of 74.72 inches, of which we had 65 inches or $\frac{5}{6}$ths of the whole in 72 days of June, July, August and September, and the remaining $9\frac{3}{4}$ inches only throughout the rest of the year. To this peculiarity, combined with the diminished fall of rain during the preceding year, which only amounted to 63.34 inches, may probably be ascribed the excessive temperature of the months of March and April in particular, and the unhealthiness that prevailed at that period in consequence. The following Table exhibits the peculiarity of wind and weather generally throughout the year.

* At sunset.

TABLE III.

Shewing the quantity of Rain and Variations of Wind and Weather, during the year 1843-44.

	Months.	Weather.				Of the Wind at Noon.									
		Quantity of Rain.	Number of Days on which Rain fell.	Number of Days on which no rain fell.	Days on which it Thundered.	N.	N. E.	N. W.	S.	S. E.	S. W.	W.	E.	Calm.	No. of Days of Observations.
1843	November,	0	0	29	0	16	3	7	0	0	1	3	0	0	29
	December,*	0.86	2	29	0	15	4	6	0	0	0	3	1	1	30
1844	January, ..	0.22	1	30	0	15	2	4	3	0	0	6	1	0	31
	February, ..	0.08	1	28	0	19	3	4	4	0	2	6	1	0	29
	March, ..	0.22	1	30	0	0	2	1	8	0	10	10	0	0	31
	April, ..	3.13	6	24	1	0	1	0	17	1	3	6	2	0	30
	May, ..	7.44	12	19	3	0	3	1	20	1	4	0	2	0	31
	June, ..	12.13	14	16	3	1	2	2	11	1	7	3	3	0	30
	July,†.. ..	13.72	23	8	1	0	1	1	10	6	3	4	5	0	30
	August, ..	26.91	23	8	4	1	0	1	11	6	4	1	7	0	31
	September,	5.02	12	18	3	0	2	4	7	2	6	6	3	0	30
	October,‡ ..	4.99	6	14	0	1	3	3	0	2	2	5	4	0	20
	Totals ..	74.72	101	252	15	68	26	34	91	19	42	53	29	1	353

Thunder, it will be observed from the above Table, occured on 15 days from April to September, while the rest of the year was exempt from it; on five of these occasions it occurred at noon; On seven it occurred at 2h. 40m.; and on three occasions at sunset. The following Table exhibits the days and hours on which it thundered during the year.

* Observation interrupted at 9 o'clock on the 21st, and at the same and subsequent hours on the 25th.

† 15th July one observation interrupted.

‡ Observations interrupted from 15th to 26th of October.

TABLE IV.

Shewing the Periods at which Thunder occurred from 1*st November* 1843 *to* 31*st October* 1844.

Hours.	1843. November.	December.	1844. January.	February.	March.	April.	May.	June.	July.	August.	September.	October.
Sunrise, ...	..	..	..	..	..	....	....	..	..	....	....	....
9h. 50 m. ..	..	..	..	..	..	....	....	..	..	....	....	....
Noon, ...	..	..	..	..	..	30th,	18th 19th	..	..	18th 19th	....	....
2h. 40 m. ..	..	..	..	..	..	....	18th 30th	24th	3rd	6th 11th	4th 12th	....
4h.	..	..	..	..	..	....	....	..	..	....	....	....
Sunset, ...	..	..	..	..	..	....	....	2d 7th	.. ..	....	.... 7th	....

The following are the proportions of the prevailing winds, to 350, the number of days on which observations were kept at six different periods each day. North wind 51.6, north-east 19.6, north-west 29.8, south 89.3, south-east 26.5, south-west 32-6, west 36, east 24.1, calm 38.5.

There were 137 calm mornings at sunrise, and only one calm day at noon throughout the year, while there were 78 calm evenings at sunset. The results under this head are exhibited in the following Table :—

TABLE V.

Shewing the Direction of the Wind each day at 6 *different hours, and the relative duration of each Wind throughout the year.*

Hours.	N.	N. E.	N. W.	S.	S. E.	S. W.	W.	E.	Calm.	Number of Obs. each stated hour throughout the year.
Sunrise, ...	32	20	16	68	29	19	7	25	137	= 353
9h. 50m.... ...	59	37	29	75	34	49	42	23	3	= 351
Noon, ...	58	26	34	90	19	42	53	29	1	= 352
2h. 40m.... ...	52	24	40	105	20	27	58	20	6	= 352
4h.	53	12	42	93	34	36	45	31	6	= 352
Sunset, ...	56	9	18	116	23	23	11	17	78	= 341
Total each 6. ÷	310	118	179	536	150	190	216	145	231	=2101
Proportion of each, ...	51.6	19.6	29.8	89.3	26.5	32.6	36.	24.1	38.5	= 350

*

The relative proportions of the prevailing appearances of the sky and changes in the atmosphere are as follows, during the 350 days on which observations were recorded. Clear 114.3, generally clear, *i. e.* presenting only such slight appearances of vapour in some part of the horizon, as not to deserve to be ranked under any definite term, 12.8, cirro strati 21.3, cirro cumuli 16.8, cumulo strati 41.6, cumuli 35.5, rain 12.3, cloudy 73.8, foggy 3.3, nimbi 10.8, haze 5.3. The following Table exhibits these results:—

TABLE VI.

Representing the aspect of the Sky at different hours, and the relative proportion of the various prevailing appearances of the Atmosphere.

Hours.	Clear.	Generally Clear.	Cirro Strati.	Cirro Cumuli.	Cumulo Strati.	Cumuli.	Rain.	Cloudy.	Foggy.	Nimbi.	Haze.	Number of Obs. each stated hour throughout the year.
Sunrise, ...	115	19	43	32	9	15	14	80	15	11		= 342
9h. 50m.	135	6	8	20	56	34	8	62	2	13	6	= 349
Noon, ...	125	6	6	12	60	53	11	51	1	14	10	= 349
2h. 40m.	101	8	14	11	58	59	15	64	1	12	5	= 347
4h. P. M.	102	10	15	12	55	42	13	86	0	5	8	= 348
Sunset, ...	108	28	42	14	12	8	13	100	1	10	3	= 338
Total, number of Obs. 6. ÷	686	77	12.8	101	250	213	74	433	20	65	32	2073
Proportion of each	114.3	12.8	21.3	16.8	41.6	35.5	12.3	73.8	3.3	10.8	5.3	= 350

Under the head of cloudy, are comprehended those appearances which, form the opacity of the air could not be arranged under any of the definite forms of clouds. There is an obscurity likewise in the distinction of fogs and mists and haze, in these registers, which ought not to exist, as such terms indicate very opposite conditions of the atmosphere.

It is only necessary to allude to the circumstance in order to invite the very able attention of Mr. Rees to the subject, who I believe has the merit of superintending these important Registers. The term Haze, as it ought at least to be used in India, indicates an excessively dry condition of the atmosphere, at periods of heat and drought. See vol. 1. p. 52, of this Journal.

The following abstracts exhibit the peculiarities of the several months:—

November 1843.

The mean prevalence of north wind during the month was equal to 16; of north-east to 1.66; of north-west to 5.16; of south-east to .3; of south-west to 1.; and west to 2. in 30 days, while there were 3.83 of calm in the same period. There was neither south nor east wind during the month. The mornings at sunrise for 17 days were calm. The evenings at sunset were calm for 6 days, but there was no calm between these hours, nor was there any high wind during the month.

TABLE VII. A.

Variation of the Winds at different hours during the Month of November 1843.

Hours of Observation.	Result of Observations.									
	N.	N. E.	N. W.	S.	S. E.	S. W.	W.	E.	Calm.	
Sunrise, ...	10	1	0	0	1	1	0	0	17	
9h. 50m.	17	1	7	0	0	0	5	0	0	
Noon.	16	3	7	0	0	1	3	0	0	
2h. 40m.	17	2	7	0	0	1	3	0	0	
4h. P. M.	19	2	7	0	0	1	1	0	0	
Sunset, ...	17	1	3	0	1	2	0	0	6	
Total of each 6÷	96	10	31	0	2	6	12	0	23	in 180 Obs.
Proportion of each,	16.	1.6	5.16	0	.3	1.	2.	0	3.83	= 30 days.

The sky presented cumuli in proportion only of $1\frac{1}{2}$ in 30 days, cirro strati in about the proportion of $0\frac{1}{3}$, cirro cumuli $0\frac{1}{2}$, and cumulo strati in the proportion of a little more than $0\frac{4}{5}$ in 30, while 22.5 were clear, and 4.3 generally so, presenting merely slight vapour in particular parts of the horizon at various hours, without rain, fogs, or haze during the month.

TABLE VII. B.

Aspect of the Sky at different hours, November 1843.

Hours of Observation.	Clear.	Generally clear.	Cirro strati.	Cirro cumuli.	Cumulo strati.	Cumuli.	Rain.	Cloudy.	Foggy.	Haze.	
	Result of Observations.										
Sunrise, ...	26	4	...	...	...	...	...	...	...	...	
9h. 50m.	28	2	...	...	...	...	...	...	...	...	
Noon, ...	27	3	...	...	...	...	...	...	...	...	
2h. 40m.	18	5	...	1	2	4	...	...	...	...	
4h. P. M.	18	4	...	1	2	...	...	...	...	...	
Sunset, ...	18	8	2	1	1	5	...	...	...	...	
Total of each 6÷	135	26	2	3	5	9	...	...	...	...	in 180 Obs.
Proportion of each,	22.5	43	33	.5	.83	1.5	...	...	...	...	in 30 days.

December 1843.

The mean prevalence of north wind during this month was 12.$\frac{1}{3}$; of north-east 3$\frac{2}{3}$; of north-west 5$\frac{2}{3}$; of south-east 0$\frac{1}{3}$; of south-west 0$\frac{1}{6}$; west 2$\frac{4}{5}$, east 0$\frac{1}{2}$ in 30 days, while there was a proportion of 4$\frac{1}{2}$ of calm in the same period. As in the preceding month, there were 17 calm mornings at sunrise, with 7 calm evenings at sunset. There was no south wind during the month, but two observations of east wind at 9h. 40m.; and one at noon.

TABLE VIII. A.

Variations of the Winds at different hours in the Month of Dec. 1843.

Hours.	N.	N. E.	N. W.	S.	S. E.	S. W.	W.	E.	Calm.	
	Result of Observations.									
At Sunrise, ...	6	2	6	...	...	...	...	...	17	
,, * 9h. 50m. ...	16	8	1	...	...	...	2	2	...	
,, Noon, ...	15	4	6	...	...	...	3	1	1	
,, 2h. 40m. ...	9	5	8	...	1	...	6	...	1	
,, 4h. P. M. ...	12	3	8	...	1	...	5	...	1	
,, Sunset, ...	16	...	5	...	...	1	1	...	7	
Total of each 6 ÷	74	22	34	...	2	1	17	3	27	in 180 Obs.
Proportion of each, ...	12.33	3.66	5.66	...	.33	.16	2.83	.5	4.5	in 30 days.

* See note page 536.

The sky was overcast and cloudy 2.; attended with rain $0\frac{1}{2}$; with fog in the proportion of $0\frac{1}{3}$ of a day in 30; cirro cumuli $0\frac{2}{3}$; cumuli $1\frac{2}{3}$; and cirro strati in the proportion of 1; while there were $22\frac{1}{2}$ clear, and $1\frac{1}{2}$ of only slight vapour in particular parts of the horizon during 30 days.

TABLE VIII. B.

Aspect of the Sky at different hours during the Month of December, 1843.

	Result of Observations.									
	Clear.	Generally clear.	Cirro strati.	Cirro cumuli.	Cumuli strati.	Cumuli.	Rain.	Cloudy.	Foggy.	
Sunrise, ...	20	2	1	3	0	0	1	2	2	
* 9h. 50m.... ...	22	2	1	1	0	1	1	1	0	
Noon, ...	24	2	0	0	0	2	0	2	0	
2h. 40m.	22	1	2	0	0	3	1	1	0	
4h. P. M.	23	1	1	0	0	2	0	3	0	
Sunset, ...	23	1	1	0	0	2	0	3	0	
Total of each 6 ÷	135	9	6	4	0	10	3	12	2	in 180 Obs.
Proportion of each.	22.5	1.5	1.	.66	0	1.66	.5	2.	.33	in 30 days.

January 1844.

The prevalence of north winds diminished to $9\frac{1}{3}$, while north-east and west winds amount to $4\frac{1}{6}$ each; south winds occurred to the extent of $2\frac{4}{5}$; north-west, south-east, and south-west to the proportion of $0\frac{1}{2}$ each; east wind to $0\frac{1}{3}$ in 31 days. There were 11 calm mornings at sunrise, and 12 calm evenings at sunset.

* One observation omitted at this hour on the 21st, another at this and subsequent hours on the 25th.

TABLE IX A.

Variation of the Winds at different hours in the Month of January, 1844.

Hours of Observation.	N.	N. E.	N. W.	S.	S. E.	S. W.	W.	E.	Calm.	
	Result of Observations.									
Sunrise, ...	5	7	4	2	0	0	1	0	11	
9h. 50m.	12	8	4	2	1	0	4	0	0	
Noon.	14	2	4	3	0	0	6	1	0	
2h. 40m.	8	3	7	1	1	3	7	0	0	
4h. P. M.	5	3	9	5	1	0	7	0	1	
Sunset.	9	2	2	4	0	0	0	1	12	
Total of each 6÷	56	25	30	17	3	3	25	2	24	in 185 Obs.
Proportion of each,	9.33	4.18	5.	2.83	.5	.5	4.16	.33	4.	in 31 days.

No rain fell in January, and the relative proportions of the various aspects of the sky and conditions of the atmosphere were as follows: Clear $18\frac{1}{3}$, generally so 2; cirro strati $1\frac{1}{6}$; cirro cumuli 3; cumuli strati $0\frac{1}{3}$; cumuli $1\frac{1}{6}$; cloudy 3; foggy $0\frac{4}{5}$; nimbi $0\frac{1}{6}$; haze 1. In 31 days there were 4 foggy mornings at sunrise, and one foggy day at noon.

TABLE IX. B.

Aspect of the Sky at different hours daily during the Month of January, 1844.

Hours of Observation.	Clear.	Generally clear.	Cirro strati.	Cirro cumuli.	Cumuli strati.	Cumuli.	Rain.	Cloudy.	Foggy.	Ninbi.	Haze.	
	Result of Observations.											
Sunrise, ...	13	2	4	4	0	1	...	2	4	1	0	
9h. 50m. ...	22	0	1	4	1	0	...	2	0	0	2	
Noon, ...	19	0	0	4	0	2	...	3	1	0	2	
2h. 40m. ...	19	1	0	3	0	2	...	4	0	0	1	
4h. P. M. ...	19	3	0	2	0	2	...	4	0	0	1	
Sunset, ...	18	6	2	1	1	0	...	3	0	0	0	
Total of each 6÷	110	12	7	18	2	7	...	18	5	1	6	in 185 Obs.
Proportion of each, ...	18.33	2.	1.16	3.	.33	1.16	...	3.	.83	.16	1	in 31 days.

February 1844.

High south wind observed on the 21st at 9h. 50, and on the 27th at 2h. 40m. The relative proportion of the different winds during the month was at follows:—

North $7\frac{4}{5}$, west wind $6\frac{1}{6}$, south $3\frac{2}{3}$, north-west $3\frac{1}{2}$, north-east 2, south-east $0\frac{1}{6}$, south 1, east $0\frac{1}{3}$, calm $3\frac{1}{2}$ in 29 days. There were 9 calm mornings at sunrise, and 12 calm evenings at sunset.

TABLE X. A.

Variation of the Wind at different hours in the Month of February 1844.

Hours of Observation.	N.	N. E.	N. W.	S.	S. E.	S. W.	W.	E.	Calm.	
	Result of Observations.									
Sunrise	6	3	2	4	..	2	2	1	9	
9h. 50m.	11	3	2	3	..	1	9	..	..	
Noon, ...	9	3	4	4	..	2	6	1	..	
2h. 40m.	6	3	5	4	..	2	9	..	..	
4h. P. M.	8	..	6	3	1	2	9	..	..	
Sunset, ...	7	..	2	4	..	2	2	..	12	
Total of each, 6 ÷	47	12	21	22	1	11	37	2	21	= in 174 Obs.
Proportion of each,	7.83	2.	3.5	3.66	.16	1.83	6.16	.33	3.5	in 29 days.

There was no rain during this month, and the aspect of the sky clear, in the proportion $22\frac{4}{5}$ to 29. Generally clear, or with slight vapour only in some particular parts of the horizon $0\frac{4}{5}$; cirrostrati $1\frac{1}{3}$, cirro cumuli $1\frac{1}{3}$, cumuli strati $0\frac{1}{3}$, cumuli $2\frac{1}{3}$, cloudy 3, foggy $0\frac{1}{2}$. Fogs only occurred for two mornings at sunrise.

TABLE X. B.

Aspect of the Sky at different Hours during the Month of February 1844.

Hours of Observation.	Clear.	Generally clear.	Cirri strati.	Cirri cumuli.	Cumuli strati.	Cnmuli.	Rain.	Cloudy.	Foggy.	
	Result of Observations.									
Sunrise, ...	16	..	2	1	..	..	..	7	3	
9h. 50m.	24	1	1	..	..	1	..	2	..	
Noon, ...	24	1	..	1	1	1	..	1	..	
2h. 40m.	17	1	3	..	..	6	..	2	..	
4h. P. M.	18	..	..	2	1	6	..	2	..	
Sunset, ...	18	1	2	4	..	..	..	4	..	
Total of each, 6 ÷	137	4	8	8	2	14	..	18	3	= in 174 Obs.
Proportion of each,	22.8	.83	1.33	1.33	.33	2.33	..	3.	.5	= in 29 days.

March 1844.

High winds from south and south-west on the 14th, 21st and 23d. The following are the relative proportions of the direction of the wind during the month.

South wind $12\frac{2}{3}$, south-west $5\frac{1}{3}$, west $5\frac{1}{6}$ north-west $1\frac{1}{2}$, north-east 1; east and south-east, each 1; north $0\frac{1}{3}$ in 31 days.

N. B.—The south wind prevailed chiefly in the early and latter part of the day throughout the month, becoming an arid dry westerly wind towards noon, frequently continuing so till sunset, or subsiding into a suffocating calm.

TABLE, XI. A.

Variation of the Wind at different Hours in the Month of March, 1844.

Hours of Observation.	Result of Observations.									
	N.	N. E.	N. W.	S.	S. E.	S. W.	W.	E.	Calm.	
Sunrise, ...	...	1	1	14	3	1	...	2	9	
9h. 50m.	...	2	...	11	1	12	2	2	...	
Noon, ...	...	2	1	8	...	10	10	...	...	
2h. 40m.	1	1	4	13	...	3	9	...	...	
4h. P. M.	1	...	2	13	1	4	9	1	...	
Sunset, ...	...	...	1	17	1	2	1	1	8	
Total of each, 6÷	2	6	9	76	6	32	31	6	17	185 Obs.
Proportion of each	.33	1.	1.5	12.66	1.	5.33	5.16	1.	2.83	31 in days.

The following are the different aspects of the sky, and the proportions in which they respectively prevailed, $11\frac{1}{2}$ clear, 3 cirro strati, $3\frac{1}{2}$ cumuli, $2\frac{1}{6}$ cumuli strati, 7 cumuli, $2\frac{1}{2}$ cloudy, $0\frac{2}{3}$ foggy, 1 haze, $0\frac{1}{6}$ nimbi in 31 days.

N. B.—Short partial storms from north-west, with one or two very light partial showers (not affecting the pluviometer) took place.

TABLE XI. B.

Aspect of the Sky at different hours during the Month of March, 1844.

Hours of Observation.	Result of Observations.											
	Clear.	Generally clear.	Cirro strati.	Cirro cumuli.	Cumuli strati.	Cumuli.	Rain.	Cloudy.	Foggy.	Haze.	Nimbi.	
Sunrise, ..	11	..	3	7	..	7	..	..	3	..	..	
9h. 50m... ..	15	..	2	3	..	8	..	1	..	1	1	
Noon, ...	14	..	1	3	..	8	..	2	..	3	..	
2h. 40m, ...	11	..	2	3	5	8	..	2	..	..	..	
4h. P. M... ..	9	..	5	3	4	6	..	4	..	..	..	
Sunset, ...	9	..	5	1	4	5	..	4	1	2	..	
Total 6 ÷	69	..	18	20	13	42	..	13	4	6	1	= 186
Proportion.	11.5	..	3.	3.33	2.16	7.	..	2.16	.66	1.	.16	= 31

April 1844.

There was high west wind on the 3rd, 4th, and 10th; high south and south-west wind on the 8th, 9th, 13th, 18th, 21st, 24th and 25th. The following are the relative proportions and various directions of the wind during the month.

South wind 20, south-west $3\frac{1}{6}$, west $2\frac{1}{6}$, east $1\frac{1}{2}$, south-east $1\frac{2}{3}$, north-west $0\frac{1}{3}$, north-east $0\frac{4}{5}$, north $0\frac{1}{6}$, calm $0\frac{1}{6}$ in 30 days.

N. B.—Light southerly winds prevailed, rising gradually towards noon; closeness and oppression very great, at night particularly; in the early part of this, and latter part of the preceding month, Cholera prevailing.

TABLE XII. A.

Variation of the Wind at different Hours in the month of April, 1844.

Hour.	Result of Observations.									
	N.	N. E.	N. W.	S.	S. E.	S. W.	W.	E.	Calm.	
Sunrise, ...	...	1	...	18	3	2	...	5	1	
9h. 50m.	...	2	1	19	1	5	1	1	...	
Noon, ...	...	1	...	17	1	3	6	2	...	
2h. 40m.	...	...	...	22	1	3	3	1	...	
4h. P. M.	1	...	...	19	2	5	3	...	...	
Sunset, ...	...	1	1	25	2	1	...	...	...	
Total of each 6 ÷	1	5	2	120	10	19	13	9	1	= 180
Proportion of each	.16	.83	.33	20.	1.66	3.16	2.16	1.5	.16	= 30

The aspect of the sky was clear in the proportion of $12\frac{4}{5}$, and cloudy $4\frac{1}{2}$, cumuli strati and cumuli each 4, cirro cumuli $1\frac{1}{3}$, foggy $0\frac{2}{3}$, haze $1\frac{1}{2}$, mist $0\frac{4}{5}$ and cirro strati $0\frac{1}{3}$ in 30 days.

N. B.—After a period of $3\frac{1}{2}$ months drought, a fall of rain at intervals took place, commencing about the middle of the month, accompanied with thunder; this checked the excessive heat, but the nights continued sultry and close.

TABLE XII. B.

Aspect of the sky at different hours during the month of April, 1844.

Hour.	Result of Observations.											
	Clear.	Generally clear.	Cirro strati.	Cirro cumuli.	Cumuli strati.	Cumuli.	Rain.	Cloudy.	Foggy.	Haze.	Mists.	
Sunrise, ..	13	..	1	3	..	3	..	8	2	..	..	
9h. 50m... ..	16	..	..	3	4	5	..	..	2	..	..	
Noon, ...	13	..	..	..	4	6	..	4	..	2	1	
2h. 40m... ..	11	..	..	..	6	4	..	3	..	3	3	
4h. P. M... ..	11	..	..	..	8	5	..	2	..	4	..	
Sunset, ...	13	..	1	2	2	1	..	10	..	..	1	
Total 6 ÷	77	..	2	8	24	24	..	27	4	9	5	= 180
Proportion.	12.83	..	.33	1.33	4.	4.	..	4.5	.66	1.5	.83	= 30

May 1844.

There was high wind from the north on the 13th and 30th at 9h. 50m., and from the south on the 14th, 15th, and 26th; from the south-west at 4 P.M. on the 17th. The relative proportion of each wind during the month was follows :—

South 16, south-east $3\frac{1}{6}$, south-west $2\frac{2}{3}$, east $2\frac{2}{3}$, north-east 1, north-west $0\frac{2}{3}$, north $\frac{4}{5}$ and calm 3.33 in 31 days.

TABLE XIII. A.

Variations of the Wind at different hours in the Month of May, 1844.

Hours.	Result of Observationss.									
	N.	N. E.	N. W.	S.	S. E.	S. W.	W.	E.	Calm.	
Sunrise, ...	1	...	...	6	5	1	...	2	16	
9h. 50m.	...	1	1	20	2	6	...	1	...	
Noon, ...	...	3	1	22	1	4	...	2	...	
2h. P. M.	3	1	2	14	2	2	1	3	2	
4h. 40m.	1	...	...	14	6	3	1	5	...	
Sunset, ...	...	1	...	20	3	...	2	3	2	
6 ÷	5	6	4	96	19	16	4	16	20	=186
	.83	1.	.66	16.	3.16	2.66	.66	2.66	3.33	= 31

Cloudy $8\frac{4}{5}$, cumuli strati $6\frac{1}{2}$, cumuli 7, cirro strati $3\frac{1}{2}$, rain $1\frac{1}{2}$, clear 1, generally clear $0\frac{4}{5}$, cirro cumuli $0\frac{2}{3}$, mist $0\frac{1}{3}$, nimbi $0\frac{1}{3}$, thunder $0\frac{1}{2}$, in 31 days.

TABLE XIII. B.

Aspect of the Sky at different Hours during the Month of May, 1844.

Hours.	Result of Observations.													
	Clear.	Generally clear.	Cirri strati.	Cirro cumuli.	Cumuli strati.	Cumuli.	Rain.	Cloudy.	Foggy.	Mist.	Haze.	Nimbi.	Thunder.	
Sunrise, ..	5	2	10	1	..	2	1	9	..	1	..	..	..	Thunder at noon 19 & 20th.
9h. 50m. ..	..	..	..	2	11	8	1	8	..	..	1	..	2	
Noon, ...	..	..	2	..	9	13	2	2	..	1	1	1	..	
2h. 40m. ..	..	..	1	1	9	12	3	5	..	..	..	..	1	30th thunder.
4h. P. M. ..	..	..	..	..	9	7	..	13	..	..	1	1	..	
Sunset, ..	1	3	8	..	1	..	2	16	..	..	..	..	..	
Total of each $6\frac{1}{2}$ ÷	6	5	21	4	39	42	9	53	..	2	..	2	3	= 186
Proportion of each.	1	.83	3.5	.66	6.5	7	1.5	8.83	..	.33	..	.33	.5	= 31

June 1844.

High wind from the south and south-west on the 9th, 10th, 12th, 16th, 17th and 18th.

South wind $13\frac{1}{3}$, south-west $5\frac{1}{6}$, west 2, east $2\frac{1}{6}$, north-east $0\frac{1}{3}$, south-west $0\frac{2}{3}$, south-east $1\frac{2}{3}$, calm $2\frac{2}{3}$ in 30 days.

TABLE XIV.

Variations of the Wind at different Hours during the Month of June, 1844.

Hours.	Result of Observations.									
	N.	N. E.	N. W.	S.	S. E.	S. W.	W.	E.	Calm.	
Sunrise, ...	..	3	..	12	2	4	1	..	8	
9h. 50m.	..	3	1	6	2	10	5	1	2	
Noon, ...	1	2	2	10	1	7	3	3	..	
2h. 40m.	1	1	..	18	..	2	3	4	1	
4h. P. M.	..	2	..	15	1	7	..	4	1	
Sunset, ...	..	..	1	19	4	1	..	1	4	
Total of each 6 ÷	2	11	4	80	10	31	12	13	16	= 180
Proportion of each.	.33	1.83	.66	13.33	1.66	5.16	2	2.16	2.66	= 30

Cloudy $13\frac{1}{2}$, cumuli $4\frac{4}{5}$, cirro cumuli $2\frac{2}{3}$, cumulo strati $1\frac{1}{6}$ nimbi $1\frac{1}{2}$, haze $1\frac{1}{2}$, thunder $0\frac{1}{3}$, drizzly $0\frac{2}{3}$, cirro strati 2, clear $\frac{1}{6}$, generally clear 1, rain $0\frac{1}{2}$ in 30 days.

TABLE XIV. A.

Aspect of the Sky at different Hours, during the Month of June, 1844.

Hours.	Result of Observations.													
	Clear.	Generally clear.	Cirro strati.	Cirro cumuli.	Cumuli strati.	Cumuli.	Rain.	Cloudy.	Foggy.	Nimbi.	Haze.	Thunder.	Drizzly.	
Sunrise, ..	..	..	2	4	..	2	1	17	..	4	..	..	..	
9h. 50m. ..	..	1	..	4	2	3	..	14	..	3	3	..	..	
Noon,.. ..	..	..	1	3	1	10	..	12	..	1	2	1	..	
2h. 40m. ..	..	..	4	3	3	8	..	10	..	..	1	1	..	Drizzly haze.
4h. P. M. ..	1	1	3	1	3	6	..	10	..	..	2	..	2	
Sunset. ..	..	4	2	1	1	..	2	16	..	1	1	2	..	
Total of each 6 ÷	1	6	12	16	10	29	3	81	..	9	9	2	2	= 18
Proportion of each.	.16	1.	2.	2 66	1.16	4.83	.5	13.5	..	1.5	1.5	.33	66	= 30

July 1844.

High wind from the south on the 2d at noon.

The following are the relative proportions of each wind during this month: south 8, south-east $5\frac{2}{3}$, east $4\frac{1}{2}$, south-west $3\frac{1}{3}$, west $2\frac{1}{2}$, north-west 1, north-east $1\frac{1}{2}$, and calm $3\frac{1}{2}$, in 30 days.

N.B.—This was the only month in which north wind has not been noted on any one of the daily observations.

TABLE XV. A.

Variation of the Wind at different Hours during the Month of June 1844.

Hours.	Result of Observations.									
	N.	N. E.	N. W.	S.	S. E.	S. W.	W.	E.	Calm.	
Sunrise,*	..	1	..	4	2	2	1	5	15	
9h. 50m.	..	2	1	5	9	4	3	7	..	
Noon,*	..	1	1	9	6	3	4	5	..	
2h. 40m.	..	5	2	11	4	1	4	2	1	
4h. P. M.	..	..	1	10	8	3	2	6	..	
Sunset, ...	..	..	1	9	5	7	1	2	5	
Total of each 6 ÷	..	9	6	48	34	20	15	27	21	= 180
Proportion of each.		1.5	1	8	5.66	3.33	2.5	4.5	3.5	= 30

* An observation is interrupted for Sunrise and noon on the 15th instant.

The following are the proportions of the different aspects of the sky during May: cloudy $12\frac{1}{3}$, cumuli strati $6\frac{1}{2}$, cirro strati $3\frac{1}{3}$, cirro cumuli $0\frac{1}{2}$, cumuli $0\frac{1}{3}$, rain 3, nimbi 3, foggy $0\frac{1}{6}$, drizzly $0\frac{2}{3}$ in 3, in 30 days.

TABLE XV. B.

Aspect of the Sky at different Hours, during the Month of July, 1844.

Hours.	Result of Observations.												
	Clear.	Generally clear.	Cirro strati.	Cirro cumuli.	Cumuli strati.	Cumuli.	Rain.	Cloudy.	Foggy.	Nimbi.	Drizzly.	Thunder.	
Sunrise,* ..	..	..	8	2	1	..	5	13	..	1	..	..	
9h. 50m. ..	..	..	..	1	11	..	2	12	..	4	..	..	
Noon,* ..	..	..	..	..	10	2	3	9	..	5	..	..	
2h. 40m. ..	..	..	1	..	10	..	3	12	1	3	..	..	{ Cloudy & haze. Drizzly.
4h. P. M. ..	..	..	2	..	7	..	4	13	..	2	2	..	3dthunder.
Sunset, ..	..	..	9	..	..	..	1	15	..	3	2	..	{ Thunder on the 30th.
Total of each } 6 ÷	..	..	29	3	39	2	18	74	1	18	4	..	= 180
Proportion of } each.			3.33	.5	6.5	.33	.3	12.33	.16	3.	.66	..	= 30

August 1844.

High wind on the 21st at noon.

As in the preceding month south-east and east winds predominated slightly over the south, the following are the relative proportions of each: south wind $8\frac{4}{5}$, south-east $6\frac{1}{3}$, east $5\frac{2}{3}$, south-west $2\frac{2}{3}$, west $1\frac{1}{6}$, north-west $1\frac{1}{6}$, north $0\frac{4}{5}$, north-east $0\frac{2}{3}$, $3\frac{1}{2}$ calm in 31 days.

* An observation is interrupted for Sunrise and Noon on the 15th instant.

TABLE XVI. A.

Variation of the Wind at different Hours, in the Month of August, 1844.

Hours.	Result of Observations.									
	N.	N. E.	N. W.	S.	S. E.	S. W.	W.	E.	Calm.	
Sunrise, ...	1	0	1	4	7	0	1	6	10	
9h. 50m.	1	2	3	8	10	2	0	4	1	
Noon, ...	1	0	1	11	6	4	1	7	0	
2h. 40m.	0	0	0	13	6	3	3	5	1	
4h. P. M.	1	0	1	7	7	5	1	7	2	
Sunset, ...	1	2	1	10	2	2	1	5	7	
Total of each 6 ÷	5	4	7	53	38	16	7	34	21	= 186
Proportion of each.	.83	.66	1.16	8.83	6.33	2.66	1.16	5.66	3.5	= 31

The aspect of the sky was as follows: cloudy $12\frac{2}{3}$, cumuli strati $7\frac{1}{2}$, rainy $3\frac{2}{3}$, nimbi 4, cirro cumuli 1, cumuli $0\frac{1}{6}$, cirro strati $0\frac{1}{2}$, drizzling $0\frac{1}{2}$, generally clear $0\frac{1}{2}$.

TABLE XVI. B.

Aspect of the Sky at different Hours, during the Month of August, 1844.

Hours.	Result of Observations.											
	Clear.	Generally clear.	Cirro strati.	Cirro cumuli.	Cumuli strati.	Cumuli.	Rain.	Cloudy.	Foggy.	Nimbi.	Drizzly.	
Sunrise, ..	..	1	0	4	8	0	3	11	..	4	0	
9h. 5m.	..	0	0	1	12	0	2	13	..	3	0	
Noon, ...	..	0	1	0	12	1	4	7	..	5	1	
2h. 40m.	..	0	0	0	9	0	3	14	..	5	0	
4h. P. M.	..	0	1	0	6	0	5	17	..	2	1	
Sunset, ...	..	2	1	1	0	0	5	15	..	5	2	
Total of each 6 ÷	..		3	6	47	1	22	77	..	24	3	= 189
Proportion of each. ..	..	.5	.5	.1	7.5	.16	3.69	12.66	..	.4	.5	= 31

September 1844.

No high wind.

The winds were variable during this month, south and south-west being the prevailing points. The following are the proportions of each wind: south-west 6, south $5\frac{1}{3}$, south-east 4, east $2\frac{2}{3}$, west 4, north-west $2\frac{1}{3}$, north 1.16, north-east 1, and $3\frac{1}{2}$ calm in 30 days.

N.B.—This, which is usually an unhealthy month in Calcutta, was remarkably exempt from sickness.

TABLE XVII. A.

Variations of the Wind at different Hours, during the Month of September, 1844.

Hours.	Result of Observations.									
	N.	N. E.	N. W.	S.	S. E.	S. W.	W.	E.	Calm.	
Sunrise, ...	1	..	1	4	4	6	1	3	10	
9h. 50m.	1	1	4	1	6	8	7	2	..	
Noon, ...	..	2	4	7	2	6	6	3	..	
2h. 40m.	1	1	2	8	4	6	6	2	..	
4h. P. M.	1	1	3	6	4	6	3	5	1	
Sunset, ...	3	1	..	6	4	4	1	1	10	
Total of each 6 ÷	7	6	14	32	24	36	24	16	21	= 180
Proportion of each.	1.16	1	2.33	5.33	4.	6.	4.	2.66	3.5	= 30

The aspect of the sky was clear $3\frac{1}{3}$, generally clear $0\frac{4}{5}$, cirro strati $3\frac{4}{5}$, cirro cumuli 1, cumuli strati $6\frac{1}{2}$, cumuli $2\frac{2}{3}$, rainy 2, cloudy $8\frac{1}{6}$, nimbi $1\frac{1}{3}$, light hazy $0\frac{1}{3}$, in 30 days.

TABLE XVII. B.

Aspect of the Sky at different Hours, during the Month of September, 1844.

Hours.	Result of Observations.											
	Clear.	Generally clear.	Cirro strati.	Cirro cumuli.	Cumuli strati.	Cumuli.	Rain.	Cloudy.	Foggy.	Nimbi.	Light haze.	
Sunrise, ...	4	4	11	3	..	..	1	6	..	1	..	
9h. 50m.	5	..	2	1	10	5	1	3	..	2	1	
Noon, ...	3	..	1	1	13	4	1	5	..	1	1	
2h. 40m.	2	..	..	..	7	6	4	8	..	3	..	
4h. P. M.	2	..	2	1	8	1	3	13	..	..	..	
Sunset.	4	1	7	..	1	..	2	14	..	1	..	
Total of each 6 ÷	20	5	23	6	39	16	12	49	..	8	2	=180
Proportion of each.	3.33	.83	3.88	1.	6.5	2.66	2.	8.16	..	1.33	.33	= 30

October 1844.

Winds variable; west $3\frac{1}{4}$, north-west $2\frac{4}{5}$, east $2\frac{4}{5}$, north $2\frac{1}{2}$, north-east $2\frac{4}{5}$, south $0\frac{2}{3}$, south-east $1\frac{2}{3}$, south-west $0\frac{2}{3}$, and calm $3\frac{1}{3}$ in 20 days.

TABLE XVIII. A.

Variations of the Wind at different Hours, during the Month of October, 1844.

Hours.	Result of Observations.									
	N.	N. E.	N. W.	S.	S. E.	S. W.	W.	E.	Calm.	
Sunrise, ...	1	1	1	0	2	0	0	1	14	
9h. 50m.	1	5	4	0	2	1	4	3	0	
Noon, ...	1	3	3	0	2	2	5	4	0	
2h. 40m.	5	2	3	1	1	1	4	3	0	
4h. P. M.	4	1	5	1	2	0	4	3	0	
Sunset,*	3	1	1	2	1	1	2	3	5	
6, +	15	13	17	4	10	5	19	17	19	= 119
	2.5	2.26	2.83	.66	1.66	.83	3.16	2.83	3.16	= 20

The following are the proportions of the remarks on the aspect of the sky; clear 3, generally so $1\frac{1}{6}$, cirro strati 1, cirro cumuli $0\frac{4}{5}$, cumuli strati $0\frac{1}{2}$, cumuli $2\frac{1}{2}$, rainy $1\frac{1}{6}$, cloudy $4\frac{2}{3}$, foggy $0\frac{1}{6}$, nimbi $0\frac{1}{3}$, in 20 days.

TABLE XVIII. B.

Variations of the Wind at different Hours, during the Month of October, 1844.

Hours.	Result of Observations.										
	Clear.	Generally clear.	Cirro strati.	Cirro cumuli.	Cumuli strati.	Cumuli.	Rain.	Cloudy.	Foggy.	Nimbi.	
Sunrise, ...	7	4	1	0	0	0	2	5	1	..	
9h. 50m.	4	0	1	0	5	3	1	6	..	..	
Noon, ...	1	0	0	0	10	4	1	3	..	1	
2h. 40m.	1	0	1	0	7	6	1	3	..	1	
4h. P. M.	1	1	1	2	7	2	1	5	..	..	
Sunset,*	4	2	2	3	1	0	1	6	..	..	
Total of each 6 ÷	18	7	6	5	30	15	7	28	1	2	= 19
Proportion of each.	3.	1.16	1.	.83	5.	2.5	1.16	4.66	.16	.33	= 20

* Observation on the 2d at Sunset interrupted.

The following Table exhibits the mean temperature of the days, months and year reduced from six observations daily. An uniform fall of temperature is observed in November. In December the fall of temperature took place towards the middle of the month, rising slightly towards the end. The same is observed in January, the lowest temperature being about the middle of the month. In February the increase of heat was gradual throughout, and the Thermometer continued to rise with sudden fluctuations till the early part of April, when it exhibited the maximum temperature of the year. From the 10th of April, the Thermometer gradually fell, rising slightly in the early part of May. From this period it gradually fell, presenting sudden fluctuations from the 20th to the 27th of June. A similar fluctuation took place about the 24th of July. The months of August and October approximated nearly to the mean temperature of the year.

TABLE XIX.

Temperature of the Air from Nov. 1843 to Oct. 1844, reduced from the Mean of six Observations daily the year.

Day.	1843.		1844.									
	Nov.	Dec.	Jan.	Feb.	March	April.	May.	June.	July.	August.	Sept.	Oct.
1	81.2	75.	74.45	74.33	80.86	90.9	86.61	71.36	81.88	85.3	86.33	82.86
2	79.58	76.5	75.75	71.16	81.3	92.21	83.53	84.9	85.11	85.55	85.58	86.66
3	80.2	76.56	74.51	74.25	83.78	94.61	88.46	83.25	82.46	85.3	85.26	87.51
4	80.8	77.80	75.10	71.33	69.71	93.16	89.16	87.85	82.36	84.58	82.8	88.66
5	80.83	76.66	74.13	72.76	80.7	93.48	90.78	88.31	84.	83.98	84.23	89.18
6	80.63	67.01	75.63	73.21	86.38	92.83	91.43	83.44	84.10	83.36	83.56	82.5
7	79.46	74.41	75.91	75.21	86.11	91.11	90.9	84.8	83.61	82.8	85.63	83.7
8	79.9	73.38	73.46	77.6	85.36	89.8	91.23	84.6	85.73	79.85	78.88	84.85
9	79.13	73.5	70.75	79.53	87.2	87.25	91.38	84.85	83.38	82.21	81.9	81.51
10	78.7	72.23	69.61	76.36	88.31	95.8	90.93	87.56	84.86	85 6	82.18	75.21
11	78.85	71.45	69.41	72.46	89.38	94.4	88.41	88.71	83.93	84.68	83.41	78.21
12	79.25	69.63	66.38	72.96	89.23	90.46	86.9	88.36	82.83	84.43	85.41	81.2
13	79.	70.15	71.21	74.15	90.01	92.2	81.43	85.66	83.43	83.9	82.78	79.48
14	79.56	71.43	72.95	75.41	88.11	88.76	88.33	86.96	82.61	81.15	84.28	83.61
15	80.4	71.55	68.96	73.76	86.6	85.41	89.85	87.81	84.	83.83	84.4	85.73
16	79.36	69.86	67.3	76.35	87.56	88.65	87.13	87.61	84.46	85.53	86.95	,, ,,
17	78.73	69.9	68.11	78.10	87.18	87.96	88.61	88.73	82.86	84.45	87.9	,, ,,
18	79.66	71.	71.18	79.6	86.48	89.91	81.83	74.10	81.66	82.81	85.96	,, ,,
19	79.56	70.83	70.18	80.78	89.7	89.91	82.83	89.15	84.55	83.48	86.81	,, ,,
20	78.2	70.96	71.93	81.75	90.11	90.7	80.25	90.31	81.63	82.3	86 46	,, ,,
21	77.45	57.56	73.46	81.38	88.95	89.63	86.85	89.36	85.3	80.3	86.75	,, ,,
22	78.25	69.55	71.35	84.0	87.71	89.28	79.56	84.73	84.4	79.44	87.5	,, ,,
23	79.25	71.78	72 96	84.48	84.41	89.3	88.31	90.6	87.53	85.5	88.53	,, ,,
24	76.96	70.	71.25	82.41	82.86	87.75	90.13	87.25	90.23	85.68	89.53	,, ,,
25	75.60	....	76.3	84.01	87.46	87.96	90.78	85.96	85.95	87.	89.61	,, ,,
26	75.48	76.	73.43	86.8	88.83	88.13	89.4	87.78	85.83	84.33	90.61	,, ,,
27	76.38	74.5	73.75	84.21	90.66	86.55	88.53	83.6	86.68	83.5	90.88	84.9
28	75.90	74.0	74.53	83 8	75.53	85.66	89.55	88.41	85.81	84.23	90.21	84.85
29	74.58	73.6	72.58	80.48	84.71	81.81	90.01	85.55	83.28	83.38	82.53	84.76
30	74.78	72.3	71.3	....	87.38	83.56	86.68	83.38	85.41	84.4	79.01	84.26
31	....	73.63	72 9	....	90.65	....	87.65	....	85.48	85.46	....	84.86
Mean.	78.48	71.99	27.23	78.28	86.51	89.51	87.59	85.72	84.34	83.69	85.42	83.62

Mean Temperature of the year =82.28.

It remains to notice the gradations of the mean temperature from one month to another, as exhibited by the foregoing Table. The results bear on the peculiar effects of the cold season on the constitution. The difference of temperature between October and November was 3.80, and between February and March 8.23, more than double the amount of all the changes put together from April to September. The following exhibits these results.

Between the Mean Temp. of	Oct. and Nov.	—	3.80	difference.
—	November and December,	—	6.49	—
—	December and January,..	+	.24	—
—	January and February, ..	+	6.05	—
—	February and March, ..	+	8.23	—
—	March and April, ..	+	3.	—
—	April and May, ...	—	1.92	—
—	May and June,.. ..	—	1.87	—
—	June and July, ..	—	1.38	—
—	July and August, ..	—	.65	—
—	August and September,..	+	1.73	—
—	September and October,	—	1.80	—

The wet bulb thermometer would add greatly to the value of these results, but there are discrepancies in the register of the instrument in use, which prove it to be imperfect. With this exception, the observations are highly creditable, and have now we believe been continued for a sufficient series of years to render their results of the highest importance.

Without drawing any conclusion from the results of a single year, particularly when we have materials for a series of years available, we may advert to the remarkable correspondence between the ratio of Variation of temperature, and that of Mortality, as exhibited in the following Table. The third column is taken from an important paper by Colonel Sykes, read at the recent meeting of the British Association, at York.

TABLE XX.

Shewing the mean monthly gradations of Temperature and Pressure for the year 1843-44, *as compared with the Ratio of Mortality.*

	Difference of Mean Temp. from that of the preceding month.	Difference of Mean pressure from preceding month.	Average. Ratio of Mortality monthly.
November, ...	— 3.80	+ .234	11.039
December, ...	— 6.49	+ .884	10.351
January, ...	+ .24	+ .014	7.877
February, ...	+ 6.05	— .022	6.870
March, ...	+ 8.23	— .222	8.850
April, ...	+ 3.	— .137	10.232
May, ...	— 1.92	— .093	8.381
June, ...	— 1.87	— .379	5.822
July, ...	— 1.38	+ .333	6.671
August, ...	— .65	— .001	7.631
September, ...	+ 1.73	+ .146	8.008
October, ...	— 1.80	— .029	8.895

It is necessary to observe, that the temperature of September and October last was lower than usual, the thermometer consequently exhibits a less remarkable depression in November 1843 as compared with October 1844, than it would be found to do in an average season; the result therefore of a wider survey of these registers for a series of years, would show, I think, a still greater conformity between the two ratios in question.

Thus the greatest average monthly Mortality takes place in November, accompanied by a rapid full of temperature and increased pressure, as indicated by the rise of the Barometer. But Mortality diminishes, notwithstanding the increased intensity of these conditions, in December and January. Again, we find the ratio of Mortality to increase, (not with the increased ratio of temperature, because the lowest scale throughout the year, as shown by Colonel Sykes, is in June) with the ratio of *variation;* whether of the falling temperature of November, or the increasing heat of March. Some such general rule in the ordinary course of seasons, would appear to be indicated by the foregoing results, and however faintly, the subject is well worth pursuing.

On Microscopic Life in the Ocean at the South Pole, and at considerable depths. By Prof. Ehrenberg.*

The following is the substance of a paper laid by Professor Ehrenberg, May 23rd, 1844, before the Berlin Academy, and containing some of the results derived from his recent investigations upon materials furnished from the South Polar expedition of Captain Ross, and the voyages of Messrs. Darwin and Schayer; their object being to determine the relation of minute organic life in the ocean, and at the greatest depths hitherto accessible.

Last year the author submitted to the Academy a survey of the geographical distribution of such organisms over the entire crust of the earth; but the field of these inquiries being one of such vast extent and importance, it became evident to him, that to arrive at any positive general results, it was necessary to examine the subject under a more special point of view, and under this conviction, two different courses of investigation suggested themselves as best adapted to fulfil that purpose; viz. first, to ascertain both the constant and periodical proportion which minute organisms bear to the surface of the ocean in different latitudes; and secondly, to examine submarine soil or sea-bottom raised from the greatest possible depths. It is an easy matter, generally, to collect materials of this kind; but before applying to them the test of philosophic criticism and research, the author feels that it is essentially requisite to retrace the contributions of other writers upon the same subject; premising, however, that their value will always be enhanced in so far as the materials collected have been obtained with due care and reference to their several localities.

Very essential progress was made in our knowledge of the minute and invisible forms of organic life during the years devoted to this expedition by Captain Ross. In the year 1840, the Royal Society of London appointed a committee to prepare a series of physical and meteorological questions to be solved by the proposed expedition; and it was at the express desire of the author that Alex. v. Humboldt undertook to suggest to that body the importance of

* The Annals and Magazine of Natural History, No. 90, September, 1844.

attention being paid to the study of the relations under which minute organisms exist, as one likely to throw considerable light upon the principal questions now agitated, involved in the recent history of the earth's crust, and also to recommend that the directions given by the author as to the methods of collecting them should be adopted throughout the whole voyage. Through the scientific ardour of Dr. J. Hooker, son of the well-known botanist, and a voyager on board the ship Erebus, a variety of valuable materials were collected during the expedition, and a short time back about forty packages and three glasses of water were transmitted to Germany from the neighbourhood of Cape Horn and Victoria Land. About the same time also, Mr. Darwin, the profound observer upon the formation of coral reefs in the South-seas, contributed objects from other localities.

The author set about examining carefully without delay, as such an opportunity might not again recur, water which had been taken from the South Polar sea of from 75° to 78° 10′ south latitude, and 162° west longitude, with a view of determining its relative amount of minute organic life. Of the dry materials some packets only have as yet been examined, those namely which from their localities appear to possess the greatest interest, and among these were specimens of the remains of melted polar ice and sea-bottom, taken under south latitudes 63° and 78°, from depths of 190 to 270 fathoms (*i. e.* 1140—1620 feet), the greatest depths that have been hitherto sounded.

The relations of minute organic life were found, as the author had anticipated, to be the same at the south as at the north pole, and generally of great extent and intensity at the greatest depths of the ocean.

Previous observations upon those loftiest mountains whose pinnacles are capped with eternal ice, had determined that a gradual progressive disappearance of organic life takes place from the base to their summit, and that too in accordance with particular laws; to the tree succeeding the lowly shrub, next grass and lichens, till finally we arrive at the regions of perpetual snow where there is a complete absence of all life. In like manner the development of organized beings has been conceived to diminish from the equator to the arctic regions of the earth, the latter becoming first destitute of trees, then of grass, lastly of lichens and algæ until at the poles ice and death hold solemn reign.

The greatest depths in the ocean at which Mollusca had been found to exist were, according to the observations of Mr. Cuming in the year 1834, the genera *Venus Cytherea* and *Venericardia* at 50, *Byssoarca* at 75, and *Terebratula* in 90 fathom water. According to Milne-Edwards and Elie de Beaumont, 244 metres, or 732 foot, formed the extreme range for the growth of corals and the development of organic matter in the sea off the coast of Barbary. From a 100-fathom depth, Peron drew up in the year 1800, off New Holland, *Sertulariæ* and a variety of corallines, which were all luminous, and on an average three degrees higher in temperature than the surface of the sea. In 1824 and 1825 Quoy and Gaimard, in their valuable researches upon the structure of corals, asserted that branched corallines could occur only in a depth of from 40 to 50 fathom, and that in a 100 fathom of water *Retepora* alone existed. According to Ellis and Mylius, who wrote in 1753, the greatest known depth from which a living animal had been taken was the *Umbellaria Encrinus*, which was fished up by Captain Adrian in Greenland from 236 fathom of water, equal to a depth of 1416 foot. Specimens, however, of the sea-bottom have been drawn up from still greater depths; for at Gibraltar, Captain Smith found in 950 fathom, or 5700 foot of water, sand containing fragments of shells; and Captain Vidal, according to Mr. Lyell, detected in the mud of Galway Firth, from a depth of 240 fathom, only some *Dentalia*, the remainder of the sea-bottom from the same depth consisting of pulverized shells and other organic remains devoid of life.

According to the calculations of Parrot, a column of sea-water at a depth of 1500 foot exercises a pressure of 750 pound, or 7½ hundred-weight, upon the square inch; and since the atmospheric air enclosed in these animals of a delicate cellular structure descending from the surface of the ocean would produce alternately such extremes of expansion and contraction as to appear destructive to such organisms, just doubts have been raised whether organic life could actually subsist at great depths.

Wollaston, moreover, in 1840 proved that at the great depth of 670 fathom, in the Mediterranean Sea off Gibraltar, the proportion of salt in the water was four times greater than at the surface. Very accurate and scientific investigations upon the amount of salts of the sea had been already published by Lenz in Petersburg during 1830; and Mr. Lyell, in his ' Geology' of 1840, was induced to regard the observations of Wollaston not as simply indicating a local phænomenon, but to conclude that at still greater depths the relative proportion of saline matter would be still more remarkable, and must progress in a similar advancing ratio.

Lastly, Elie de Beaumont, in 1841, adopted the opinion, that the limits to which the waters of the sea had been found by Siau capable of being set in motion, must be also those at which sessile marine animals could exist, since these have to wait for their food, which in this way only could be conveyed to them, and that consequently the limits of stationary organic life, taken in conjunction with the depth of the waves, could not much exceed 200 metres or 600 foot.

Such considerations, deeply affecting the general science of geology, and to which must be added observations upon the increase of temperature towards the centre of the earth have ever suggested as an interesting matter for inquiry to the author, to examine minute organic life in relation to the depth of the element in which it could exist.

Science indeed owes a great debt of gratitude to those travellers who have so industriously provided the materials of this investigation; in respect of which materials it may be observed generally, that they are very rich in quite new typical forms, particularly in genera, of which some contain several species; these, occasionally with some mud and fragments of small crustaceans, form the chief part of the mass. The new genera* and species are here recorded, and of these the *Asteromphali* are very remarkable, from their particularly beautiful stellate forms.

* Of the 7 new genera of Polygastrica, viz. *Anaulus*, *Asteromphalus*, *Chætoceros*, *Halionyx*, *Hemiaulus*, *Hemizoster*, and *Triaulacias*, short characters are given in the Proceedings of the Academy: also of the 71 new species.

Analysis of the various materials furnished by Dr. Hooker from the South Polar Voyage.

1. Residue from some melted Pancake Ice* at the barrier in 78° 10′ S. lat., 162° W. long.

A. SILICEOUS POLYGASTRICA.

1. *Actinoptychus biternarius.*
2. ASTEROMPHALUS *Hookerii.*
3. ... *Rossii.*
4. ... *Buchii.*
5. ... *Beaumontii.*
6. ... *Humboldtii.*
7. ... *Cuvierii.*
8. *Coscinodiscus actinochilus.*
9. ... *Apollinis.*
10. ... *cingulatus.*
11. ... eccentricus.
12. ... *gemmifer.*
13. ... limbatus.
14. ... lineatus.
15. ... *Lunæ.*
16. ... Oculus Iridis,
17. ... radiolatus.
18. ... subtilis.
19. ... velatus.
20. *Dicladia antennata.*
21. ... *bulbosa.*
22. *Dictyocha* aculeata.
23. ... Binoculus.
24. ... *biternaria.*
25. ... Epiodon.
26. ... *octonaria.*
27. *Dictyocha* Ornamentum.
28. ... septenaria.
29. ... Speculum.
30. *Flustrella* concentrica.
31. *Fragilaria* acuta,
32. ... Amphiceros.
33. *Gallionella pileata.*
34. ... sulcata ?
35. HALIONYX *senarius.*
36. ... *duodenarius.*
37. HEMIAULUS *antarcticus.*
38. HEMIZOSTER *tubulosus.*
39. *Lithobotrys denticulata.*
40. *Lithocampe australis.*
41. *Pyxidicula dentata.*
42. ... hellenica.
43. *Rhizosolenia Calyptra.*
44. ... *Ornithoglossa.*
45. *Symbolophora Microtrias.*
46. ... *Tetras.*
47. ... *Pentas.*
48. ... *Hexas.*
49. *Synedra* Ulna ?
50. *Triceratium Pileolus.*
51. *Zygoceros australis.*

B. SILICEOUS PHYTOLITHARIA.

52. *Amphidiscus* Agaricus.
53. ... clavatus.
54. ... *Helvella.*
55. *Lithasteriscus bulbosus.*
56. *Spongolithis* acicularis
57. *Spongolithis* aspera.
58. ... *brachiata.*
59. ... Caput serpentis.
60. ... cenocephala.
61. ... Clavus.

* Thin and level fragments of ice found floating in the ocean.

62. *Spongolithis*	collaris.	69. *Spongolithis*	*radiata.*
63. ...	Fustis.	70. ...	trachelotyla.
64. ...	*Heteroconus.*	71. ...	*Trachystauron.*
65. ...	inflexa.	72. ...	*Trianchora.*
66. ...	*Leptostauron.*	73. ...	*vaginata.*
67. ...	mesogongyla.	74. ...	verticillata.
68. ...	neptunia.	75. ...	uncinata.

C. CALCAREOUS POLYTHALAMIA.

76. *Grammostomum divergens,*	78. *Rotalia Erebi.*
77. *Rotalia antarctica.*	79. *Spiroloculina*—?

In several forms of the genus *Cossinodiscus* their green ovaries were recognizable, consequently they must have been alive.

2. Residue from melted ice, while the ship sailed through a broad tract of brown pancake ice, in 74° to 78° south latitude. (Materials from 75° S. lat., 170° W. long.)

A. SILICEOUS POLYGASTRICA.

1. ASTEROMPHALUS	*Buchii.*	8. *Dictyocha*	aculeata.
2. ...	*Rossii.*	9. *Eunotia*	gibberula.
3. *Coscinodiscus.*	lineatus.	10. *Fragilaria*	acuta.
4. ...	*Lunæ.*	11. ...	*pinnulata.*
5. ...	Oculus Iridis.	12. ...	rotundata.
6. ...	radiolatus.	13. HEMIAULUS	*antarcticus.*
7. ...	subtilis.	14. HEMIZOSTER	*tubulosus.*

B. SILICEOUS PHYTOLITHARIA.

15. *Spongolithis Fustis?* Fragm.

These and the former specimens were sent over in bottles of water. They were the same sealed bottles in which they were collected in the year 1842. In the first little bottle, in which the sediment was considerable, almost every atom being a distinct siliceous organism, *Hemiaulus antarcticus* predominated. The larger bottle of the second mass had allowed the greater part to leak through the sealed cork, so that only about a quarter remained. The mass of sediment arrived in Berlin in May 1844, almost all in such a condition, that the author had no hesitation in considering them still alive, although they all belonged to the almost or perfectly motionless forms. The Fragilarias predominated *F. (pinnulata)*; these, though rarely adherent in chains, had their green ovaries mostly preserved in a distinct natural disposition : *Coscinodisci* and *Hemiaulus* also often exhibited groups of green granules in their interior. No movement.

The following numbers were sent over dried :—

3. Sea-bottom drawn up by the lead from 190 fathom depth, in 78° 10′ S. lat., 162° W. long.

A. SILICEOUS POLYGASTRICA.

1. ASTEROMPHALUS *Hookerii.*	14. *Fragilaria* al. sp.
2. ... *Buchii.*	15. *Gallionella Sol.*
3. ... *Humboldtii.*	16. HEMIAULUS *antarcticus.*
4. ... *Cuvierii.*	17. *Lithobotrys denticulata.*
5. *Coscinodiscus Apollinis.*	18. *Mesocena Spongolithis.*
6. ... *gemmifer.*	19. *Pyxidicula.*
7. ... limbatus.	20. *Rhizosolenia Ornithoglossa.*
8. ... lineatus.	21. *Symbolophora ? Microtrias.*
9. ... *Lunæ.*	22. ... *Tetras.*
10. ... radiolatus.	23. ... *Pentas.*
11. *Dictyocha septenaria.*	24. ... *Hexas.*
12. ... Speculum.	25. TRIAULACIAS *triquetra.*
13. *Fragilaria* Amphiceros.	26. *Triceratium Pileolus.*

B. SILICEOUS PHYTOLITHARIA.

27. *Amphidiscus Polydiscus.*	34. *Spongolithis* Fustis.
28. *Spongolithis* acicularis.	35. ... neptunia.
29. ... aspera.	36. ... *Pes Mentidis.*
30. ... *brachiata.*	37. ... *Trianchora.*
31. ... Caput serpentis.	38. ... *vaginata.*
32. ... cenocephala.	39. ... uncinata.
33. ... *Clavus.*	

4. From snow and ice taken from the sea in 76° S. lat., 165° W. long., near Victoria Land.

SILICEOUS POLYGASTRICA.

1. *Coscinodiscus* lineatus.	4. *Fragilaria pinnulata.*
2. ... *Lunæ.*	5. ... rotundata
3. ... subtillis.	6. ... al. sp.

The chief mass was densely crowded with *Fragilaria pinnulata* and with *Coscinodiscus,* which on softening in water generally exhibited their green ovaries, perhaps originally brown.

5. Contents of the stomach of a Salpa, 66° S. lat., 157° W. long. 1842.

SILICEOUS POLYGASTRICA.

1. *Actiniscus Lancearius.*	8. *Dictyocha* aculeata.
2. *Coscinodiscus Apollinis.*	9. ... Speculum.
3. ... *cingulatus.*	10. *Fragilaria* acuta.
4. ... *gemmifer.*	11. ... *granulata.*
5. ... lineatus.	12. ... rotundata.
6. ... *Lunæ.*	13. Helionyx *duodenarias.*
7. ... subtilis.	14. *Pyxidicula.*

This material contained a large number of *Dictyochas,* which evidently must have been particularly sought for by the Salpa, since they do not occur in the other samples, and consequently appear to be a favourite food of the Salpa.

6. Flakes floating on the surface of the ocean in 64° S. lat., 160° W. long.

They are like the *Oscillatoriæ* of our waters, matted with delicate fibres and granules interspersed through the mass. The chief substance is formed of siliceous, very delicate, lateral tubes of the quite new and peculiar genus *Chætoceros.* The nature of the granules remains doubtful. The other forms are scattered through this matted substance; all exhibit however their dried-up ovaries, and consequently were collected alive.

SILICEOUS POLYGASTRICA.

1. Asteromphalus *Darwinii.*	10. *Dictyocha* aculeata.
2. ... *Hookerii.*	11. ... Binoculus.
3. ... *Rossii.*	12. ... Ornamentum.
4. ... *Buchii.*	13. ... Speculum.
5. ... *Humboldtii.*	14. *Fragilaria* Amphiceros.
6. Chetoceros *Dichæta.*	15. ... *granulata.*
7. ... *Tetrachæta.*	16. Hemiaulus *obtusus.*
8. *Coscinodiscus* lineatus.	17. *Lithobotrys denticulata.*
9. ... subtilis.	

7. The mass brought up by the lead from the bottom of the sea in the Gulf of Erebus and Terror, at the depth of 207 fathoms, in 63° 40′ N. lat., 55° W. long.

The following species, occasionally with distinct green ovaries, were found in this very small sample, mixed among the apparently unorganic sand.

B. SILICEOUS POLYGASTRICA.

1. ANAULUS *scalaris.*
2. *Biddulphia ursina.*
3. *Coscinodiscus Apollinis.*
4. ... *cingulatus.*
5. *Coseinodiscus Lunæ.*
6. ... subtilis.
7. ... velatus.
8. *Fragilaria* rotundata.
9. *Gallionella Sol.*
10. ... *Tympanum.*
11. *Grammatophora* parallela.
12. HEMIAULUS *antarcticus.*
13. *Rhaphoneïs faciolata.*
14. *Zygoseros ? australis.*

B. SILICEOUS PHYTOLITHARIA.

15. *Spongolithis* acicularis.
16. *Spongolithis* Fustis.

8. Sea-bottom drawn up by the lead from 270 fathom, in 63° 40′ S. lat., 55° W. long.

A. SILICEOUS POLYGASTRICA.

1. *Achnanthes* turgens.
2. *Amphora* libyca.
3. ANAULUS *scalaris.*
4. *Biddulphia ursina.*
5. *Campylodiscus* Clypeus.
6. *Coscinodiscus Apollinis.*
7. ... *gemmifer.*
8. ... lineatus.
9. ... *Lunæ.*
10. ... Oculus Iridis.
11. ... radiolatus.
12. ... subtilis.
13. *Denticella lævis.*
14. *Discoplea Rota.*
15. ... *Rotula.*
16. *Flustrella* concentrica.
17. *Fragilaria* Amphiceros
18. *Fragilaria pinulata.*
19. *Gallionella Oculus.*
20. ... *Sol.*
21. ... sulcata.
22. *Grammatophora* africana.
23. ... parallela
24. ... *serpentina.*
25. HEMIAULUS *antarcticus.*
26. *Lithocampe* n. sp.
27. *Mesocena Spongolithis.*
28. *Navicula elliptica.*
29. *Podosphenia* cuneata.
30. *Pyxidicula* hellenica ?
31. *Rhaphoneïs fasciolata.*
32. *Rhizosolenia Calyptra.*
33. ... *Ornithoglossa.*
34. *Stauroptera* aspera.

35. *Symbolophora Microtrias.*
36. ... *Tetras.*
37. ... *Pentas.*
38. *Symbolophora Hexas.*
39. *Synedra* Ulna.

B. SILICEOUS PHYTOLITHARIA.

40 *Amphidiscus* clavatus.
41. *Spongolithis* acicularis.
42. ... aspera.
43. ... *brachiata.*
44. ... Caput serpentis.
45. ... Clavus.
46. ... Fustis.
47. *Spongolithis Heteroconus.*
48. ... *ingens.*
49. ... neptunia.
50. ... obtusa.
51. ... *vaginata.*
52. ... uncinata.

C. CALCAREOUS POLYTHALAMIA.

53. *Grammostomum divergens.*

9. Samples from Cockburn's Island, the furthest limit of vegetation at the South Pole, 64° 12′ S. lat., 57° W. long.

Off Cockburn's Island (Cockburn's Head) Dr. Hooker saw an Alga, as the lowest and furthest step of vegetation, with forms of *Protococcus*. The Alga is one of the *Tetraspora* allied to *Ulva,* which Dr. Hooker has reserved, in order to describe more accurately : I have not recognised the *Protococcus* in its dried condition. This mass, however, is chiefly and equally peopled with and made up of Siliceous Polygastrica. An apparently unorganic sand, penguins' feathers and excrements, the *Ulva,* and only five as yet distinguished species of siliceous Infusoria in great numbers, form the mass sent over. The vegetable substances may indeed have disappeared by putrefaction. The excrement of the birds, like guano, might abundantly furnish solid matter; but the solid siliceous earthy element of the little invisible polygastric animals appears to form no inconsiderable part of the solid substance, which by the death of generations goes to form earth and land.

The following forms were observed:—

SILICEOUS POLYGASTRICA.

1. *Eunotia* amphioxys.
2. *Pinnularia* borealis.
3. ... peregrina?
4. *Rhaphoneïs Scutellum.*
5. *Stauropiera capitata.*

Two forms are new, two have been observed also at the north pole, and one is widely distributed.

II. *Oceanic materials from M. Schayer.*

M. Schayer of Berlin, who for fifteen years was superintendent of English sheep-folds at Woolnorth in Van Diemen's Land, has, in answer to a request sent to him in the year 1842 by the author, collected materials unquestionably rich in microscopic animals; he also collected water taken from the ocean in different regions on his return in 1843, and brought with him to Berlin four bottles holding from a quarter to half a pint. The author had wished that water had been drawn up at a distance from the coast in accurately known places, in order to become acquainted in some measure with the usual amount of microscopic life of the ocean.

The four well-preserved sealed bottles which have arrived in Berlin were shown to the Academy by the author, and the water is still quite clear and transparent, having only a few flakes at the bottom, which render it turbid when shaken, but soon subside again to the bottom, and the former transparency is restored. When opened, a slight but yet evident trace of sulphuretted hydrogen was perceptible.

The microscopic investigation has given the following results:

1. Water from the south of Cape Horn on the high sea under 57° S. lat., 70° W. long., contained—

SILICEOUS POLYGASTRICA.

1. *Fragilaria granulata.*
2. HEMIAULUS *obtusus.*
3. *Lithostylidium* Serra.

2. Water from the region of the Brazilian coast near Rio de Janeiro on the high sea, in 23° S. lat., 28° W. long.

A. SILICEOUS POLYGASTRICA.

1. *Cocconeïs* Scuttellum.
2. *Fragilaria* Navicula.
3. *Gallionella* sulcata.
4. *Haliomma* radiatum.
5. *Navicula* dirhynchus.
6. *Navicula* Scalprum.
7. *Pinnularia oceanica.*
8. ... peregrina.
9. *Surirella* sigmoidea.
10. *Synedra* Ulna.

B. SILICEOUS PHYTOLITHARIA.

11. *Spongolithis* aspera.
12. ... cenocephala.
13. *Spongolithis Fustis.*
14. ... *vaginata.*

3. Water from the equatorial ocean in direction of St. Louis in Brazil, in 0° lat., 28° W. long.

A. SILICEOUS POLYGASTRICA.

1. *Fragilaria* rhabdosoma.
2. *Fragilaria* Navicula.

B. SILICEOUS PHYTOLITHARIA.

3. *Lithostylidium* rude.
4. *Lithostylidium* Serra.

4. Water from the Antilles Ocean, 24° N. lat., 40° W. long.

A. SILICEOUS POLYGASTRICA.

1. *Haliomma* radiàtum.

B. SILICEOUS PHYTOLITHARIA.

2. *Lithodontium* nasutum.
3. *Lithostylidium* Amphiodon.
4. *Lithostylidium* rude.

C. MEMBRANOUS PORTIONS OF PLANTS.

5. *Pollen* pini.

It follows from these four series of observations obtained through M. Schayer, that the ocean, in its usual condition, without peculiarity of colour, without storms and other influences, contains, in the most transparent sea-water, numerous perfect and wholly invisible organisms suspended in it, and that the siliceous-shelled species are the most predominant in all those cases, although the analysis of sea-water does not show silica as a constant ingredient.

III. *On a Cloud of Dust which rendered the whole air hazy for a long time on the high Atlantic Ocean in* 17° 43′ *N. lat.,* 26° *W. long., and its being constituted of numerous siliceous animalcules.*

Mr. Darwin, the well-known and most meritorious English traveller and writer on coral reefs, relates in the account of his travels, that a fine dust constantly fell from the hazy atmosphere off the Cape Verd Islands, and also on the high sea of that region, while he was there; and likewise on a ship, which, according to the account in his letter, was 380 sea-miles distant from land. The wind was then blowing from the African coast. Mr. Darwin has sent to the author for examination a sample of the dust which fell on the ship on the high sea at that great distance from land. This dust has been universally regarded hitherto as volcanic ashes. The microscopic analysis has clearly shown that a considerable portion, perhaps one-sixth of the mass, consists of numerous speceis of Siliceous Polygastrica and portions of silicated terrestrial plants, as follows :—

A. SILICEOUS POLYGASTRICA.

1 *Campylodiscus* Clypeus.	10. *Himantidium* Arcus.
2. *Eunotia* Amphioxys.	11. ... Papilio.
3. ... gibberula.	12. *Navicula* affinis?
4. *Gallionella* crenata.	13. ... lineolata.
5. ... distans.	14. ... Semen.
6. ... granulata.	15. *Pinnularia* borealis.?
7. ... marchica.	16. ... gibba.
8. ... procera.	17. *Surirella* (peruviana?)
9. *Gomphonema* rotundatum?	18. *Synedra* Ulna.

B. SILICEOUS PHYTOLITHARIA.

19. *Amphidiscus* Clavus.	29. *Lithostylidium* Ossiculum.
20. *Lithodontium* Bursa.	30. ... quadratum.
21. ... curvatum.	31. ... rude.
22. ... furcatum.	32. ... Serra.
23. ... nasutum.	33. ... *spiriferum.*
24. ... truncatum.	34. *Spongolithis* acicularis.
25. *Lithostylidium* Amphiodon.	35. ... aspera.
26. ... *clavatum.*	36. ... mesogongyla.
27. ... cornutum.	37. ... obtusa.
28. ... læve.	

The forms included in this catalogue, mostly known and for the most part European, prove—

1. That this meteoric shower of dust was of terrestrial origin.

2. That it is not volcanic ash.

3. That it was dust which had been lifted up to a great height from a dried-up marshy district by an unusually strong current of air or a whirlwind.

4. That the dust did not necessarily and evidently come from Africa, as being the nearest land, although the wind blew from thence when the dust fell; for this reason, that no exclusively African forms are among it.

5. That as *Himantidium Papilio,* a very marked form, has hitherto occurred only in Cayenne (see the Mikroskopische Leben in Sud- und Nord-Amerika, plate 2. fig. 2.), and as the *Surirella* is also probably an American form, only two conclusions present themselves; either that the dust was raised in South America into the upper strata of air, and brought by a change of the current in another direction, or *Himantidium Papilio,* together with *Surirella,* likewise occur elsewhere, namely in Africa.

Review of the Results of these Investigations.

1. Not only is there, as resulted from the former observations of the author (vide d. Mikroskopische Leben in Amerika, Spitzbergen, &c.), an invisible minute creation in the neighbourhood of the Pole, where the larger animals can no longer subsist, but a similar creation is highly developed at the South Pole.

2. Even the ice and snow of the South Polar Sea is rich in living organisms, contending successfully with the extremity of cold.

3. The microscopic living forms of the South Polar Sea contain great riches hitherto wholly unknown, frequently of very elegant shape, since no less than seven peculiar genera have been discovered, of which some contain several, one as many as seven species.

4. The forms collected in the year 1842, near Victoria Land, were capable of being examined in an almost fresh state in Berlin in May 1844, which shows how long preservation is possible.

5. The ocean is not only populated at certain localities and in inland seas or on the coasts, with invisible living atoms, but is proportionately thickly crowded with life everywhere in the clearest state of the sea-water and far from the coasts.

6. Hitherto but one perfectly microscopic form from the high sea was known, and even that from the neighbourhood of the coast, namely the *Astasia oceanica,* which Von Chamisso had observed;

all other accounts were imperfect and useless. By the new materials the number of species is increased nearly 100.

7. The hitherto observed oceanic microscopic forms are chiefly siliceous-loricated animals with some calcareous-shelled. Do these numerous forms derive the material of their shells from the bottom of the sea ? This question becomes daily more interesting.

8. Siliceous and calcareous-shelled minute living forms are not only mixed up with the muddy sea-bottom, but they themselves form it. They live even to a depth of 270 fathom, and consequently support a pressure of water equal to 50 atmospheres ; the whole influence of this does not indeed bear upon their organic tissues when they are locally fixed, but when they move from the bottom upwards or reversely ; yet it does not appear to have acted on the drawn up specimens. Who can doubt but that organic beings which can support a weight of 50 atmospheres may support 100 and more ?

9. The supposition, that in great depths, above 100 fathom, there is no fresh nutriment for organized beings of any kind, has become untenable.

10. Life and temperature in the depths of the ocean are, in their variable relation, the points which at present deserve especial attention.

11. The showers of meteoric dust, or supposed ashes, have at present been proved to be, even in the case where they fell 380 sea-miles from land, of organic and terrestrial origin.

12. It is not perishable *Protococci* or *Ulvæ* or Lichens that principally constitutes the organic covering and soil of the ultimate islands in the Polar Sea ; but the living creatures that form the first layer of solid earth are invisible, minute, free animals of the genera *Pinnularia, Eunotia* and *Stauroneis* with their siliceous loricæ. Several species from the North Pole and the South Pole are identical.

Colouring of the Waters of the Red Sea.

A memoir on the colour of the waters of the Red Sea, by M. Montagne, was read at the Académie des Sciences, July 15th. The conclusions which the author draws from all the facts contained in his memoir, whether already known or entirely new and still unpublished, are the following :—

1. That the name of Erythrean Sea, given first to the sea of Oman and to the Arabian Gulf by Herodotus, afterwards by the later Greek authors to all the seas which bathe the coasts of Arabia, probably owes its origin to the very remarkable phænomenon of the colouring of its waters.

2. That this phænomenon, observed for the first time in 1823 by M. Ehrenberg in the bay of Tor only, then again seen twenty years later by M. Dupont, but in truly gigantic dimensions, is owing to the presence of a microscopic Alga *sui generis,* floating at the surface of the sea, and even less remarkable for its beautiful red colour than for its prodigious fecundity.

3. That the reddening of the waters of the lake of Morat by an *Oscillatoria* which DeCandolle has described, has the nearest relation to that of the Arabian Gulf, although the two plants are generically very distinct.

4. That as we may well suppose, according to the accounts of navigators, who mention striking instances of the red colouring of the sea, these curious phænomena, though not observed till quite recently, have nevertheless without doubt always existed.

5. That this unusual colouring of seas is not exclusively caused, as Péron and some others seem to think, perhaps as being chiefly zoologists, by the presence of mollusca and microscopic animalcules, but that it is often also due to the reproduction, perhaps periodical and always very prolific, of some inferior algæ, and in particular of the species of the singular genus *Trichodesmium.*

6. Lastly, that the phænomenon in question, although generally confined between the tropics, is however not limited to the Red Sea, nor indeed to the Gulf of Oman; but that, being much more general, it is found in other seas, for example in the Atlantic and Pacific Oceans, as appears in the 'Journal of Researches' by Mr. Darwin, and from the unpublished documents of Dr. Hinds, communicated by Mr. Berkeley, and from which the following extract is given :—

"Dr. Hinds, who sailed in the ship Sulphur, sent to explore the western coasts of North America, first observed on the 11th of February 1836, near the Abrolhos Islands, the same Alga doubtless which Mr. Darwin saw at the same date. This Alga was again seen many days running. Some specimens of it having been brought to Dr. Hinds, he perceived that a penetrating odour escaped from it which had before been thought to come from the ship; this odour much resembled that which exhales from damp hay. In April 1837, the Sulphur being at anchor at Libertad, near St. Salvador, in the Pacific, Dr. Hinds again saw the same Alga.

"A land breeze drove it for three days in very thick masses about the ship. The sea exhibited the same aspect as at the Abrolhos Islands, but the smell was still more penetrating and disagreeable; it caused in a great many persons an irritation of the conjunctive, followed by an abundant secretion of tears. Dr. Hinds himself experienced it. The Alga in question constitutes a distinct species of the genus *Trichodesmium*, and is named by M. Montagne *T. Hindsii*. It differs from that of the Red Sea both in dimensions and smell."—*Comptes Rendus, 15th July*, 1844.

Description of a Fossil Molar Tooth of a Mastodon *discovered by* Count Strzlecki *in Australia.* By Prof. Owen, F.R.S.

The large fossil femur, transmitted to England in 1842, by Lieut. Col. Sir T. L. Mitchell, Surveyor-General of Australia, from the alluvial or tertiary deposits of Darling Downs, and described in the 'Annals of Natural History' for January 1843, p. 8. fig. 1, gave the first indication of the former existence of a large Mastodontoid quadruped in Australia.

The portion of tooth described and figured in the same communication (p. 9. figs. 2 and 3), presenting characters very like those of the molars of both the *Mastodon giganteus* as well as of the *Dinotherium*, and being from the same stratum and locality as the femur with which it was transmitted, was regarded by me as having most probably belonged to the same animal; and, on the authority of drawings subsequently received from Sir T. Mitchell, was referred to the genus *Dinotherium*.*

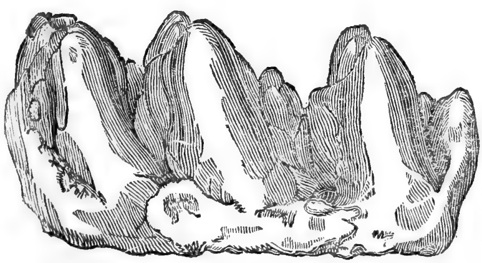
Having since received specimens of portions of lower jaws with teeth identical in structure with the fragment figured in my first

* Annals of Natural History, May 1843, p. 329, fig. 1.

communication to the 'Annals' (p. 9, figs. 2 and 3), I find that the reference to that portion of tooth to the genus *Dinotherium* was premature and erroneous. The extinct species to which it belonged does, indeed, combine molar teeth like those of the *Dinotherium* with two large incisive tusks in the lower jaw, but these tusks incline upwards instead of bending downwards, and are identical in form and structure with the tusk from one of the bone-caves of Wellington Valley, described by me in Sir T. Mitchell's 'Expeditions into the Interior of Australia,' vol. ii. 1838, p. 362. pl. 31, figs. 1 and 2, as indicative of a new genus and species of gigantic marsupial animal*, to which I gave the name of *Diprotodon australis.*

It is not my present object to describe these most interesting additional fossils of the *Diprotodon,* or to enter into the question whether the great femur before alluded to belonged, like the fragment of tooth transmitted with it, to the *Diprotodon,* or to a different and larger animal; but briefly to make known the more decisive evidence of the former existence of a large Mastodontoid quadruped in Australia, which is afforded by the tooth figured, on the scale of half an inch to one inch, in the subjoined cuts.

Fig. 1.



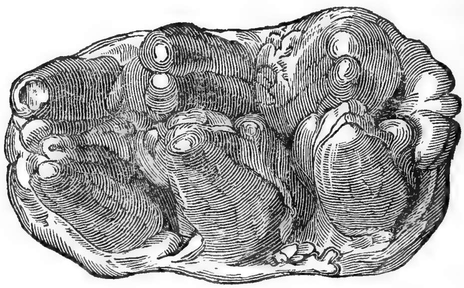
Mastodon australis, half nat. size.

If these figures be compared with those of the molar teeth of the *Mastodon angustidens,* reduced to the same scale, in Cuvier's 'Ossemens Fossiles,' 4to. vol. i., 'Divers Mastodontes,' pl. 2. fig. 11, pl. 3, fig. 2, or with that of the more abraded molar, pl. 1, fig. 4, they will be seen to present a generic and almost specific identity.

† See also my paper "On the Classification of Marsupialia," Zool. Trans. vol. ii. p. 332, in which the *Diprotodon* is placed with the Wombat in the family '*Phascolomyidæ.*'

The close approximation of the Australian Mastodon to the *Mast. angustidens* will be appreciated by a comparison of fig. 1 with a similar direct side-view of an equally incompletely-formed molar given by Cuvier, *loc. cit.* pl. 1. fig. 1; but this tooth, being from a more posterior part of the jaw, has an additional pair of pyramidal eminences; and if the proportions of the figure of half an inch be accurate, the European tooth is rather smaller than the Australian fos-

Fig. 2.



Mastodon australis, half nat. size.

sil, notwithstanding its additional tubercles and more backward position in the jaw.

The Australian fossil tooth here described was brought by a native to Count Strzlecki, whilst that enterprising and accomplished traveller was exploring the ossiferous caves in Wellington Valley. The native stated that the fossil was taken out of a cave further in the interior than those of Wellington Valley, and which Count Strzlecki was deterred from exploring by the hostility of the tribe then in possession of the district. With this circumstantial account, communicated to me by Count Strzlecki when he obligingly placed the fossil in my hands, and with the previous indication of a large Mastodontoid quadruped in the femur transmitted by Sir T. Mitchell from Darling Downs, there seems no ground for scepticism as to the veritable Australian origin of the molar tooth in question, notwithstanding its close similarity with the *Mastodon angustidens* of the European tertiary strata. It is partially mineralized and coated by the reddish ferruginous earth characteristic of the Australian fossils discovered in the Wellington ossiferous caves by Sir T. Mitchell.

The amount of difference between the Australian molar and those of the European *Mastodon angustidens,* though small, equals that by which the molars of the *Mastodon Andium* are distinguished from the molars of the *Mastodon angustidens ;* and if species so nearly allied have left their remains in countries so remote as France and Peru, still more if the *Mastodon angustidens* or *longirostris* formerly existed, as has been affirmed, in North America, we need feel the less surprise at the discovery of a nearly allied species in the continent of Australia.

The fossil in question is the crown of an incompletely formed molar, with the summits of its mastoid or udder-shaped eminences entire, its fangs undeveloped, and its base widely excavated by the unclosed pulp-cavity. It supports six principal mastoid eminences in three transverse pairs, with a narrow ridge at the anterior part of the base of the crown, and a small quadrituberculate talon or basal prominence posteriorly : the three transverse eminences are joined together by a pair of small tubercles at the basal half of each interspace, placed in the long axis of the crown, and rather to the outer side of the middle line of the grinding surface, fig. 2.

The length or antero-posterior diameter of the crown is four inches ten lines : the breadth of the posterior pair of tubercles is two inches eleven lines : the height of the middle eminences from the base of the crown is two inches six lines : the tooth is apparently the fourth molar of the left side of the lower jaw. In comparison with a corresponding molar in the same state of growth of the *Mastodon longirostris** of Kaup, a cast of which is now before me, the Australian molar differs in having the principal transverse eminences more compressed antero-posteriorly in proportion to their height, and tapering to sharper summits, which however are obtuse and bifid. The breadth of the tooth slightly increases to the posterior pair of eminences, whilst in the *Mastodon longirostris* and *angustidens* the crown maintains the same breadth, or more commonly becomes narrower from the anterior to the posterior pair of mastoid eminences.

Other differences observable on a minute comparison are too trivial to deserve notice, especially when observed in only a single ex-

* If this species be distinct from the *Mast. angustidens* of Cuvier, the molar teeth seem to me to offer precisely the same characters.

ample of a complex molar tooth. In the Australian specimen under consideration the mastodontal characters are unmistakeable, and the resemblance to the molar teeth of the *Mastodon angustidens* is very close. The specific distinction of the Australian Mastodon rests, at present, only on the slight differences pointed out in the form of the mastoid eminences and the contour of the crown of the molar tooth.

The question may arise, whether identity of generic characters in the molar teeth of an extinct Australian mammal with those of the *Mastodon* can support the inference that the remaining organization of the Probosidian Pachyderm co-existed with such a form of tooth. The analogy of the close mutual similarity which exists in the molar teeth of the Tapir, Dinothere, Manatee and Kangaroo suggests the surmise that the mastodontal type of molar teeth might also have been repeated in a gigantic Marsupial genus which has now become extinct; and such an idea naturally arose in my mind after having received evidence of the marsupial character of the *Diprotodon* and *Nototherium**, two extinct Australian genera, with the tapiroid type of molars, represented by species as large as a Rhinoceros.

The more complex character of the molars of the *Mastodon*, and the restriction of that character, so far as is now known, to that genus only, makes it much more probable, however, that the molar here described belonged to a true *Mastodon*, and the species may be provisionally termed *Mastodon australis*.

London, August 22, 1844.

* The characters of these genera, and the evidences of their marsupipal nature, will be the subjects of a future communication.

On some Fossil Remains of Anoplotherium and Giraffe, from the Sewalik Hills, in the North of India. By H. FALCONER, M.D., F.G.S., *and* CAPT. P. T. CAUTLEY, *of the Bengal Artillery,* F.G.S.

In continuation of their former researches on the fossil remains of the Sewalik Hills, the authors, in their present communication, establish, on the clear evidence of anatomical comparison, certain discoveries which, in previous publications, they had either merely announced, or had supported by proofs professedly left incomplete. They now demonstrate that there occur in the remarkable tertiary deposits of the Sewalik range, together with the osseous remains of various other vertebrate animals, bones belonging to the two genera, Anoplotherium and Giraffe: the former genus determined by Cuvier from parts of skeletons dug out from the gypsum beds of Paris; the latter genus known only as one of man's contemporaries, until in the year 1838, the authors gave reason for believing its occurrence in the fossil state.

The specimens now figured and described form part of the collection which was made by the authors on the spot, and is now deposited in the British Museum. They were found, together with remains of Sivatherium, Camel, Antelope, Crocodile, and other animals, in the Sewalik range to the west of the river Jumna.

The bones are found imbedded either in clay or in sandstone. When clay is the matrix, they remain white; and except in being deprived more or less completely of their animal matter, they have undergone little alteration. The bones in this state the authors have eleswhere designated as the "soft fossil." When sandstone is the matrix, the animal matter has completely disappeared, and the bone is thoroughly mineralized and rendered nearly crystalline by the infiltration of siliceous or ferruginous matter, and acquires a corresponding hardness, or tinge of iron, with increased specific gravity. The matrix in contact with the bone is rendered compact and crystalline in texture. The remains in this state have been designated by the authors as the "hard fossil."

The remains of Anoplotherium and of the larger species of Giraffe, described in the present communication, belong to the "soft fossils;" those of the smaller species of giraffe to the "hard fossil."

Anoplotherium.—The occurrence, in the Sewalik deposits, of bones belonging to this genus, was announced by the authors in their 'Synopsis of the fossil genera, from the upper deposits of the Sewalik hills,' published in the 4th volume of the Journal of the Asiatic Society of Bengal, in the year 1835; and the same fact was afterwards referred to in the 6th volume, p. 358, of that Journal. In these communications the species was not described, but was named provisionally, *A. posterogenium.* In a communication made to the Geological Society in the year 1836, descriptive of a quadrumanous fossil remain, and published in the 5th volume of the 2d series of their Transactions, the same species was mentioned under the name of *A. Sivalense,* a term which the authors propose to retain, in accordance with the principle they adopted in the cases of the horse, camel, hippopotamus, &c., of connecting the most remarkable new species of each fossil Sewalik genus with the formation itself.

In their present communication the authors purposely abstain from entering on the anatomical characters of this new species further in detail than is barely sufficient for its determination; and they therefore confined their notice to two fine fragments of one head, one fragment belonging to the left upper jaw; the other fragment to the right upper jaw.

By a happy chance the teeth are beautifully preserved. The age of the individual, which was just adult, was the best that could be desired to show the marks characteristic of the genus; for the teeth had attained their full development, though the two rear molars had hardly come into use.

Remarks on the Genus Anoplotherium.—The true Anoplotheria of Cuvier (of which *A. commune* may be regarded as the type), together with the *A. Sivalense* and the *Chalicotherium* (Anoplotherium ?) *Goldfussi,* are allied, by their dentition, to Rhinoceros. The Dichobunes, *A. Leporinum, A. murinum* and *A. obliquum,* Cuvier arranges with considerable doubt, and provisionally only, among the Anoplotheria. He considers it not impossible that the two latter species were small *ruminants*. The *A. Servinum* of Professor Owen (Geol. Trans. 2nd ser. vol. vi. p. 45), obtained by Mr. Pratt from Binstead in the Isle of Wight (Idem, vol. iii. p. 451), is admitted on all hands to be exceedingly like a musk deer. Such heterogeneous materials are too much for the limits of any one genus Cuvier imagined the separation of the two metacarpal bones to be a character limited to the Anoplotheria exclusively. He has also regarded the union of the metacarpal bones as holding without exception in all the ruminants; and this law with respect to ruminants, though empirical, he regards as equally certain with any conclusion in physics or morals, and as a surer mark than all those of Zadig (Disc. Prel. p. 49).

The authors, having had an opportunity of examining the skeleton of an African ruminant, the *Moschus aquaticus* of Ogilby, described in the Proceedings of the Zoological Society by that gentleman from a living specimen, found it wanting in the above supposed essential character of the ruminants, and possessing the above supposed distinctive character of Anoplotherian Pachyderms. Its metacarpals are distinct along their whole length; its fore leg, from the carpus downwards, is undistinguishable from that of the peccary; and its succentorial toes are as much developed as in the last-mentioned animal.

The deviation from the ordinary ruminant type, indicated by the foot of this Moschus, is borne out by a series of modifications in the construction of the head and in the bones of the extremities and trunk, all tending in the direction of the pachyderms.

The authors believe the present to be the first announcement of the existence of such an anomaly in any living ruminant: they had previously ascertained the occurrence of the same structure in a fossil ruminant from the Sewalik hills. As the Dorcatherium of Kaup breaks down the empirical distinction between the ruminants and pachyderms, as regards the number of the teeth, so does the *Moschus aquaticus* as regards the structure of the feet.

Giraffe.—In the 7th volume of the Journal of the Asiatic Society of Bengal (pp. 658-660) is a communication dated "Northern Doab, July 15, 1838," and intituled, "Note on a Fossil Ruminant Genus allied to Giraffidæ, in the Sewalik hills, by Capt. P. T. Cautley." The specimen referred to in that paper was the third cervical vertebra of a ruminant, which, for the reasons therein assigned, was supposed to have been a giraffe. At that time the authors of the present communication had not access either to drawings of the osteology or to a skeleton of the existing giraffe: but the grounds for referring the vertebra to that genus were, that it belonged to a ruminant with a columnar neck, the type of the ruminants being preserved, though very attenuated in its proportions: that the animal was very distinct from any of the camel tribe: that it was in the giraffe that there existed such a form most aberrant from the mean in respect of its great elongation. That the bone belonged to a giraffe was put forth at the time as only a probable inference, and chiefly to serve as an index to future inquiries.

The authors, having since the former period obtained additional specimens, and had access to the fullest means of comparison, are now able to place on the record of determined Sewalik fossils, one very marked species of giraffe, and also indications of a second species, which, so far as the scanty materials go, appears to come near to that of Africa.

The first specimen to which they refer is the identical vertebra noticed by Capt. Cautley in 1838. It is an almost perfect cervical vertebra. It were needless to enter on the characters which prove it to have belonged to a ruminant. Its elongated form shows that it belonged to one with a columnar neck; that is to say, either to one of the camel and Auchenia tribe, or to a giraffe, or some distinct and unknown type. The fossil differs from the vertebra of a camel, 1st, in the position of the vertebrary foramina (*a, a′*); 2d, in the obsolete form of the upper transverse processes. According to the masterly analysis of the Macrauchenia by Professor Owen, the Camelidæ and Macrauchenia differ from all other known mammalia in the following peculiarity; that the transverse processes of the six inferior cervical vertebræ are without perforations for the vertebrary arteries, which enter the vertebrary canal along with the spinal chord, then penetrate the superior vertebrary laminæ, and emerge on the canal again close under the anterior oblique processes. This structure appears on the cervical vertebræ of the Sewalik fossil camel. In the vertebra now under consideration, on the contrary, the foramina (*a, a′*) maintain their ordinary position, that is, they perforate the transverse processes, and appear on the surface of the body of the vertebra.

Since the bone therefore does not belong to a camel, it is the bone of a giraffe? There is preserved in the museum of the Zoological Society the skeleton of a young Nubian giraffe which died at the Society's gardens. When its third cervical vertebra is placed in apposition with the fossil, the two are found to agree in every general character, though they disagree in some of their proportions, and in certain minor peculiarities. In this young and immature giraffe the length of the third cervical vertebra is 7½ inches; what, then, is the length of this bone in the adult Nubian giraffe? The authors, from their not having had under their examination this vertebra of an adult animal, have been unable to ascertain this point directly; but they are able to infer it, from the length of a detached bone preserved in the museum of the Royal College of Surgeons of London, which is the second cervical vertebra of a giraffe, nearly, but not quite full-grown*. The length of this bone is 11½ inches. Now in the skeleton of the young giraffe belonging to the Zoological Society the 2d and 3rd cervical vertebræ are exactly of the same length. The authors infer, therefore, that in an animal nearly full-grown, such as was that to which the detached bone at the College of Surgeons belonged, the length of the 3rd cervical vertebra is 11½ inches; and consequently, that the length of the same bone in an animal which has reached full maturity, is about 12 inches†.

That the fossil vertebra belonged to an adult which had long attained its full size, is shown by the complete synostosis of the upper and lower articulating surfaces, by the strong relief of the ridges and the depth of the muscular depressions. But the length of this bone is only a little more than eight inches. As the other dimensions of the fossil and recent vertebræ that the authors placed in apposition, are nearly in proportion to their respective lengths, it follows that this fossil species of giraffe was one-third shorter in the neck than an adult of the existing Nubian variety.

But it was not only in size that the two giraffes differed; they differed also in their proportions. In the young giraffe at the Zoo-

* This appears from the detached state of the upper and lower articulating heads of the bone.

† The height of the skeleton of the young giraffe in the museum of the Zoological Society is 10½ feet; that of a full-grown Nubian giraffe is 16 feet.

logical Society the vertebra, which is 7½ inches long, has a vertical diameter of 3·8 inches; whereas in the fossil species the vertebra, which is 8 inches long, instead of having a vertical diameter exceeding 4 inches (as it ought, if its breadth were proportional to its length), has a vertical diameter of only 3·6 inches. This goes to prove that in this fossil giraffe the neck was one-tenth more slender in proportion to its length than the neck is in the existing species.

The inferior surface of the body of the vertebra is more curved longitudinally in the fossil than it is in the recent bone; the height of the arc in the former case being to the height in the latter as 3 is to 2.

On the under surface of the fossil vertebra a very distinct longitudinal ridge runs down the middle, and this ridge is wanting in the recent bone; but this difference, probably, is chiefly owing to difference of age.

In the fossil vertebra the upper articulating head is very convex; for with a transverse diameter of 1·4 inch it has a vertical height of 1 inch; laterally it is a good deal compressed.

The posterior articulating surface, forms a perfectly circular cup, two inches in diameter; and this diameter, in the immature Nubian giraffe, is one-tenth greater, although the vertebra is one-sixteenth shorter. This affords a further proof of the comparative slenderness of neck in this fossil species.

In regard to the apophyses, the inferior transverse processes are sent off downwards and outwards from the lower part of the anterior end, exactly as in the recent species, and they are developed to nearly the same amount of projection. There is, however, this considerable difference, that whereas in the recent species they do not run half-way down the body of the vertebra, in the fossil they are decurrent along the whole of its length in well-marked laminar ridges, which are confluent with the nearly obsolete ridges of the upper transverse processes, the united mass near the posterior end being dilated into two thick alæform expansions.

In the fossil, as in the recent bone, the superior transverse processes are seen only in a rudimentary state; in the former, however they run forwards across the body with less obliquity, and consequently make the canals for the vertebrary arteries twice as long as they are in the recent bone. In the fossil the orifices of these canals divide the length of the vertebra into three nearly equal portions;

whereas in the recent bone the orifices are both included within its anterior half.

The anterior oblique processes have the same general form and direction both in the fossil and recent species; but in the former they are considerably stouter and larger, and their interspace is less. The articular surfaces are convex, and defined exactly as in the recent species.

The posterior oblique processes of the fossil differ in form very little from those of the recent bone; in the fossil, however, the articular surfaces are considerably larger; and the ridges in which they are continued along the side of the upper vertebrary arch, are much less convergent than in the recent bone; so that in the latter this part is somewhat heart-shaped; whereas in the fossil it is nearly oblong, and "looks squarer," so to speak.

The spinous process in the fossil is the same thin triangular lamina that is seen in the recent species; and it differs only in having its most prominent point lower down on the arch.

The spinal canal is very much of the same form and dimensions in both the fossil and the recent vertebra. At this point some of the matrix remains attached to the fossil bone, and prevents any very precise measurement.

As a minor point of agreement between the fossil and recent bones, it may be noted that, in both, the foramen for the small nutritious artery on the inferior side of the body of the vertebra is on the right. In the other cervical vertebræ of the recent skeleton, this solitary foramen is on the left.

From the above comparisons it appears that the fossil vertebra while it is very distinct from that of a camel, fulfils all the conditions required for a strict identification with that of a giraffe; that its peculiarities are not of greater than specific importance; and consequently do not warrant its being referred to a distinct and unknown type among the ruminants.

The authors conclude that there belonged to the Sewalik fauna a true well-marked species of giraffe closely resembling the existing species in form, but one-third less in height, and with a neck proportionately more slender; and for this small species they propose the name *Camelopardalis Sivalensis*.

Second Fossil Species of Giraffe.—The fossil specimens next to be described have been in the possession of the authors ever since 1836. They are fragments from the upper and lower jaws of another fossil species of giraffe, in which the teeth are so exactly of the same size and form with those of the existing species, and so perfectly resemble them in every respect, that it requires the calipers to establish any difference between them.

The largest specimen is a fragment of a left upper jaw containing the two rear molars. The back part of the maxillary, beyond the teeth, is attached, and clearly proves that they belonged to a full-grown animal. These teeth were compared with the teeth, in the same stage of wearing, contained in the head of an adult female giraffe belonging to the museum of the College of Surgeons, and the fossil and recent teeth were found to agree together in the most minute particulars. The following are the corresponding dimensions of the fossil and recent teeth :—

	Fossil. Inches.	Recent. Inches.
Joint length of the two back molars, upper jaw, ...	2·5	2·55
Greatest width of last molar, ...	1·4	1·3
Ditto ditto of penultimate molar, ...	1·45	1·35

Five other specimens are next described in detail by the authors. They are all of them fragments of jaws and teeth more or less complete upper jaws, corresponding exactly in size and form with that of the left side, but if anything, rather more worn, and belonging therefore, probably, to different individuals. The agreement extends down to the small cone of enamel at the base of the hollow between the barrels on the inside. Its dimensions are :—

Length.............. 1·2 inches.
Width .... 1·4

The third specimen is a fragment of the left lower jaw, containing the last molar. It has precisely the form and proportions of the corresponding tooth in the left lower jaw of the female head referred to, and the same development of its third barrel or heel, which is always found in this tooth in ruminants. Its dimensions are :—

Length............. 1·7 inch.
Greatest width........ 1·0

The fourth specimen is the last false molar of the left lower jaw, detached. It agrees closely with the corresponding tooth in the recent female head above referred to. This tooth is thicker in proportion to its length in the giraffe than in other ruminants, and this constitutes one of the most distinctive characters of the giraffe's premolars. The anterior semi-barrel appears a trifle longer than the corresponding tooth of the recent animal; but this is owing to a difference of wear, and is not borne out by measurement. The dimensions are :—

	Fossil.	Recent.
Length..........	1·0 inch.	1·0 inch.
Breadth........	0·9	0·86

The authors are possessed of the same tooth of the right lower jaw, detached; but have not thought it necessary to figure it.

The fifth specimen is the penultimate false molar of the right upper jaw. It is of the same size and form with the corresponding tooth in the recent female head, with this difference, that it has three tubercles at the inside of the base. On a sixth specimen of the first false molar of the right upper jaw, which is not represented among the figures, there are three similar tubercles similarly placed. It would require an extensive comparison of recent heads to determine what value attaches to this peculiarity; whether the tubercles are constantly absent from the teeth of the recent species, or appear occasionally as a variation on those of individuals. The dimensions of the penultimate false molar of the upper jaw are :—

	Fossil.	Recent.
Length........	1·0 inch.	0·95 inch.
Breadth......	1·12	1·12

There is a peculiar, finely reticular, striated and rugose surface to the enamel of the teeth of certain quadrupeds, the appearance of which the authors compare to that of a fine net, forcibly extended, so as to bring the sides of the meshes together. This texture they formerly described as existing on the surface of the molars of the Sivatherium. It is found also on the teeth of the recent giraffe, and is more or less conspicuous on those of the hippopotamus. It is not observed in the camel, the moose deer, or the larger bovine ruminants; or if ever present, it is but faintly developed. This texture is well marked on the enamel of the teeth of this second species of giraffe. A magnified representation of it is given.

The series of teeth last described, excepting the fifth and sixth specimens, are all but undistinguishable from those of the Nubian giraffe; and the authors have sought in vain for any distinctive character by which to discriminate them. There is no good evidence to show that this fossil species and the living are even different; but in putting the case thus, the authors are far from advancing that the species are identical. The materials are far too scanty to warrant a conjecture to that extent.

Since the neck of the *C. Sivalensis* was one-third too short and slender to sustain the head that would have suited the teeth last described, the authors consider it a necessary consequence that these teeth belonged to a distinct species. Had the difference been less considerable, they might have hesitated regarding this conclusions; but the difference between 8 inches and 12 inches in the length of the same cervical vertebra of two adult animals of the same genus, admits, in their opinion, of no other construction than distinctness of species. For the present, until sufficient materials shall be obtained to determine the relationship between the African giraffe and the second Sewalik species, in reference to their supposed resemblance, the authors propose to mark the latter by the provisional name of *Camelopardalis affinis*.

General Remarks.—In a former communication to the Society, (Geol. Trans. 2nd ser. vol. v. p. 503) the authors noticed the remarkable mixture of extinct and recent forms which constituted the ancient fauna of Northern India. An extinct testudinate form, *Colossochelys Atlas,* as enormous in reference to other known Chelonians as the Saurians of the lias and the oolite are to their existing analogues, is there associated with one or more of the same species of crocodile that now inhabit the rivers of India. The evidence respecting one of these species of crocodile, resting as it does on numerous remains of individuals of all ages, is considered by the authors as nearly conclusive of the identity of the fossil with its recent analogue. These reptiles occur together with extinct species of such very modern types as the monkey, the camel, the antelope, and (as has now been shown the giraffe : and these are met by species of the extinct genera Sivatherium and Anoplotherium. As regards the geographical distribution of the true Anoplotheria, those hitherto discovered have been confined, as the authors believe, to Europe; and as regards their geological distribution, to the older and middle tertiaries. In India this genus continued down to the period when existing Indian crocodiles and probably some other recent forms had become inhabitants of that region.

It might be expected that in a deposit containing Anoplotherium, Palæotherian remains also would sooner or later be discovered. However, among the very large collection of fossil bones from the tertiary sub-Himalayan range, made by the authors during ten years in that part of India, they have never found a single fragment of a head or tooth which they were able to refer to Palæotherium. This is merely a negative result, and only proves the rarity of that form.*

Although there occur among the Sewalik fossils abundant remains of almost every large pachydermatoes genus, such as the elephant, mastodon, rhinoceros, hippopotamus, sus, horse, &c., yet no remain has been found referrible to the Tapir, a fact the more remarkable, inasmuch as one of the only two existing species of that genus is now confined to the larger Indian islands and a part of the adjoining continent.

The finding of the giraffe as a fossil, furnishes another link to the rapidly increasing chain which (as the discoveries of year after year evince) will sooner or later connect extinct with existing forms in a continuous series. The bovine, antelope, and antlered ruminants

* Mr. M'Clelland in his paper on *Hexaprotodon* (Journ. Asiatic Society of Bengal, vol. vii. p. 1046) casually mentions a species of Palæotherium as occurring among the Sewalik fossils. But he does not describe or figure the specimen. Messrs. Baker and Durand in their remarks appended to their catalogue of the Dadoopor collection (Idem, vol. v. p. 836), mention four specimens containing teeth of the upper and lower jaws belonging to what they provisionally designate "Cuvierian genera:" in regard to one of which, having the upper and lower jaws in contact, they state that, "although it affords some analogies both to the Palæotherium and Anoplotherium, its essential peculiarities are sufficiently remarkable to cause it to be separated from either genus." Till these specimens are either figured or described, the point must remain undecided in regard to Palæotherium being represented in the Sewalik fauna.

have numerous representatives, both recent and fossil. The camel tribe comprises a considerable fossil group, represented in India by the *Camelus Sivalensis*, and is closely approached to in America by extinct Pachydermatous Macrauchenia. The giraffe has hitherto been confined, like the human race, to a single species, and has occupied an isolated position in the order to which it belongs. It is now as closely represented by its fossil analogues as the camel; and it may be expected that, when the ossiferous beds of Asia and Africa are better known, other intermediate forms will be found, filling up the wide interval which now separates the giraffe from the antlered ruminants, its nearest allies in the order according to Cuvier and Owen.*

The giraffe throws a new light on the original physical characters of Northern India; for whatever may be urged in regard to the possible range of its vegetable food, it is very clear that, like the existing species, it must have inhabited an open country, and had broad plains to roam over. In a densely forest-clad tract, like that which now skirts the foot of the Himalayahs, it would soon have been exterminated by the large feline feræ, by the hyænas and large predaceous bears which are known to have been members of the old Sewalik fauna.

Postscript.—Since the above remarks were submitted to the Society, M. Duvernoy's paper, embodying two communications read to the Academy of Sciences on the 19th May and 27th November last, has appeared in the January Number of the 'Annales des Sciences Naturelles.' These notices were published in the 'Comptes Rendus,' but were unknown to the authors at the time. M. Duvernoy describes the lower jaw of a fossil giraffe found in the bottom of a well, lying on the surface of a yellow clay, along with fragments of pottery and domestic utensils, in the court of an ancient donjon of the 14th century in the town of Isoodun, Département de l'Indre. Considerable doubt remains as to the bed and source whence the fossil was derived. M. Duvernoy attributes the jaw to a distinct

* M. G. de St. Hilaire, in the zeal for the mutability of species imagined that he had detected in the Sivatherium the primeval type which time and necessity had fined down into the giraffe. Anatomical proofs were all against this inference: but if a shadow of doubt remained, it must yield to the fact, that in the Sewalik fauna the Giraffe and the Sivatherium were contemporaries.

species of giraffe, which he names *Camelopardalis Biturigum.* Professor Owen, from the examination of a cast, confirms the result, expressing his conviction "that in the more essential characters the Isoodun fossil closely approaches the genus Giraffe, but differs strikingly from the (*single*) existing species of the south and east of Africa, and that the deviations tend towards the sub-genus Elk."

M. Duvernoy also mentions the discovery of a tooth in the molasse near Neufchatel, by M. Nicolet, determined by M. Agassiz to be the outer incisor of a fossil giraffe.—*(Duvernoy, Annales des Sciences Naturelles,* No. for January 1844.)—*Proceedings Geological Society.*

Botany of the Brazils, from the President's address to the Linnæan Society.

Don José Pavon, a botanist of considerable merit, and the colleague of Ruiz in the memorable botanical expedition dispatched to Peru by the Spanish Government in the year 1777, from which were obtained such important results both in collections and publications. On the recommendation of Ortega, then Professor of Botany at Madrid, the expedition was placed under the direction of Ruiz, who was accompanied by Pavon and by two artists, Brunete and Galvez. M. Dombey also, who had been dispatched from France on a similar mission, was allowed to accompany them; and during a residence of ten years they visited many of the most interesting districts of Peru and Chile. In 1788 Ruiz and Pavon returned to Europe, bringing with them large collections of plants and an extensive series of botanical drawings, and leaving behind them two of their pupils, Tafalla (afterwards Professor of Botany in the University of Lima), and Pulgar (an artist of merit), to continue their investigations. The collections thus made by themselves, and those which were subsequently transmitted to them, formed the basis of a series of works on the botany of the Western Regions of South America, which, had they been carried on to completion, would have been indeed a magnificent contribution to science, and which even in their present incomplete state are of high importance. The first of these publications appeared in 1794, under the title of 'Floræ Peruvianæ et Chilensis Prodromus,' and contains descriptive characters and illustrative figures of their new genera. This was followed in 1798, by the first volume of the 'Flora Peruviana et Chilensis,' two other volumes of which, extending as far as the class *Octandria* of the Linnæan system, were published in 1799 and 1802. The plates of a fourth volume, as well as many others intended for subsequent publication, were also prepared. In 1798 also was published the first volume of a smaller work without figures, entitled 'Systema Vegetabilium Floræ Peruvianæ et Chilensis,' containing characters of all their new genera and of the species belonging to them, as well as of all the other species described in the first volume of their 'Flora.'

Of the immense collections made by Ruiz and Pavon and other botanists in the Spanish possessions in America, a large portion was purchased by Mr. Lambert between the years 1817 and 1824. These were dispersed at the sale of his Herbarium in 1842; but a part of them was then obtained for the British Museum, where they are now deposited. Little is known of the latter years of Pavon; his correspondence with Mr. Lambert appears to have ceased in 1824, and even the exact date of his death has not been ascertained. —*The Annals and Magazine of Natural History, Vol.* 14, *No.* 91.

Whether Lightning Rods attract Lightning.

[From an interesting work by Snow Harris Esq., F.R.S. on the protection afforded by Lightning Rods to ships of H. M. Navy.]

" Amongst the objections made to the employment of lightning rods, there appears to have been none so popular, and at the same time so plausible, as this, viz., that by setting up pointed conductors we invite lightning to our buildings, which otherwise would not fall on them; that should the quantity of electricity discharged be greater than the rod can carry off, the redundant quantity must necessarily act with destructive violence; and that since we can never know the quantity of electricity which may be accumulated in, and be discharged from the clouds, it is not improbable but that any conductor which we can conveniently apply may be too small for the safe conveyance of such a charge.

Although the advocates of these opinions have never adduced any substantial fact or any known law of electricity, in support of them; although they have never, by any appeal to experience, shown that buildings armed with lightning rods have been struck by lightning more frequently than buildings not so armed, nor demonstrated any single instance in which an efficient lightning rod, properly applied, has failed to afford protection,—nevertheless such views have been commonly entertained: indeed so strenuously have they been insisted on, and that too by persons of education and influence, that the Governor-General and Council of the Honourable the East India Company were led to order the lightning rods to be removed from their powder magazines and other public buildings, having in the year 1838 come to the conclusion, from certain representations of their scientific officers, that lightning rods were attended by more danger than advantage; in the teeth of which conclusion, a magazine at Dum-Dum, and a Corning-house at Mazagon, not having lightning rods, were struck by lightning and blown up.*

In a work on Canada, published so lately as the year 1829,† we find the following passage: " Science has every cause to dread the thunder rods of Franklin: they attract destruction, and houses are safer without than with them. Were they able to carry off the fluid they have the means of attracting, then there could be no danger, but this they are by no means able to do." Assertions such as these, appealing as they do to the fears of mankind, rather than to their dispassionate and sober judgment, have not altogether failed in obtaining that sort of temporary favour which so frequently attends a popular prejudice, promulgated without reason, and received without proof. Not only is the idea that a lightning rod invites lightning unsupported by any fact, but it is absolutely at variance with the whole course of experience.

* Correspondence with the Honorable Board of Directors; Professor Daniell and Dr. W. B. O'Shaughnessy. Our readers may remember something of a controversy on this subject in our pages a few years ago. If not, we beg to refer them to vol. 1. pp. 431 and 489. It will there be found that the fallacies and absurdities regarding lightning rods referred to by Mr. Harris, were pointed out, and some of the misstatements on which they were founded fully exposed.—Ed.

† *Three years in Canada.* By F. McTaggart, Civil Engineer in the service of the British Government.

The notion that a lightning rod is a positive evil, appears to have arisen entirely out of assumptions, and a partial consideration of facts. Thus in consequence of the track of a discharge of lightning being always determined through a certain line or lines, which upon the whole least resist its progress (48), it has often been found to fall in the direction of pointed metallic bodies, such as vanes, vane spindles, iron bars, knives, &c. The instances in which these bodies seem to have determined the course of lightning have been carefully recorded, the phenomena being peculiarly striking and remarkable (54); but on the other hand, no attention has been given to those instances in which lightning has altogether avoided such bodies, and passed in other directions (46). Now it will be found, as we shall presently show that the action of a pointed conductor is purely passive. It is rather the patient than the agent; and such conductors can no more be said to attract or invite a discharge of lightning, than a water-course can be said to attract the water which flows through it at the time of heavy rain.

We have shown, in a former section (71), what quantity of metal is really sufficient for the perfect conduction of any quantity of lightning liable to be discharged in the most severe thunderstorms: therefore, to assume that any conductor which may be applied is not sufficiently capacious, is to reason against experience, and to resort to a species of argument quite foreign to the conditions of the case. It would be, as if we were to insist upon the danger of applying water-pipes to buildings, under the assumption that we do not really know what quantity of rain may possibly fall from the clouds, and that hence the pipe may after all be too small to convey it.

In all these reasonings we should recollect, as already explained (10), that the forces in operation are distributed over a great extent of surface, and that the point or points upon which lightning strikes is dependent on some peculiar condition of the intervening air, and the amount of force in operation,—not in the mere presence of a metallic body projecting for a comparatively short distance into the atmosphere,—" that such bodies provoke the shaft of heaven is the suggestion of superstition, rather than of science."*

* *Leslie, Edin. Phil. Magazine.*

We shall now leave the theoretical discussion of this question, and direct attention to the facts themselves, and examine how far the evidence deducible from such facts is conclusive upon this important point.

During the thunderstorm which spread over the neighbourhood of Plymouth, in May, 1841, the electrical discharge struck one of the high chimneys at the Victualling-Yard, as already mentioned (94); it fell also on the topmast of the sheer-hulk off the Dock-yard, about a mile and a half distant. Now the circumstances attendant on these discharges of lightning bear directly on the question before us. The chimney at the Victualling-Yard is a round column of granite, about one hundred and twenty feet high, attached to the bakehouse; it *has not a particle of metal in its construction, nor has it any projecting point.* It stands at a distance of about one hundred yards from a clock-tower in the same yard; which on the contrary, *has* not only a metal vane, and cross-pieces of metal, indicating the four cardinal points, but its dome is covered with copper, and there is a large conductor continued partly within and partly without the tower, from the dome to the ground. In the sheer-hulk a very small metallic wire was led along the pole topmast, and connected with large metallic chains attached to the mast and sheers: the height of this pole was comparatively low, and it was completely overtopped by the neighbouring spars of the line-of-battle ship *Cornwallis,* fully rigged, and fitted with conductors on each of her masts. Now when the disruptive discharges took place, they fell on the granite tower, which had not a single metallic substance in its construction, and on the low flag-staff pole of the sheer-hulk's mast, notwithstanding that the clock-tower near the chimney offered every possible "invitation" to the discharge, and the great altitude of the line of battle ship's spars were in the most favourable position for "attracting" the electrical explosion. The chimney was rent for sixty feet; the flag-staff of the hulk's mast was slightly injured, and the small wire broken and fused; the lower mast and chains were uninjured.

On the 25th of March, 1840, Her Majesty's ships *Powerful* and *Asia,* each of eighty-four guns, were at anchor within a short distance of each other in Vourla Bay, in the Mediterranean. The

Asia had the fixed pointed conductors already described (84) attached to each of her masts; the *Powerful* was unprovided with any lightning conductor whatever. Under these conditions they were both exposed to a severe thunderstorm. A discharge of lightning fell on the *Powerful*, the ship without conductors, and shivered some of her spars; whilst the *Asia*, where every supposed "invitation" to the discharge was most prominent, experienced no ill effect.

If no other cases were on record, these alone, would be sufficient to dispel all apprehensions of a metallic conductor "attracting or inviting" lightning. A great number of instances, however, equally clear and satisfactory, exist; from these we have selected the following:—

Amongst some interesting remarks on the effects of lightning, by Professor Winthrop, communicated by Dr. Franklin to Mr. Henley, it is stated, that a tree, which stood at the distance of fifty-two feet only from a pointed conductor attached to a house, was struck by lightning and shivered, while the conductor and house escaped*,—that is to say, the lightning fell on a body, which, according to the prevalent notion, had little or no attraction for it, and held out no "invitation," in preference to one which did,—a fact totally at variance with the whole assumption.

We have already adverted to the case of the *Southampton* (46), in which a heavy electrical discharge fell upon the sea close to the ship, during a thunderstorm on the east coast of Africa. But what makes this case especially applicable to the question now under consideration, is the circumstance, that all her masts were fitted with fixed lightning conductors, which terminated in copper spikes. The storm was awful, and is stated by Mr. Martin, the master, to have lasted from ten P.M. to two A.M. "The night was pitchy dark, from the density of the surrounding clouds; the roar of the thunder was incessant, and the flashes of lightning frequently so vivid as to affect the sight for some minutes," yet no ill effect was experienced; the electrical discharge was not drawn down in an explosive form exclusively upon the conductors, although it actually fell with violence upon the sea close to the vessel.

* *Phil. Trans.* vol. lxiv., p. 152.

Similar effects were observed in His Majesty's ship *Sapphire*, armed with pointed conductors of the same kind. Captain Wellesley, who commanded this ship, states, that " the lightning was so vivid, and the flashes so quick in succession all around the ship, that although the duty to be done was important, I hesitated to expose the crew to them ;* yet the ship was not struck." In another place he states, " that the *Sapphire*, often met with very severe lightning, but it was never attracted to her."†

The frequent instances in which lightning avoids the most prominent parts of buildings, and falls obliquely upon some point far removed from them, may be further adduced as evidence against the attractive influence of such projections. The long zig-zag track of lightning, arising from the resistance of the air to its more direct path, may cause it to fall very obliquely on the earth's surface, as is well known : indeed, some of the directions of the zig-zag, may become almost horizontal. Now, in these cases, the pointed extremities of a tower, or the masts of ships, have no influence whatever on the course of the explosion ; which, on the principles already explained (45), finds its way through the least resisting interval. Mr. Alexander Small states, in a letter to Dr. Franklin, that he saw an explosion of lightning pass before his window in a direction nearly horizontal, and strike a clock-tower far beneath its summit.

In the discharge of lightning, which fell on His Majesty's ship *Opossum* in the English Channel, in March, 1825, " a peal of thunder burst on the main rigging, and split the top-mast cap‡." Her Majesty's ship *Pique* was struck by lightning in the St. Lawrence, in November, 1839, by a discharge which fell on the foremast just beneath the head of it, and from thence passing down the mast, did considerable damage. Such cases, although comparatively rare, and to a certain extent exceptions to the general course of lightning, are still sufficient to show how little the direction of electrical explosions is determined by the influence of points *considered as mere attractors*, and that it is only when they can contribute to the equalization of the opposite electrical forces, that lightning strikes on them. Franklin, in endeavouring to draw off the electricity of a charged sphere by means of a pointed wire,

* They were afraid to hoist the boats out.

† Report of Commission on Shipwreck by Lightning. ‡ Ship's log.

found that the point when placed on a rod of glass or wax, had no action on it*.

When this large mass of evidence is duly considered, together with the fact, that lightning strikes indiscriminately, trees, rocks, and buildings, and even the ground near them, we are compelled to admit that the thunder-rods of Franklin are perfectly precise in their operation, and that the common notion, that they "invite destruction" to our buildings, is not warranted by any sound argument drawn from experience.

It may not be unimportant to notice here the following extract from the *Memoirs of the Count de Forbin*, already alluded to (15). In describing the large St. Helmo's fires, observed in the vane of the main-mast, he says, "I ordered one of the sailors to take it (the vane) down; but scarcely had he taken the vane from its place, when the fire fixed itself on the head of the main-mast, from which it was impossible to remove it†," so that the presence of the metallic point was not at all necessary to the electrical discharge.

Before quitting the subject of the absolute protection from lightning afforded by conductors, the Naval Commission inquire, whether, according to the common prejudice, conductors have the power of *attracting* a flash of lightning, which in their absence would not have occurred; and their report states "that instances of accidents to ships *without conductors,* and the comparatively rare occurrence of lightning being observed to *strike* on a conductor, would tend to negative such a supposition‡." They further consider, from the instances which were submitted to them, of ships without conductors having been struck by lightning, in the presence of ships furnished with them, which were not so struck, that most complete evidence is afforded "either of the little influence exerted by such conductors in inducing or attracting an explosive discharge, or of their efficacy in harmlessly and imperceptibly conveying away electricity to the water§."

* Franklin's Letters, p. 56.

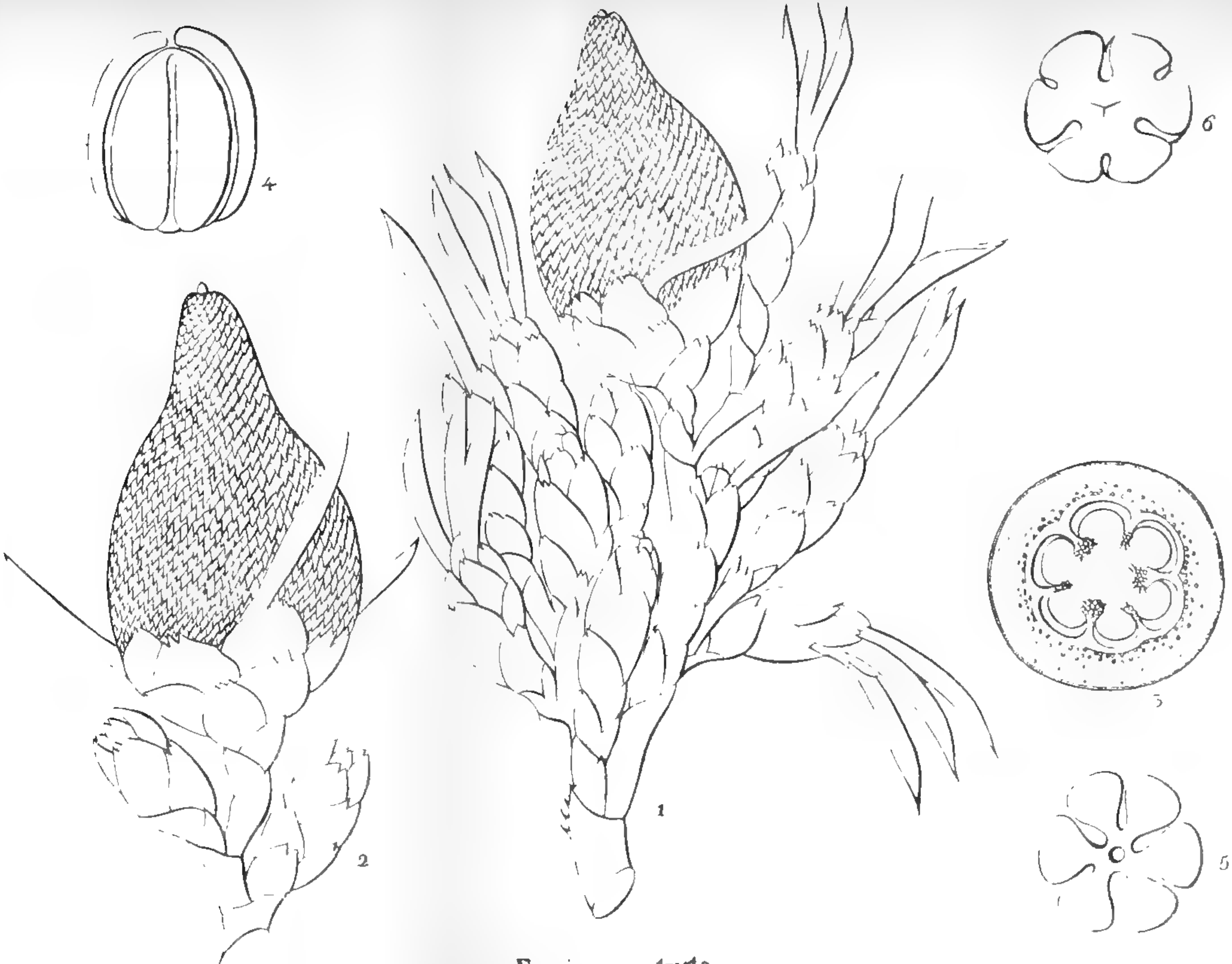
† Letters on Electricity. By the Abbé Nollet.—Vide Phil. Trans. for 1753, p. 201.

‡ Report of Commission, p. 4.

§ Report of Commission p. 4.

Calamosagus laciniosus

Eugeissona triste



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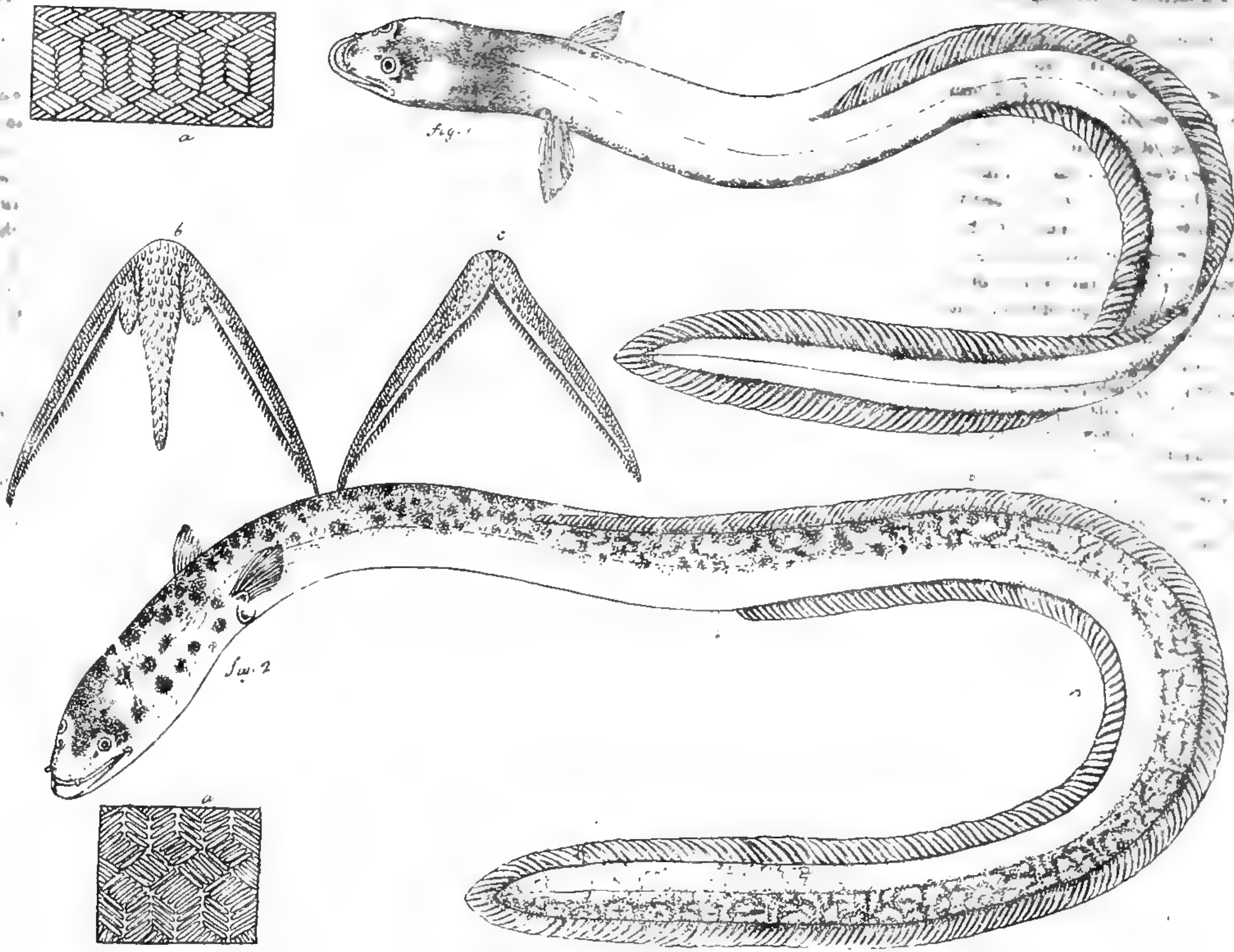
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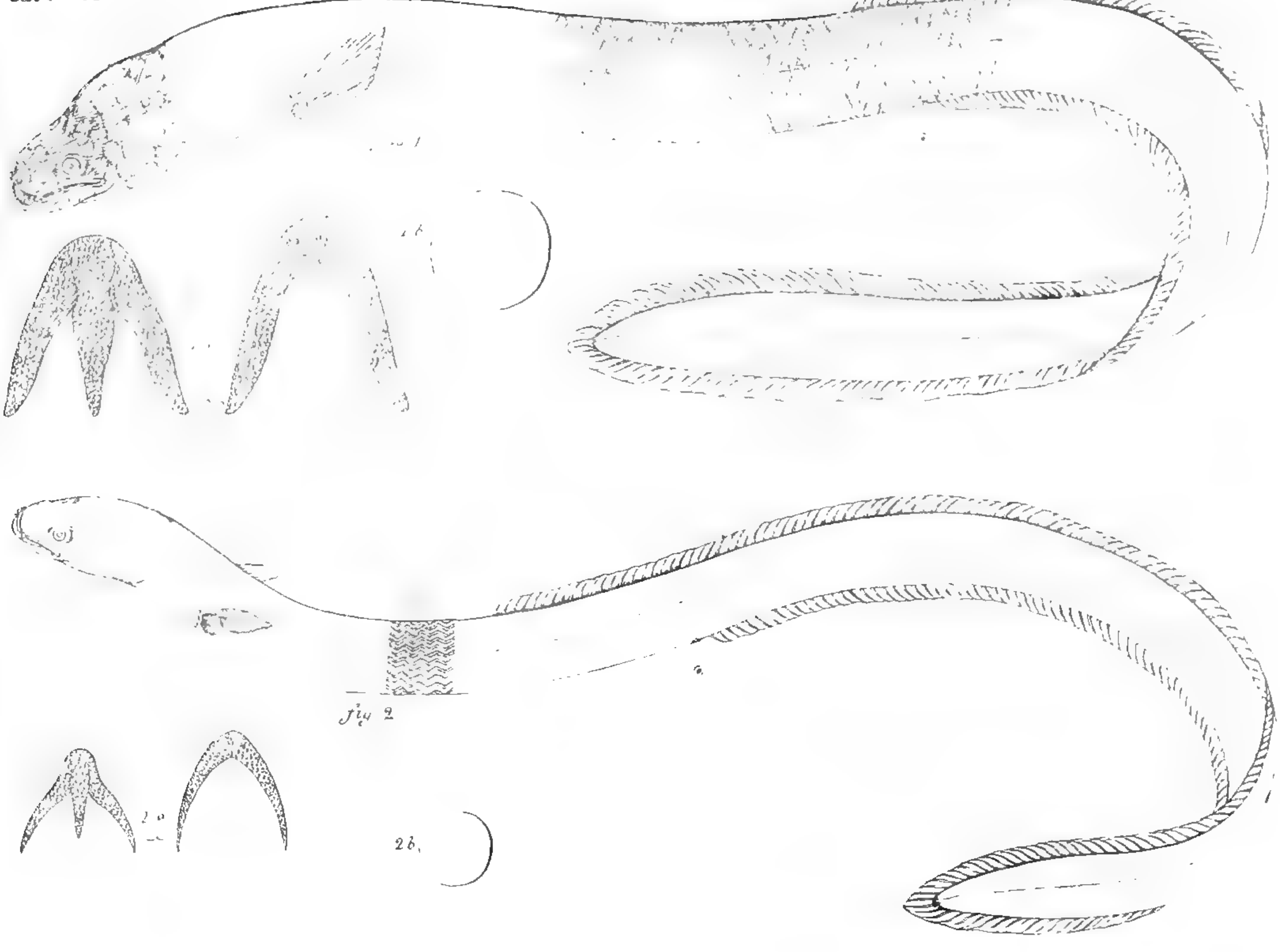
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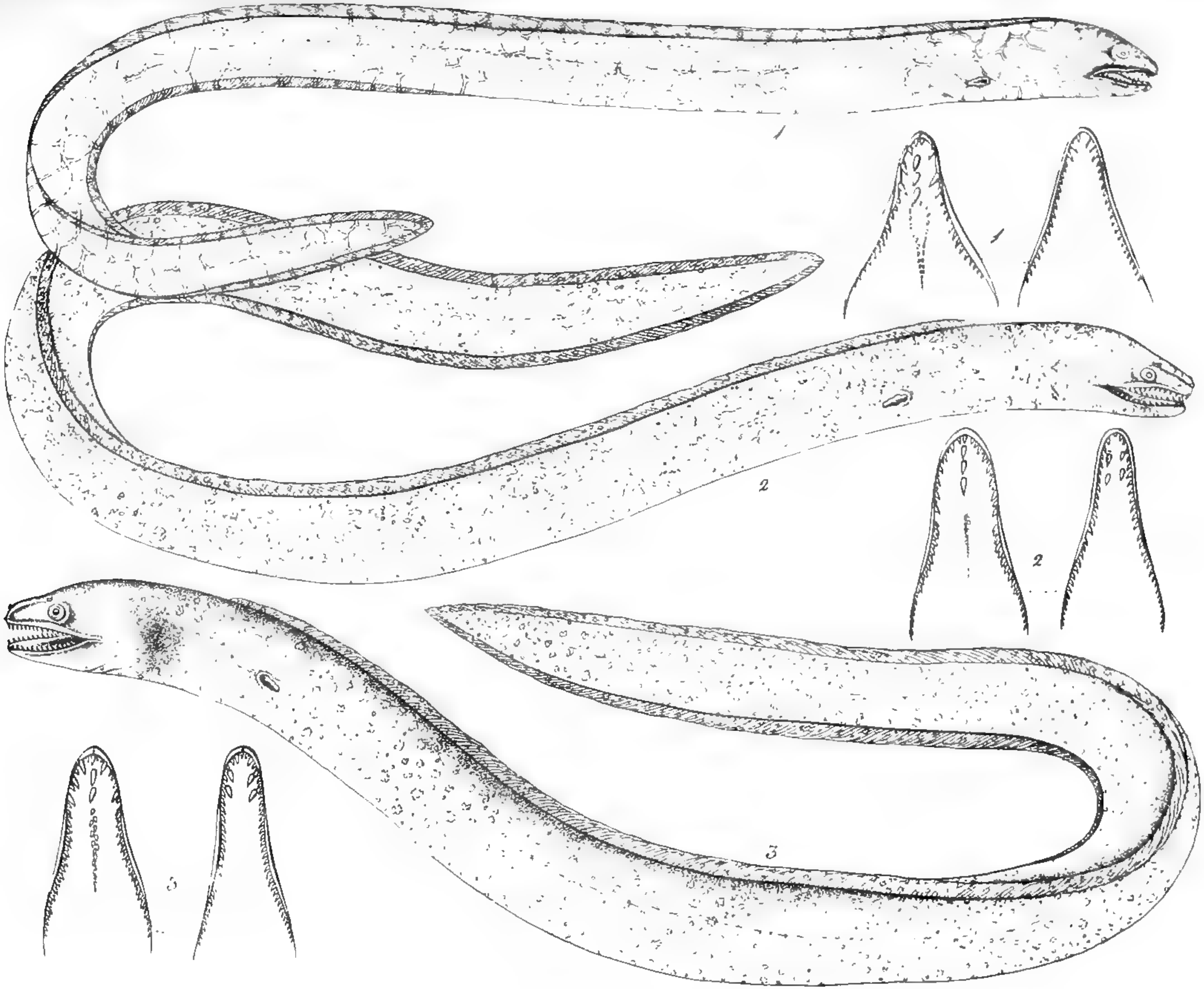
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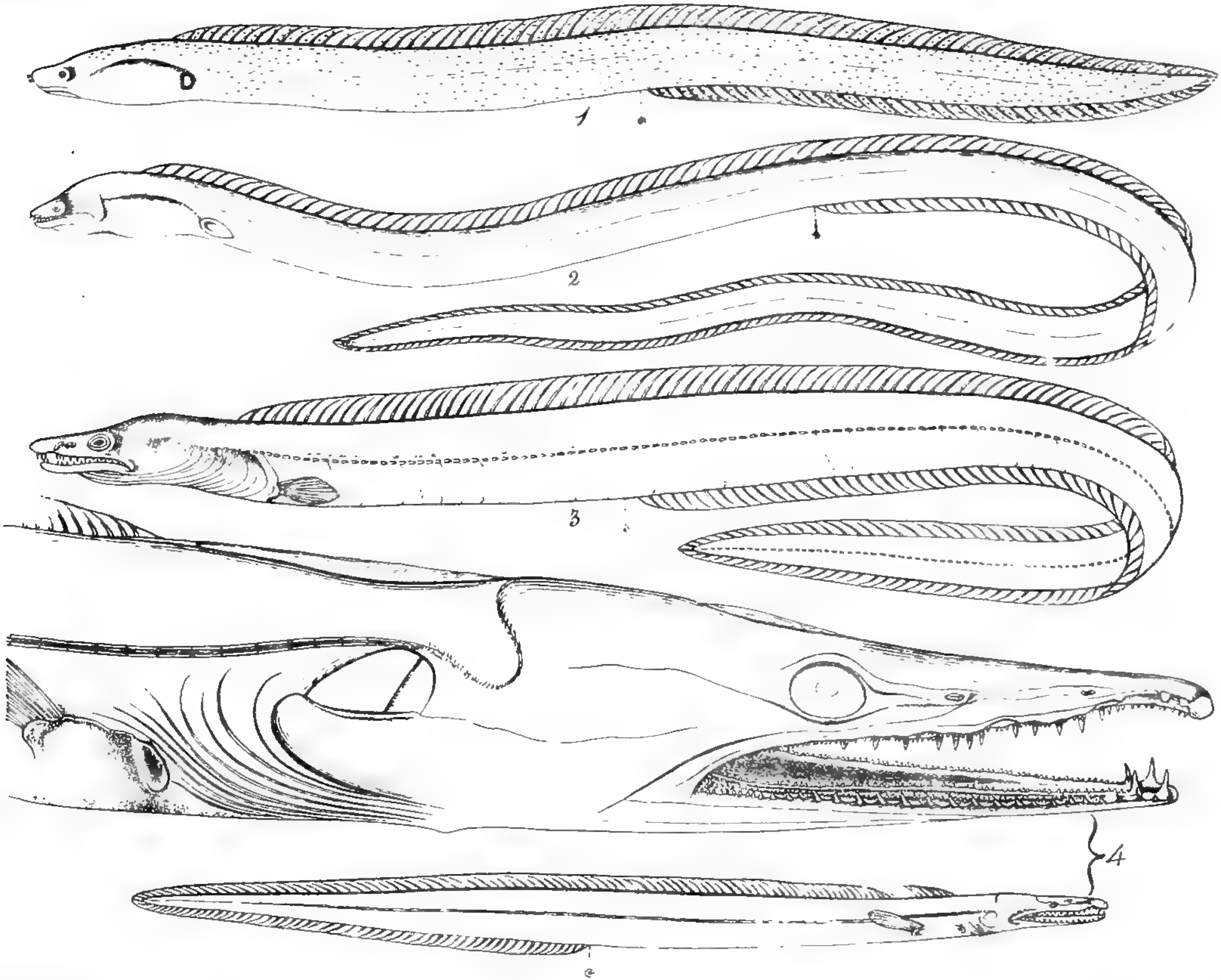
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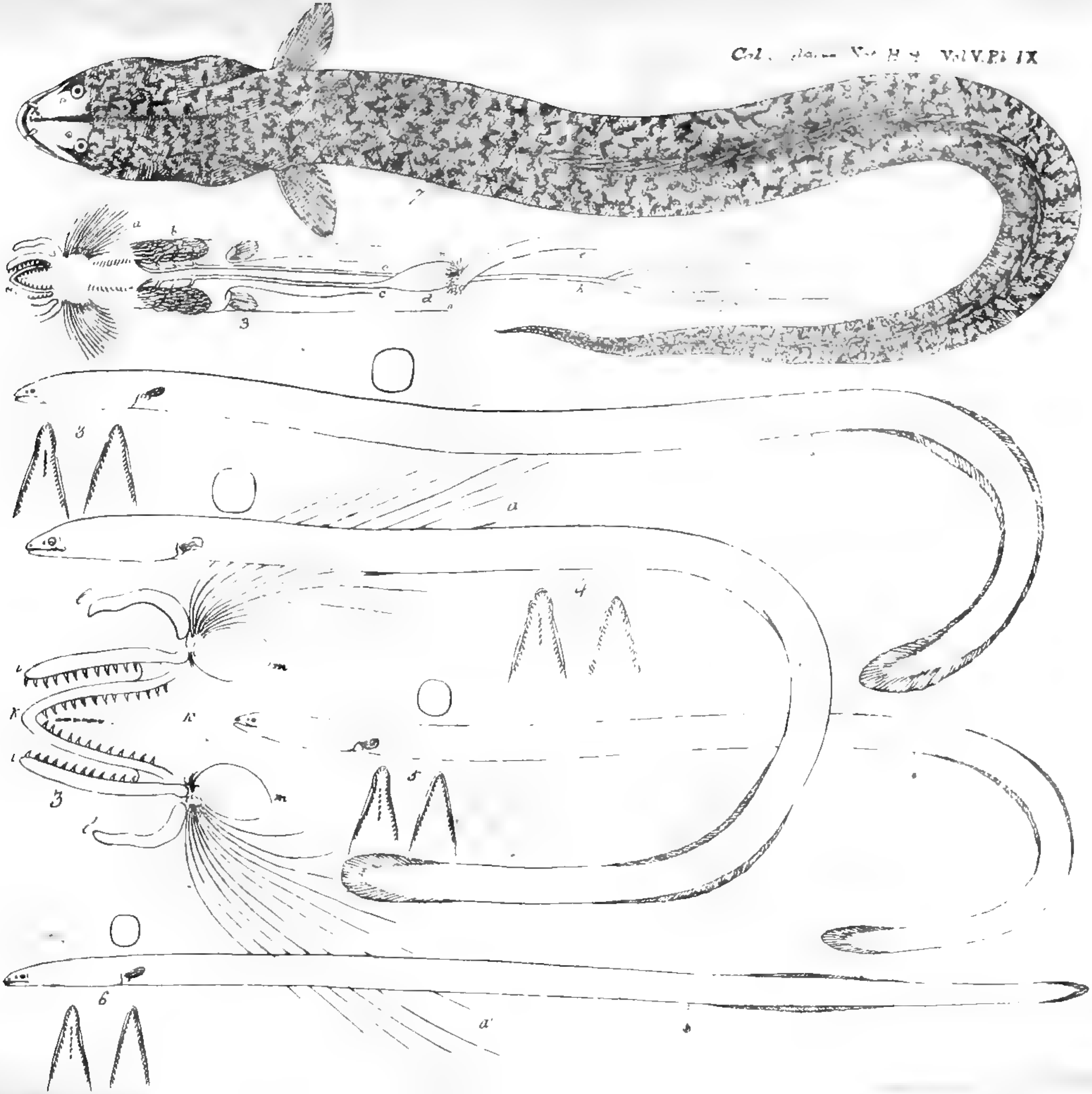

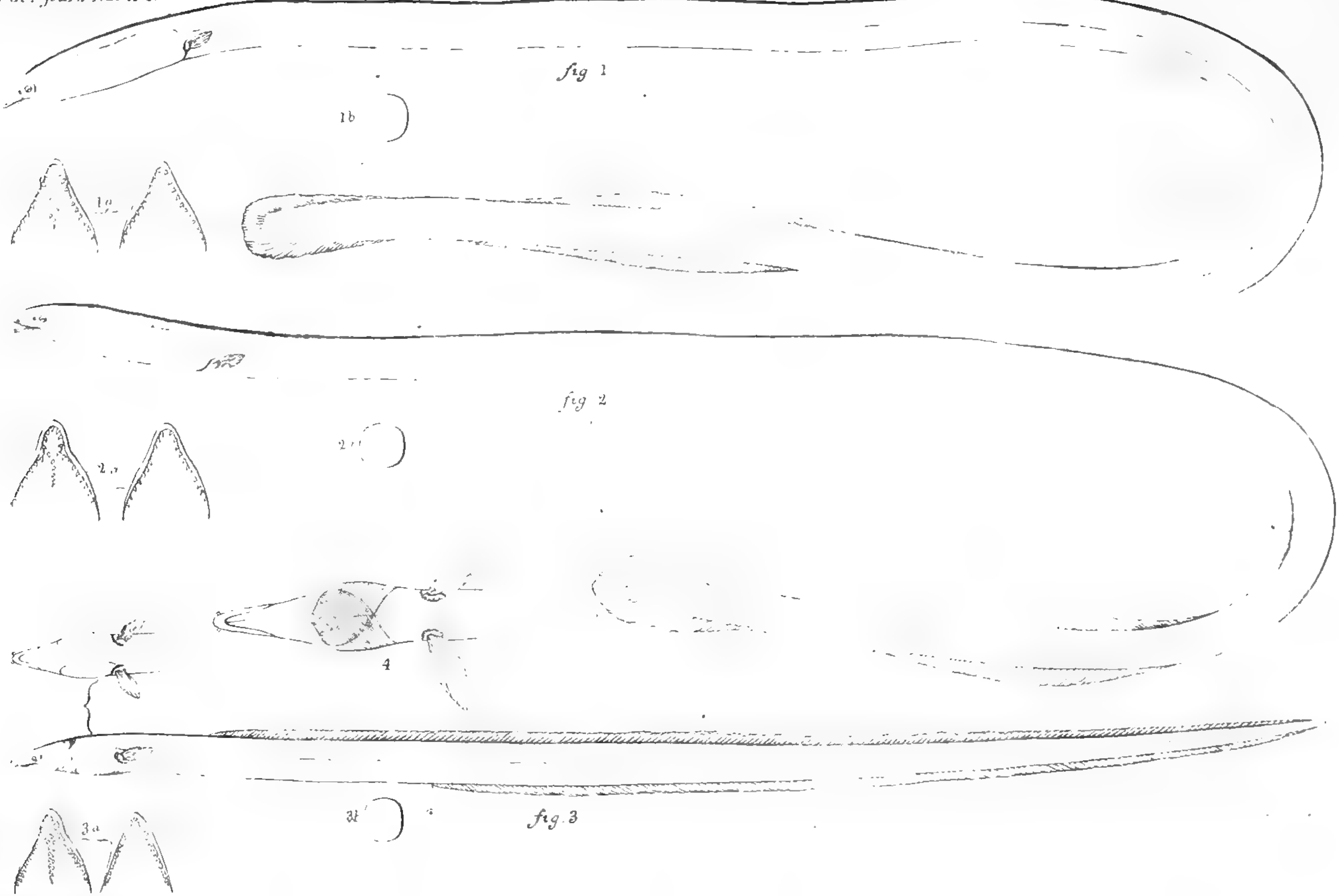
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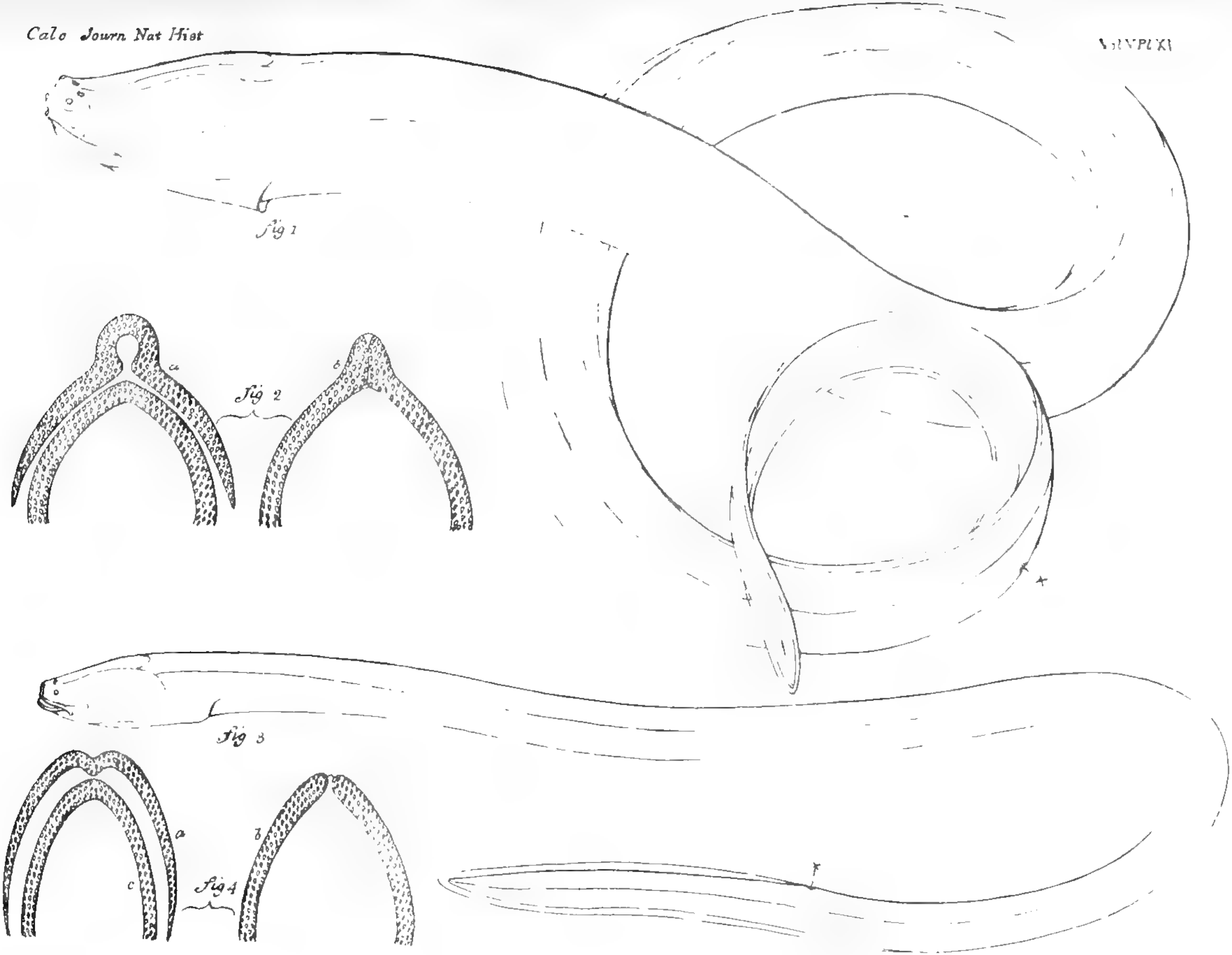
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fig 3
fig 4

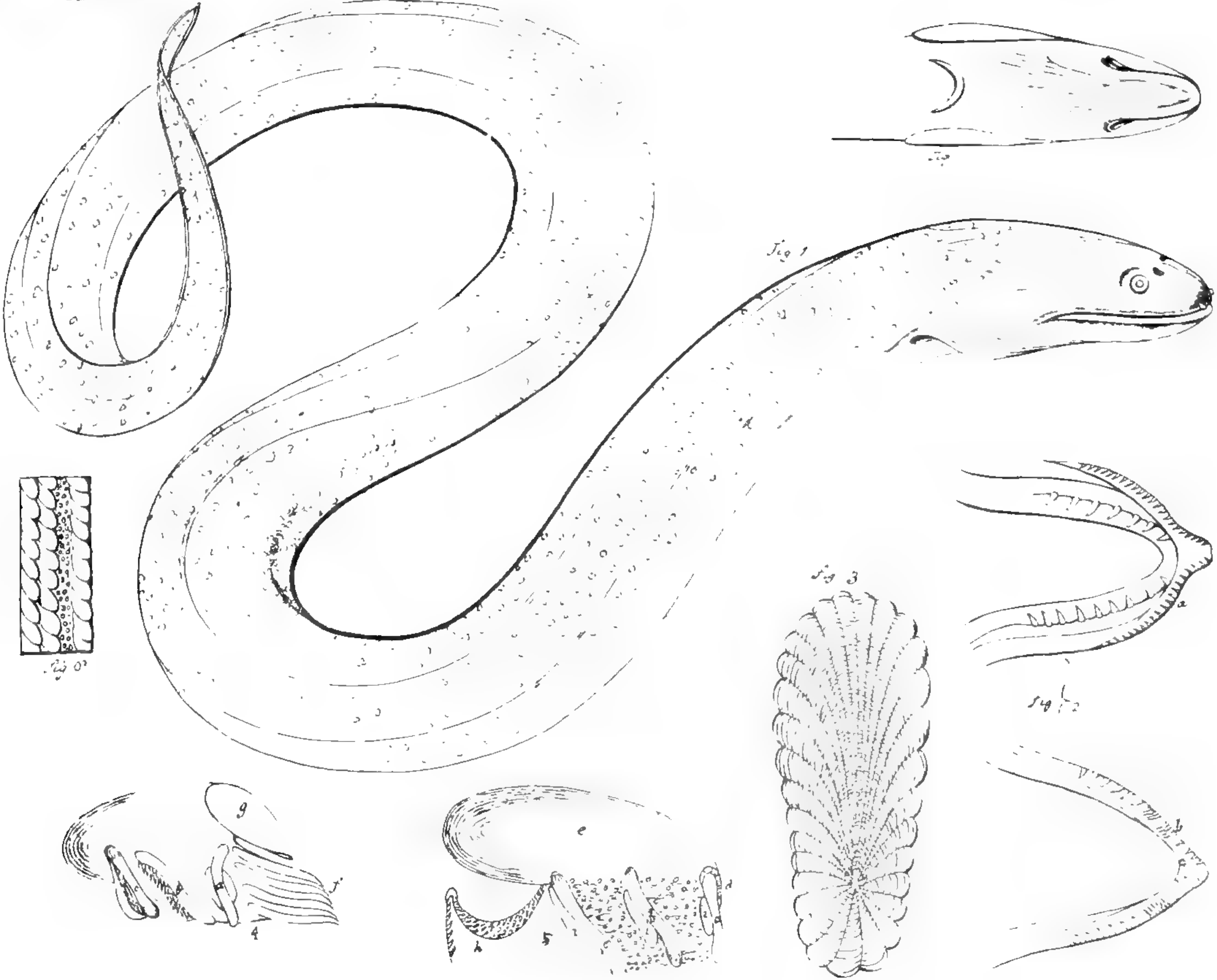
Fig 1
Fig 3
g
e
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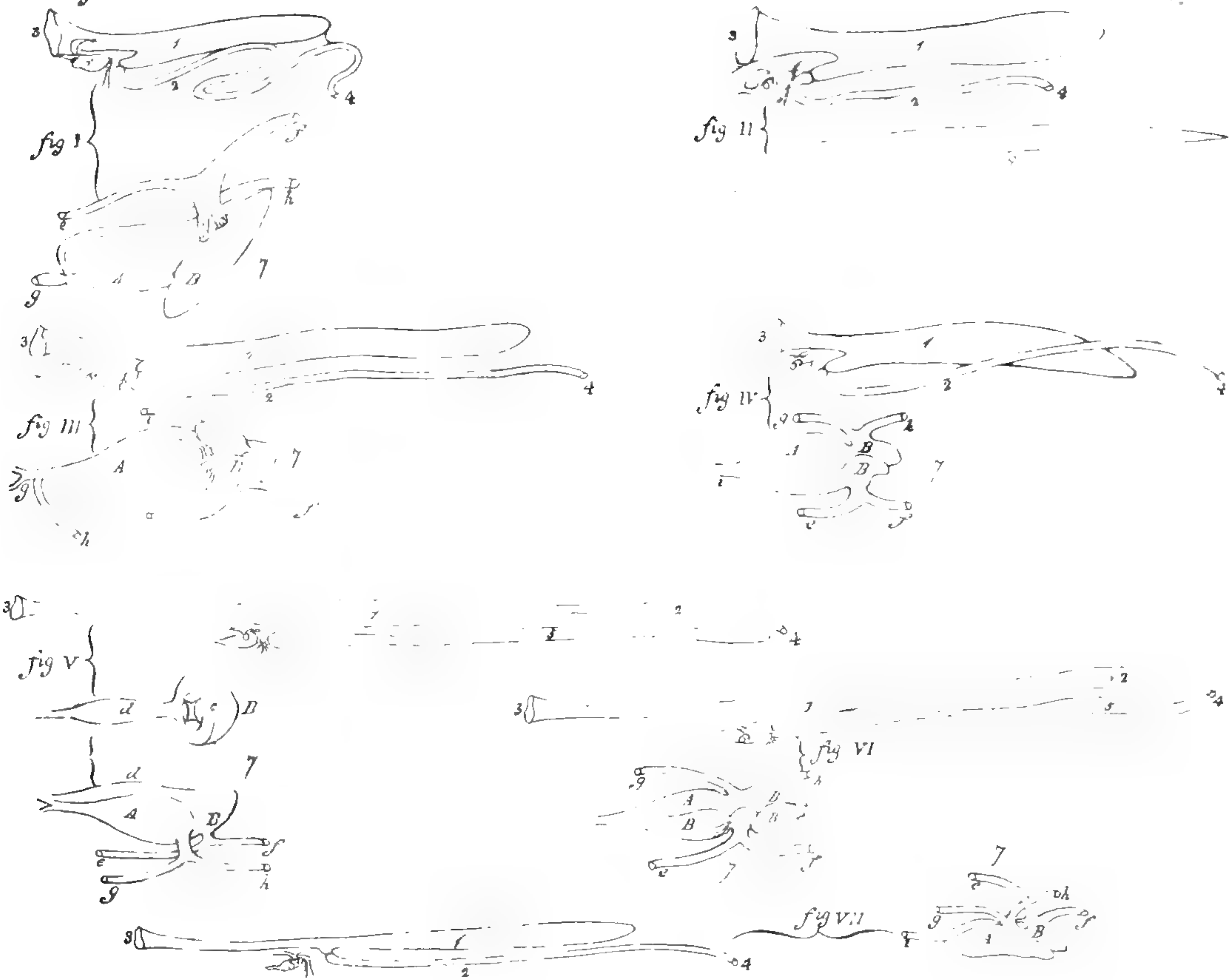
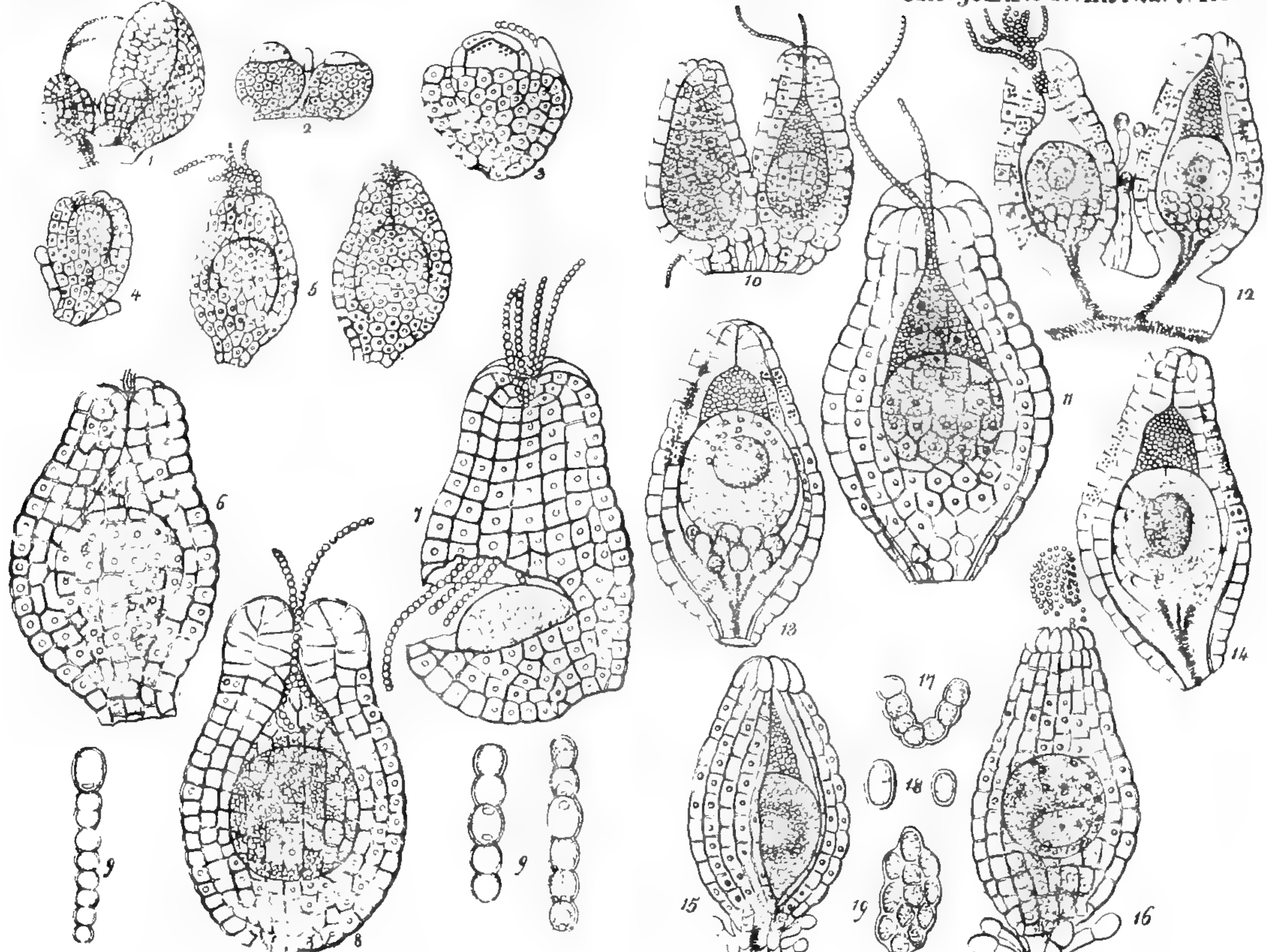
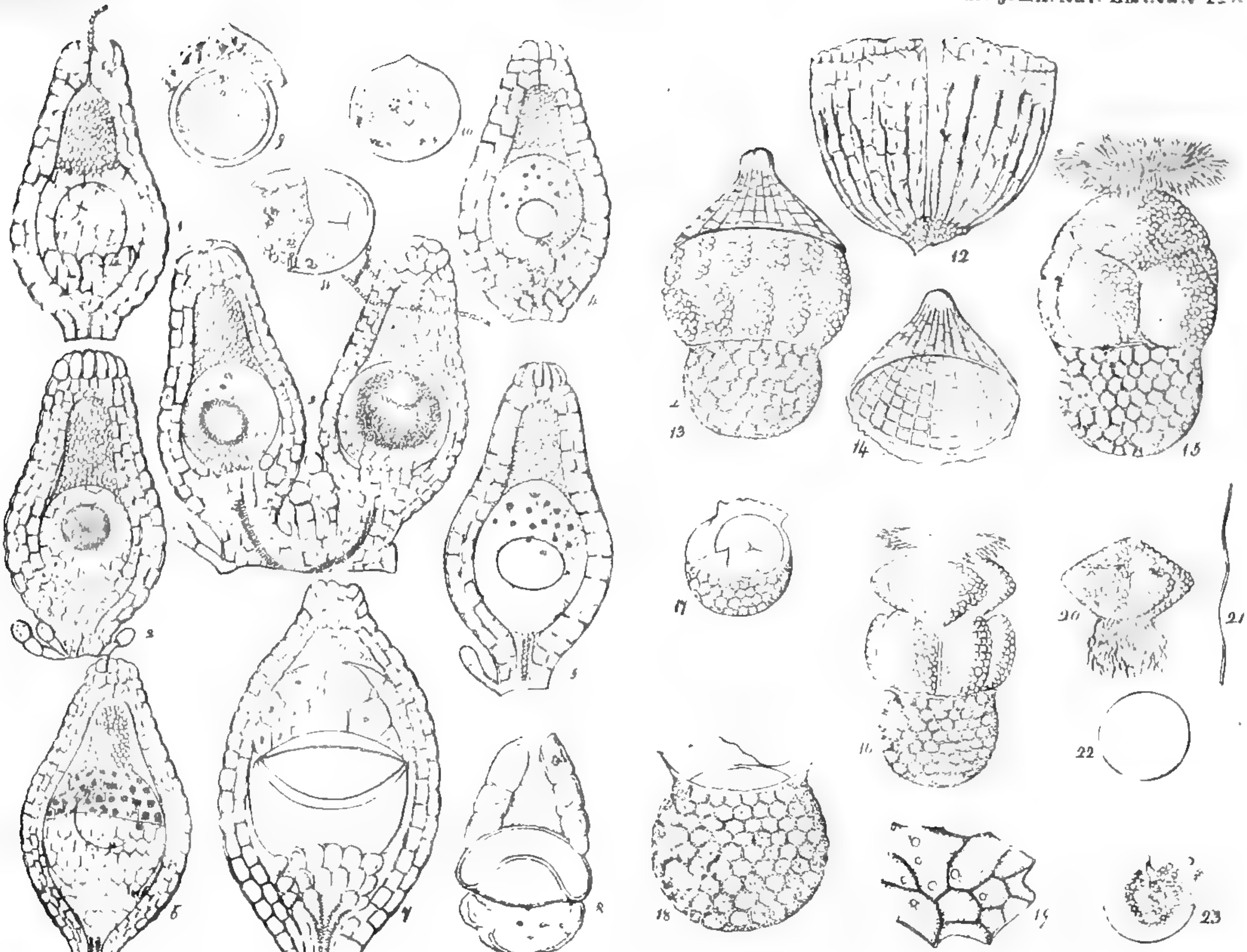


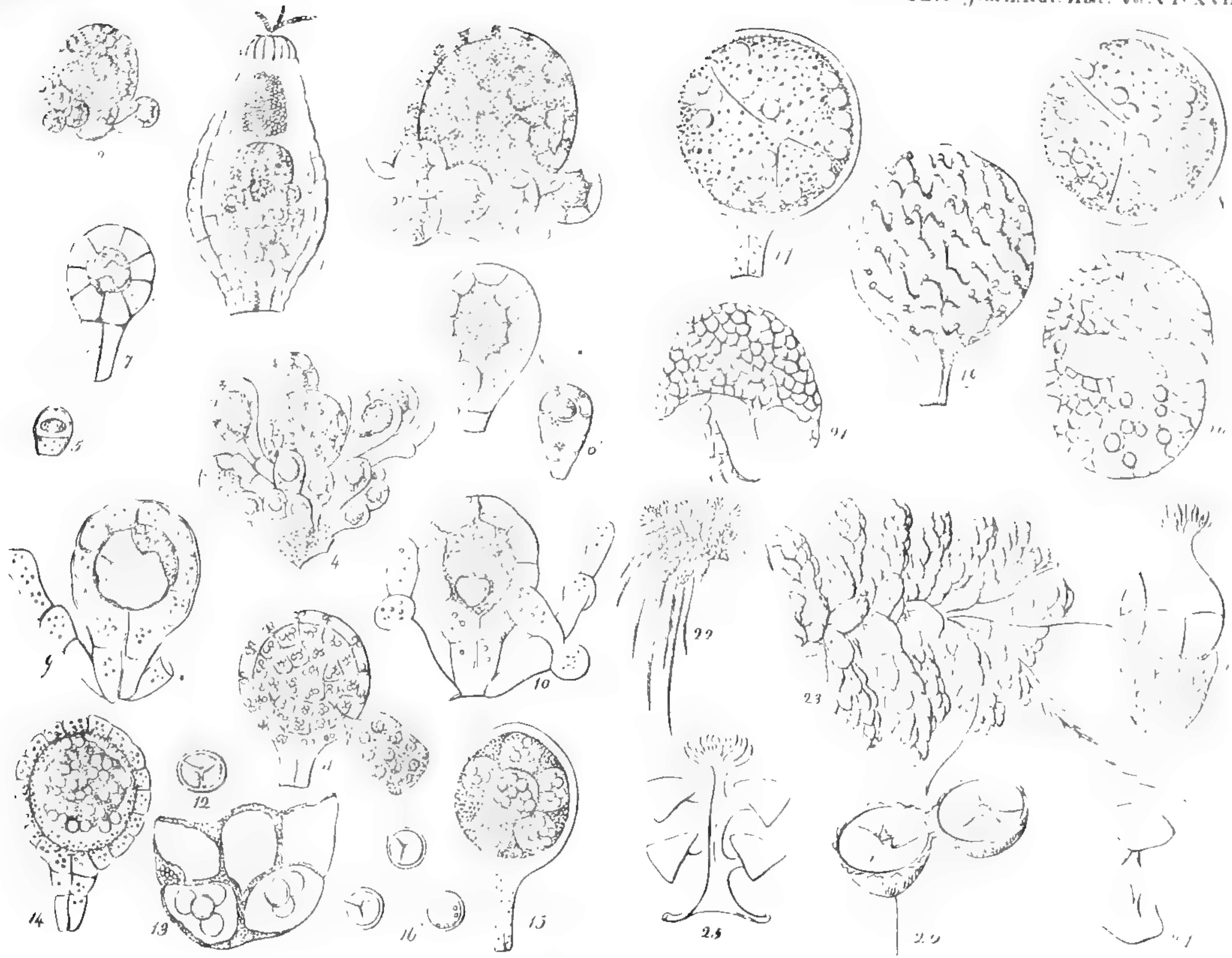
fig I
fig II
fig III
fig IV
fig V
fig VI
fig VII



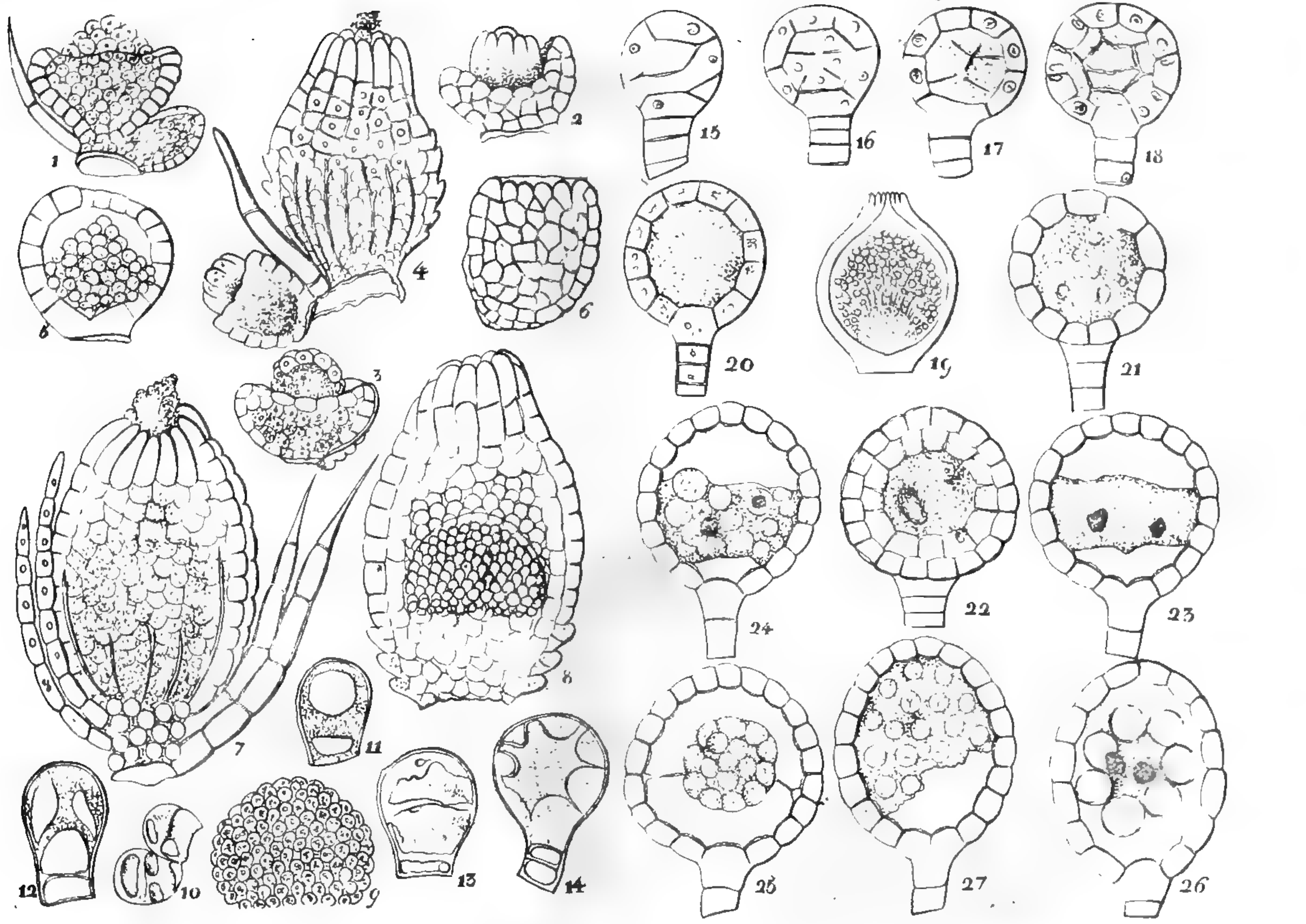
Azolla pinnata.



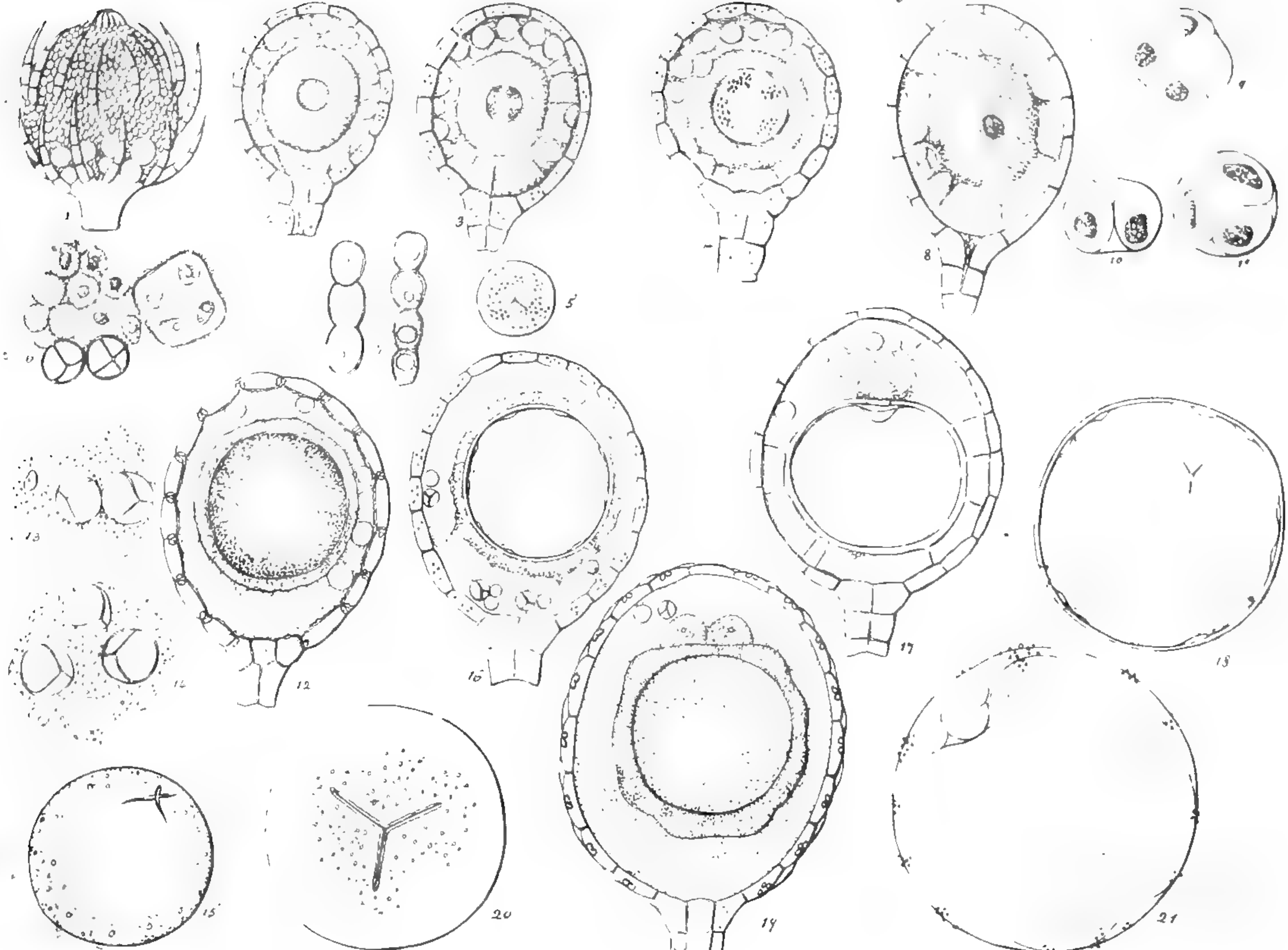
A zolla pinnata.



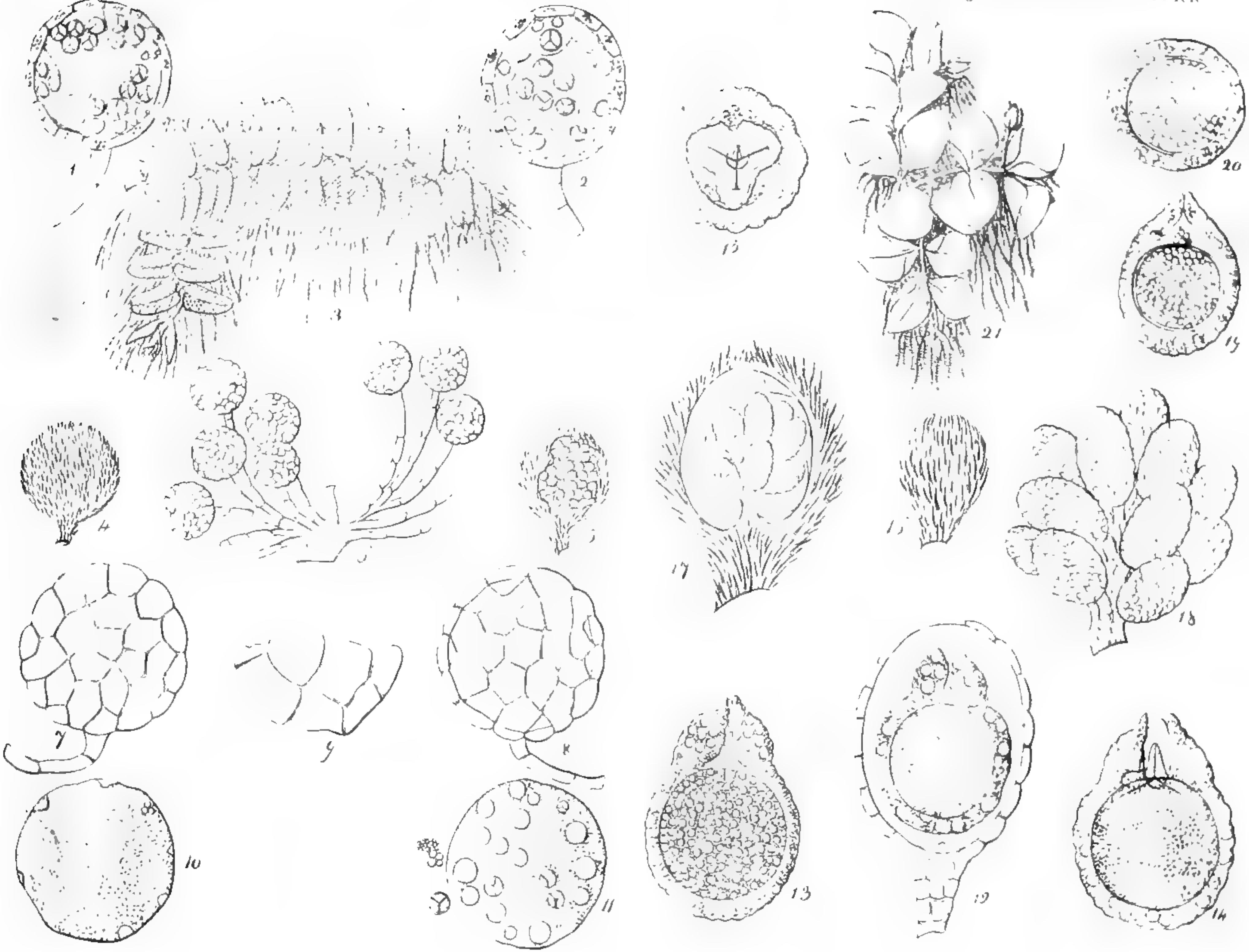
Azolla pinnata.



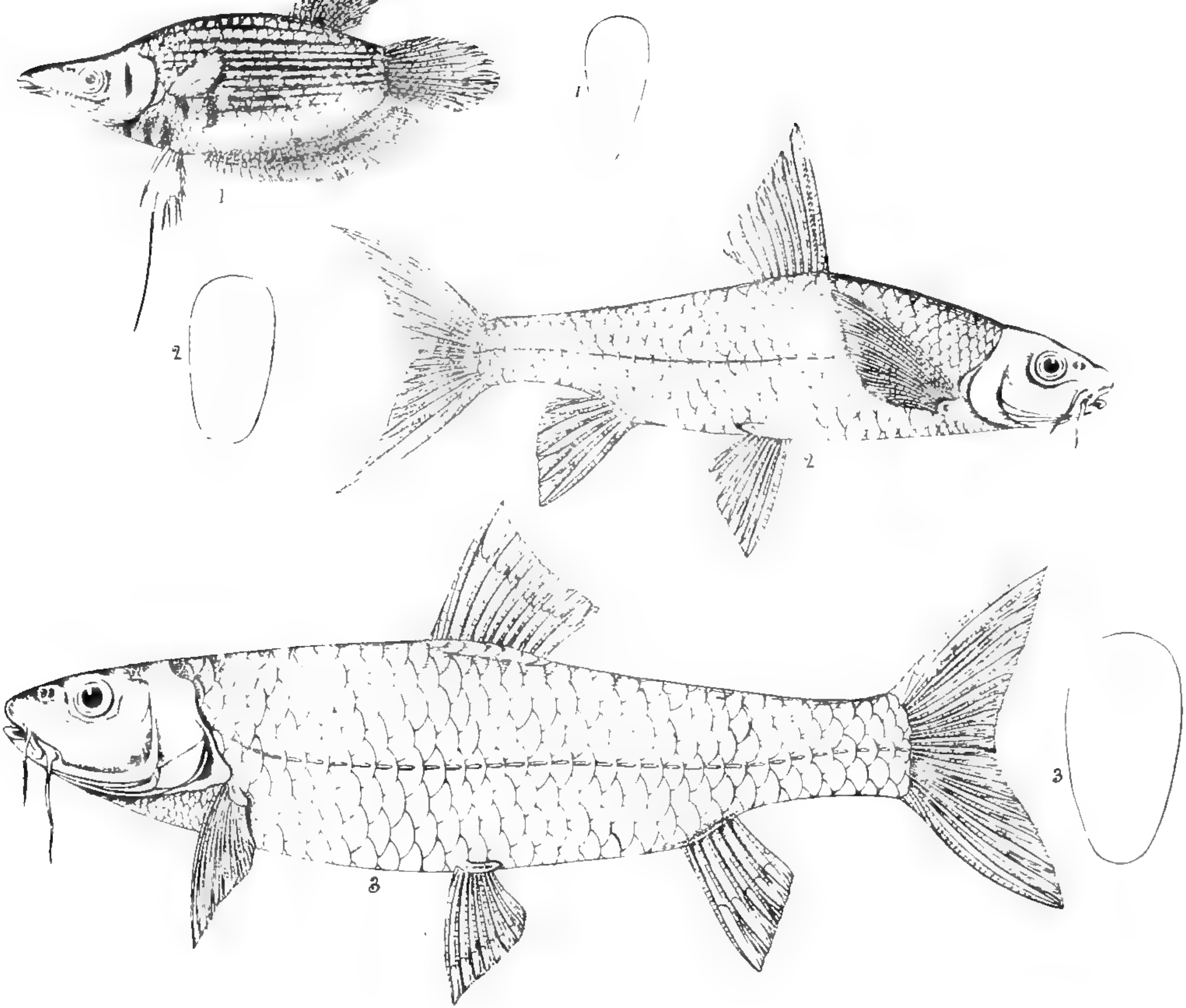
Salvinia verticillata.



Salvinia verticillata.



Salvinia verticillata.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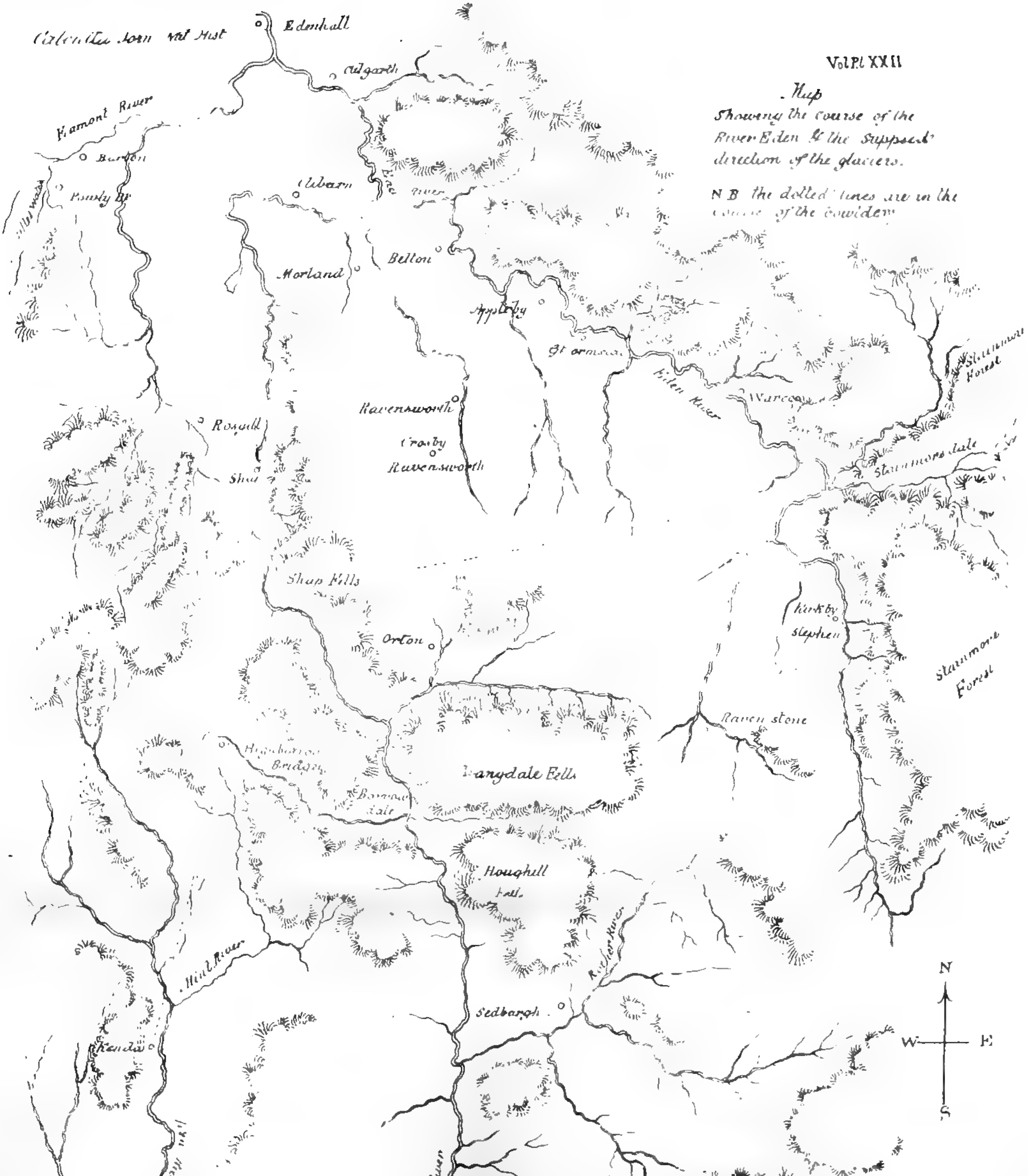
2
3

Vol.Pl.XXII


Map
Showing the course of the
River Eden & the supposed
direction of the glaciers.
Edenhall
Eamont River
Pooly Br
Morland
Appleby
Eden River
Ravensworth
Crosby
Ravensworth
Shap Fells
Orton
Kirkby
Stephen
Stainmore dale
Stainmore
Forest
Raven stone
Langdale Fells
Houghill
Fell
Sedbergh
Mint River
Kendal
Lune River
N
S
W
E

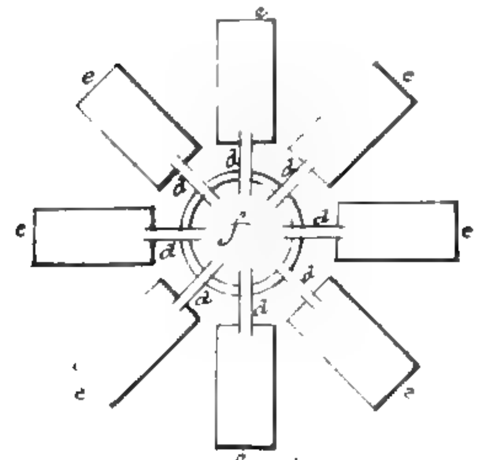


fig 3

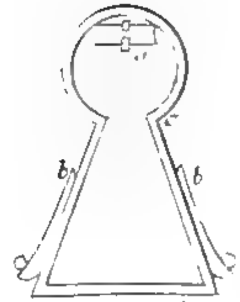


fig 1

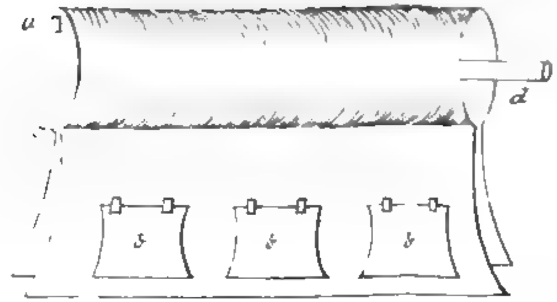


fig 2

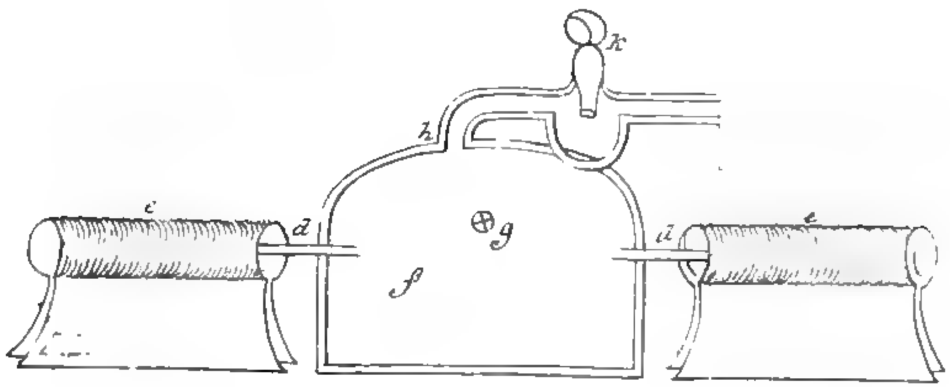
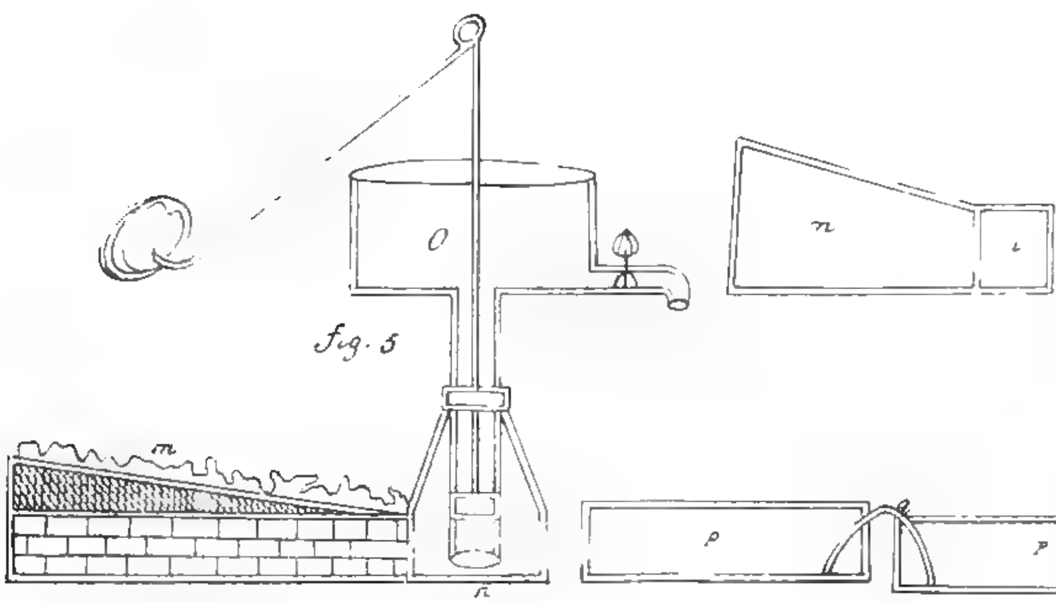


fig 4



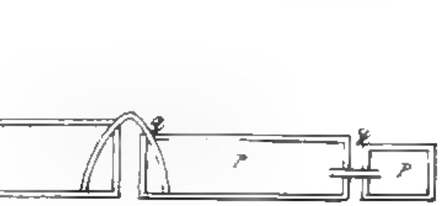


fig. 5

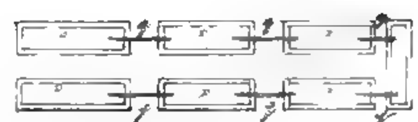
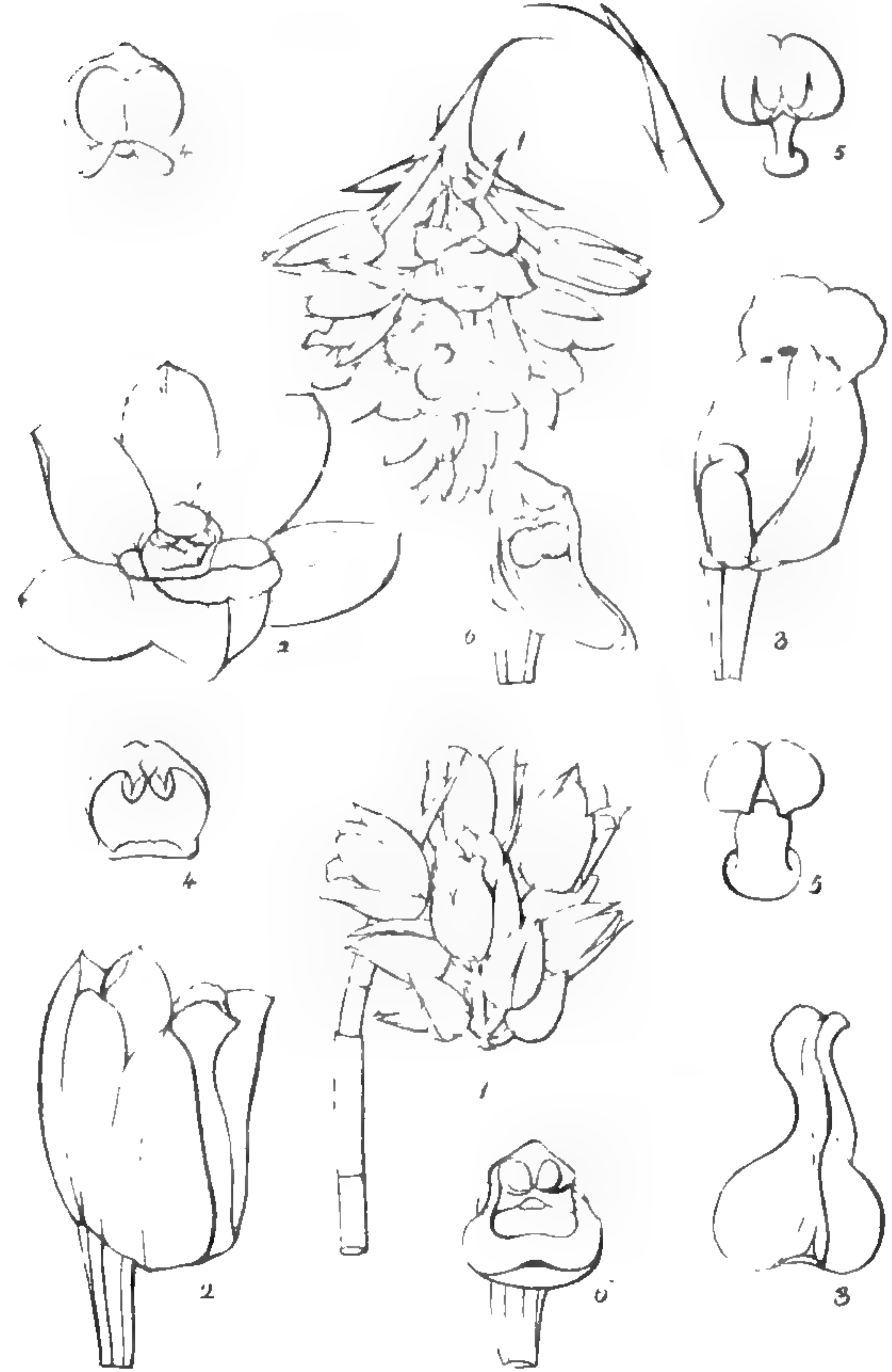


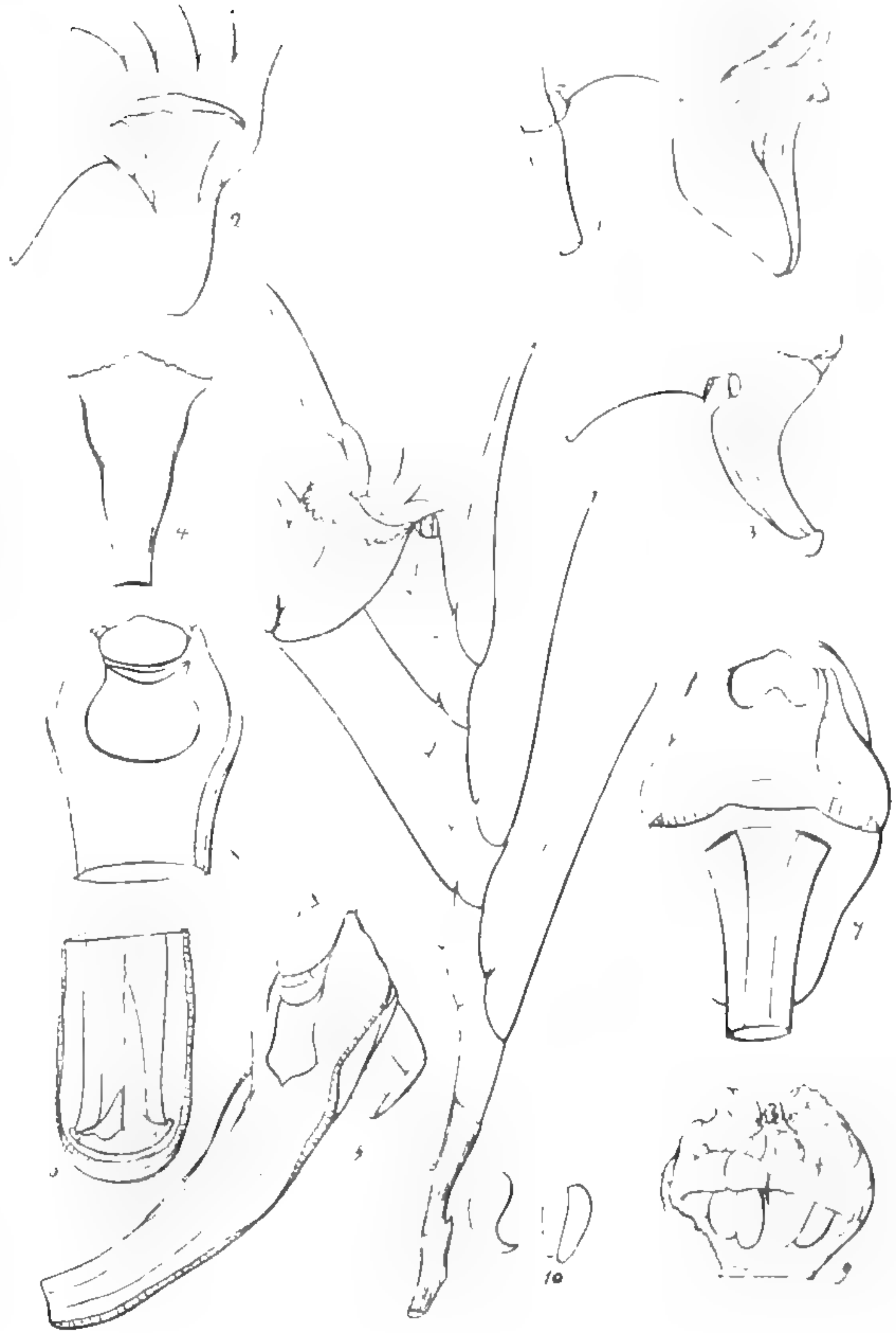
fig. 6

Geodorum laxiflorum

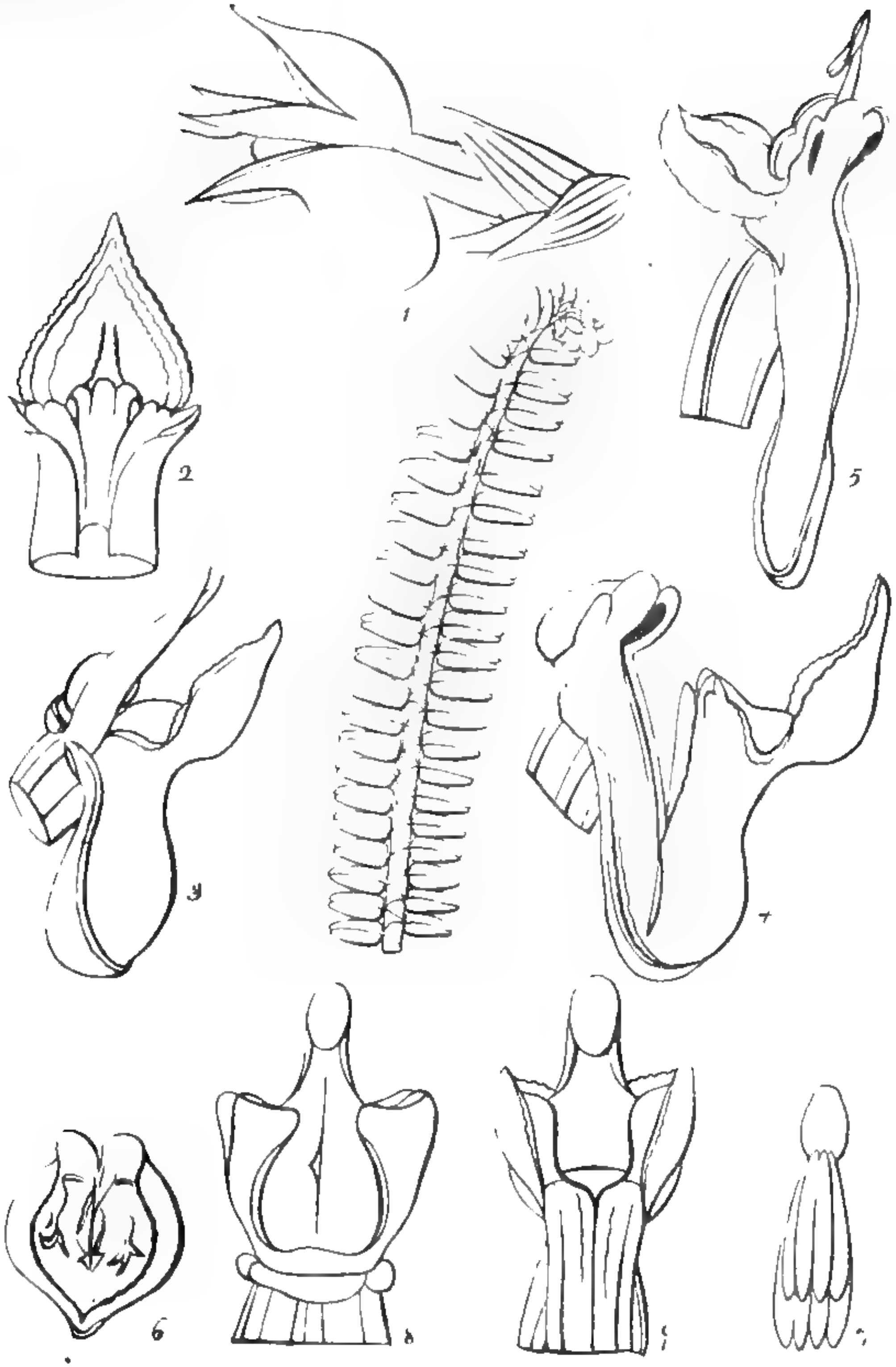


Geodorum appendiculatum
" attenuatum.

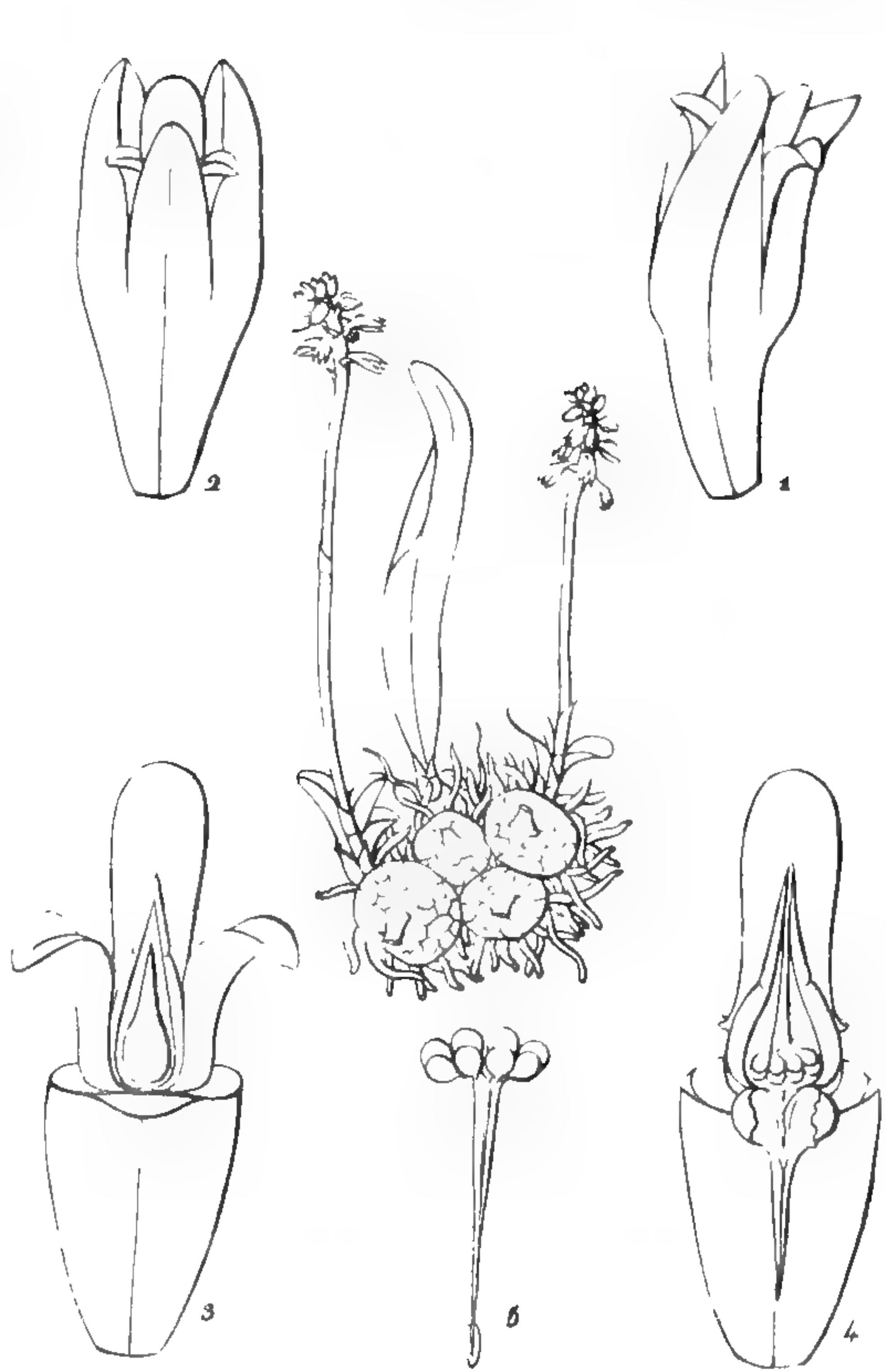
Xiphosium acuminatum.



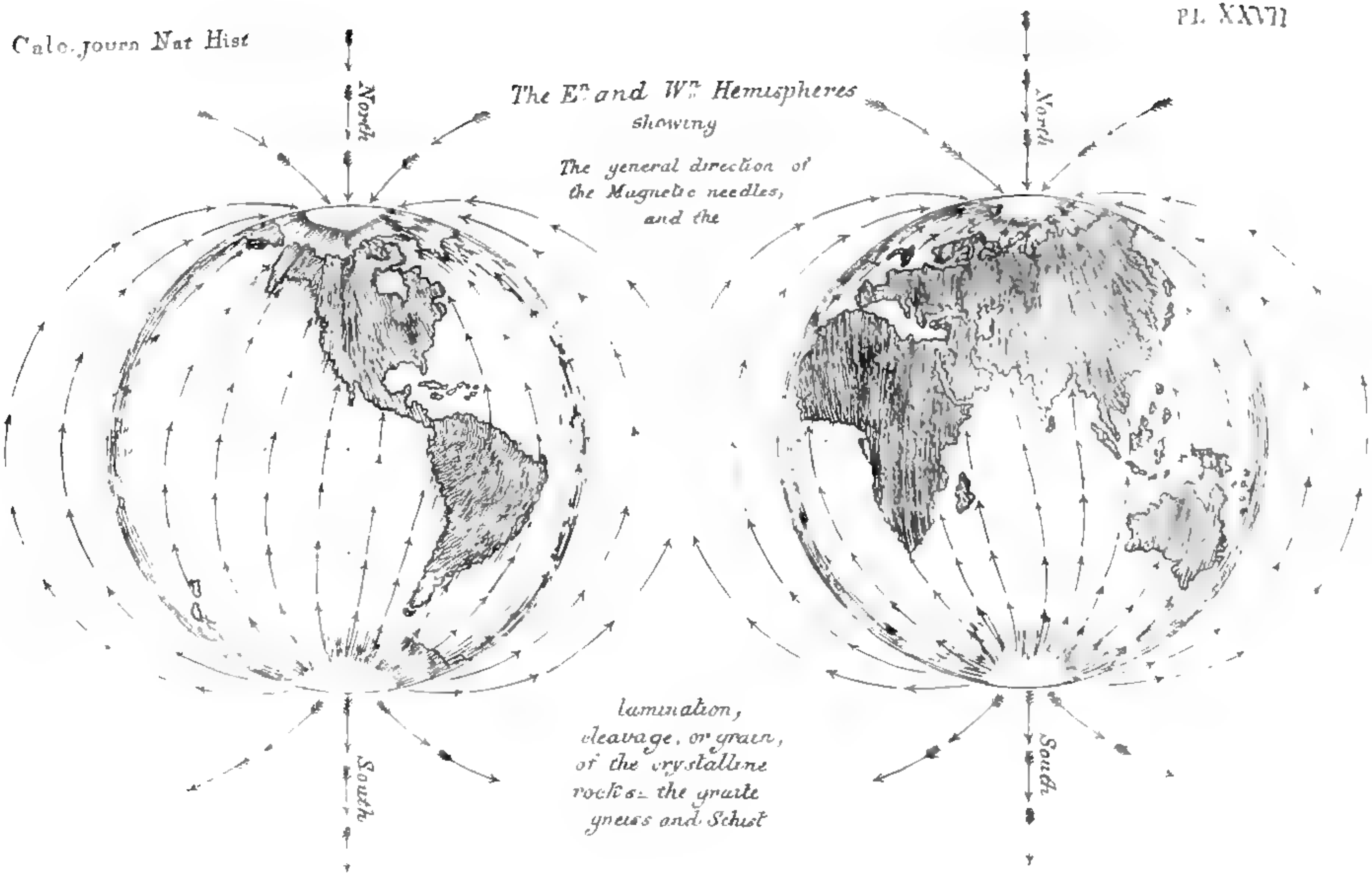
Aporum fenxinsu

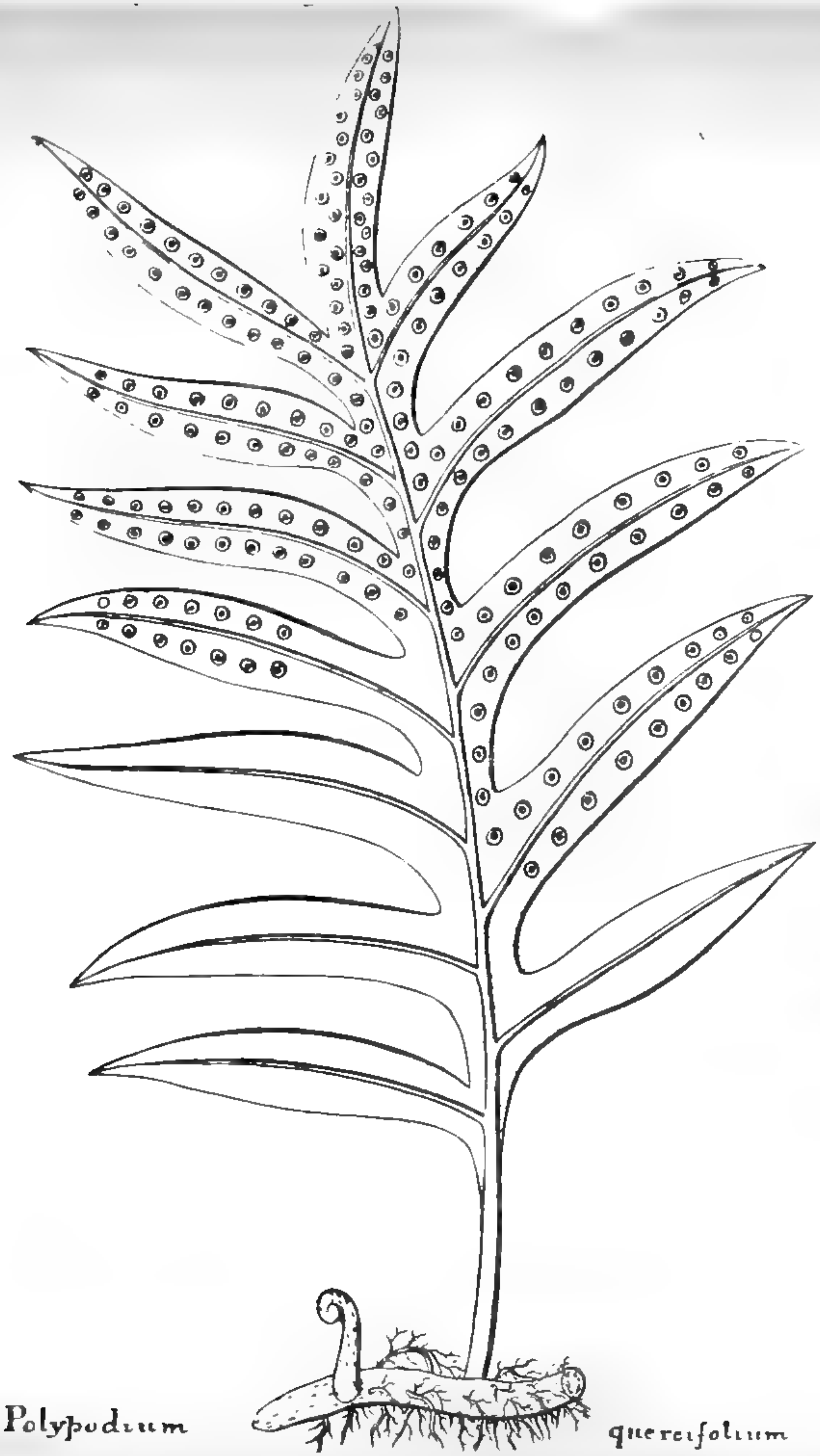


Appendicula callosa.

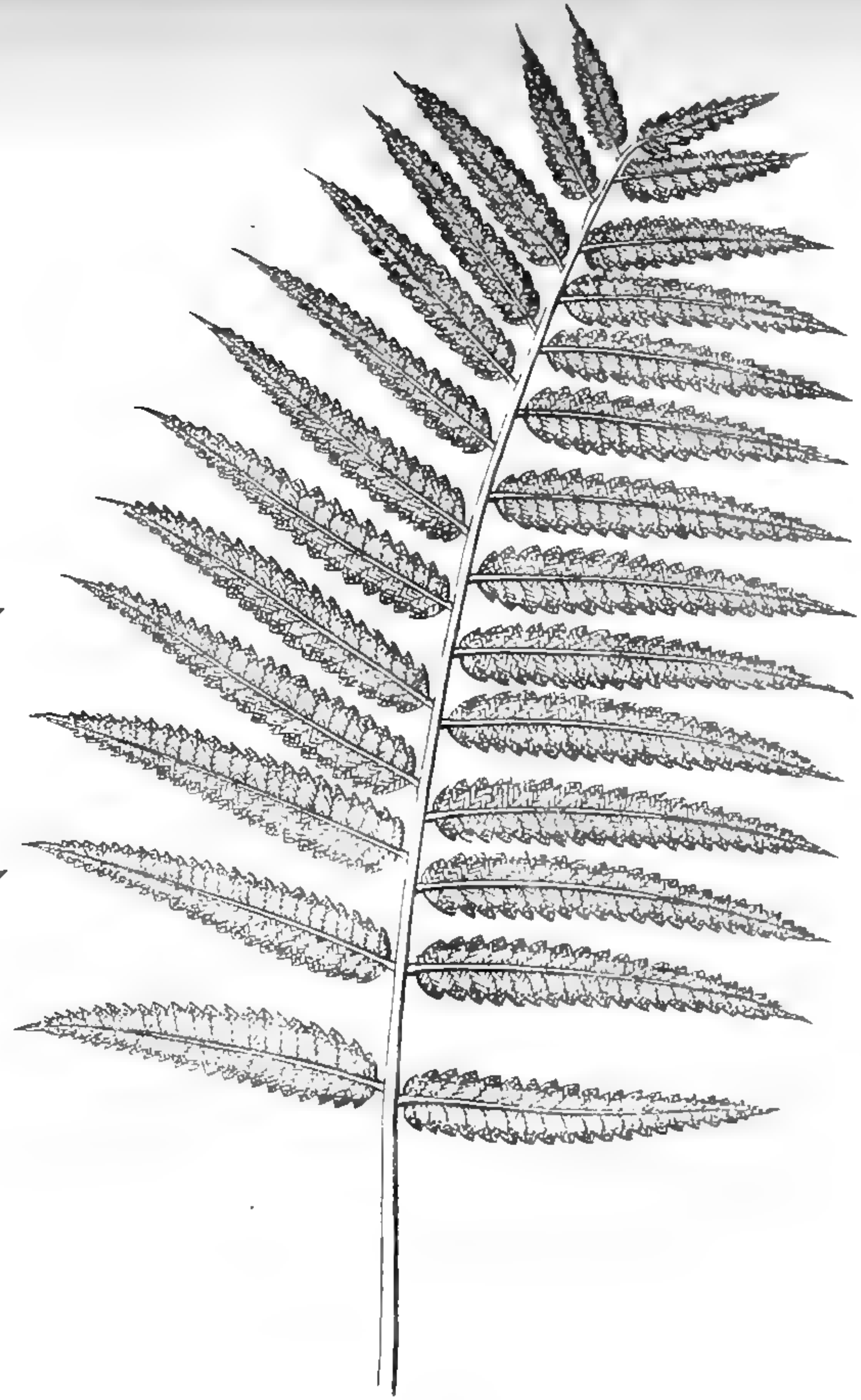


Euproboscis pygmæa.

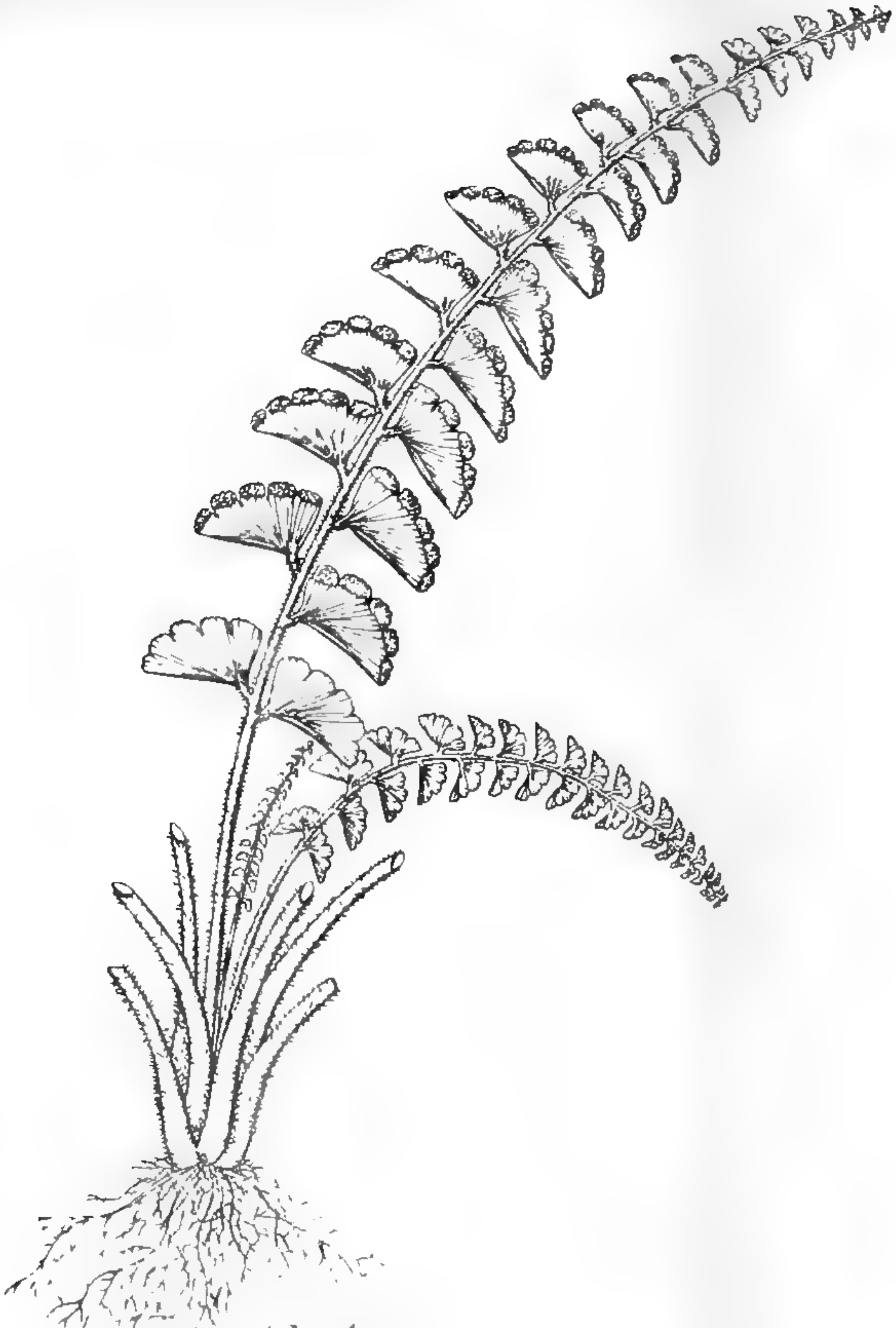

The E^n and W^n Hemispheres
showing
The general direction of
the Magnetic needles,
and the
lamination,
cleavage, or grain,
of the crystalline
rocks = the granite
gneiss and Schist
North
South
North
South



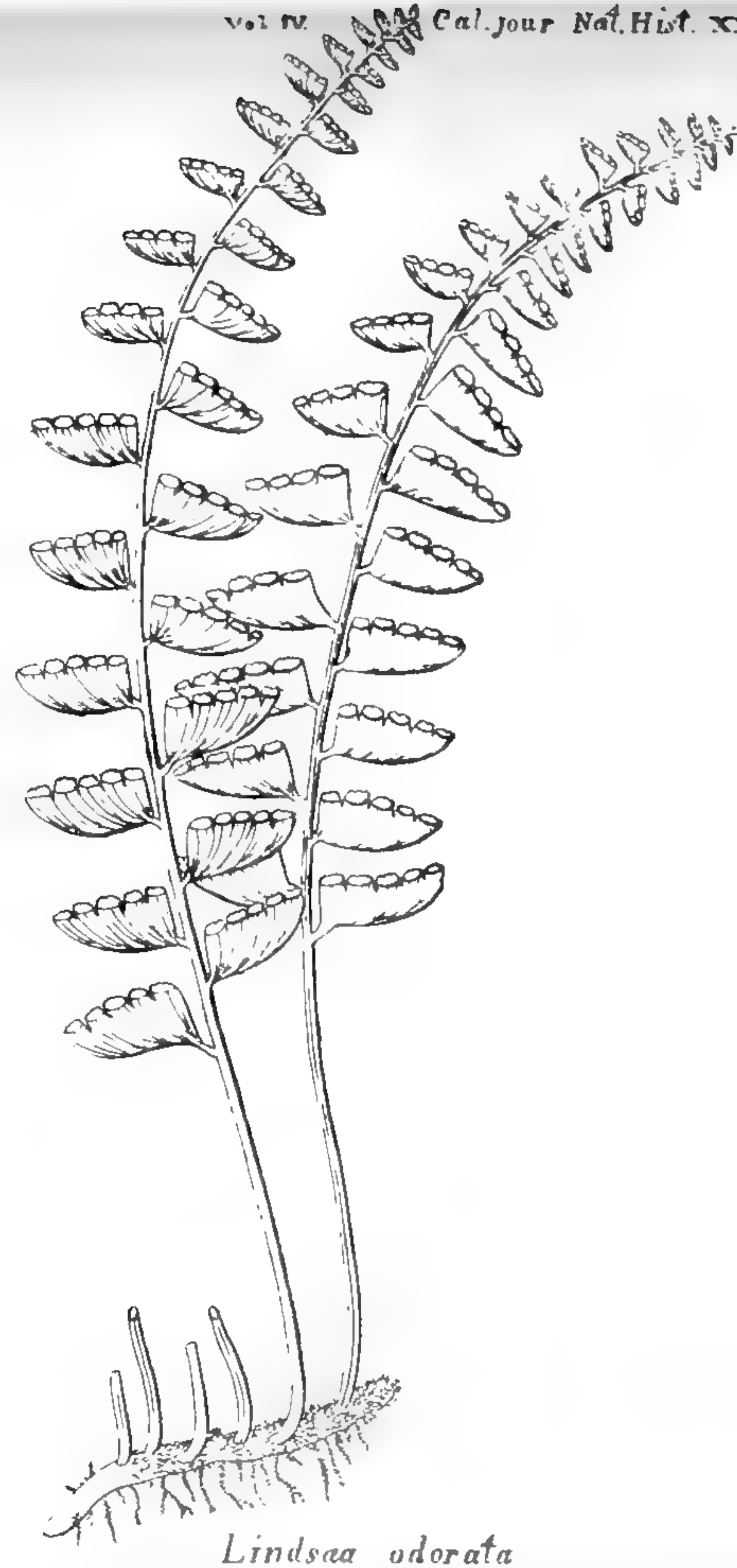
Polypodium quercifolium



Polypodium unitum



Adiantum Caudatum



Lindsaa odorata

GENERAL INDEX, VOL. V.

INDEX OF PLANTS, VOL. V.

INDEX OF FISHES, VOL. V.

ERRATA.

Page 552, line 18, from top, for '*remarks on the*,' read *various*.

,, 552, line 22, from top, for '*variation of the wind*,' read *aspect of the sky*.

,, 555, line 7, from bottom, omit the parenthesis.

,, 555, line 5, from bottom, omit the parenthesis, and insert *but*.

Preface, pages vii, viii, for '*resin*,' read *rosin*.