

XV. *An Account of a new Genus of Plants, named RAFFLESIA.*
By Robert Brown, Esq., F.R.S. Libr. L.S.

Read June 30, 1820.

It is now nearly eighteen months since some account of a Flower of extraordinary size was received by my lamented friend and patron the late revered President of the Royal Society, from Sir Stamford Raffles, Governor of the East India Company's establishments in Sumatra.

This gigantic Flower, which forms the subject of the present communication, was discovered in 1818 on Sir Stamford's first journey from Bencoolen into the interior. In that journey he was accompanied by a naturalist of great zeal and acquirements, the late Dr. Joseph Arnold, a member of this Society, from whose researches, aided by the friendship and influence of the Governor, in an island so favourably situated and so imperfectly explored as Sumatra, the greatest expectations had been formed. But these expectations were never to be realized ; for the same letter which gave the account of the gigantic Flower, brought also the intelligence of Dr. Arnold's death.

As in this letter many important particulars are stated respecting the plant which I am about to describe, and a just tribute is paid to the merits of the naturalist by whom it was discovered, I shall introduce my account by the following extract.

“ Bencoolen, 13th August, 1818.

“ You will lament to hear that we have lost Dr. Arnold : he fell a sacrifice to his exertions on my first tour into the interior, and died of fever about a fortnight ago.

“ It is impossible I can do justice to his memory by any feeble encomiums I may pass on his character ; he was in every thing what he should have been, devoted to science and the acquisition of knowledge, and aiming only at usefulness.

“ I had hoped, instead of the melancholy event I have now to communicate, that we should have been able to send you an account of our many interesting discoveries from the hand of Dr. Arnold. At the period of his death he had not done much ; all was arrangement for extensive acquirement in every branch of natural history. I shall go on with the collections as well as I can, and hereafter communicate with you respecting them, and in the mean time content myself with giving you the best account I can of the largest and most magnificent Flower which, as far as we know, has yet been described. Fortunately I have found part of a letter from poor Arnold to some unknown friend, written while he was on board ship, and a short time before his death, from which the following is an extract.

“ After giving an account of our journey to Passummah, he thus proceeds :

“ ‘ But here (at Pulo Lebbar on the Manna River, two days journey inland of Manna) I rejoice to tell you I happened to meet with what I consider as the greatest prodigy of the vegetable world. I had ventured some way from the party, when one of the Malay servants came running to me with wonder in his eyes, and said, “ Come with me, Sir, come ! a flower, very large, beautiful, wonderful ! ” I immediately went with the man about a hundred yards in the jungle, and he pointed to a flower growing close to the ground under the bushes, which was truly astonishing. My first impulse was to cut it up and carry it to the hut. I therefore seized the Malay’s parang (a sort of instrument like a woodman’s chopping-hook), and finding that it sprang from a small root which ran horizontally (about as large as two fingers,

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or a little more), I soon detached it and removed it to our hut. To tell you the truth, had I been alone, and had there been no witnesses, I should I think have been fearful of mentioning the dimensions of this flower, so much does it exceed every flower I have ever seen or heard of; but I had Sir Stamford and Lady Raffles with me, and a Mr. Palsgrave, a respectable man resident at Manna, who, though equally astonished with myself, yet are able to testify as to the truth.

“ ‘ The whole flower was of a very thick substance, the petals and nectary being in but few places less than a quarter of an inch thick, and in some places three-quarters of an inch; the substance of it was very succulent. When I first saw it a swarm of flies were hovering over the mouth of the nectary, and apparently laying their eggs in the substance of it. It had precisely the smell of tainted beef. The calyx consisted of several roundish, dark-brown, concave leaves, which seemed to be indefinite in number, and were unequal in size. There were five petals attached to the nectary, which were thick, and covered with protuberances of a yellowish-white, varying in size, the interstices being of a brick-red colour. The nectarium was cyathiform, becoming narrower towards the top. The centre of the nectarium gave rise to a large pistil, which I can hardly describe, at the top of which were about twenty processes, somewhat curved and sharp at the end, resembling a cow’s horns; there were as many smaller very short processes. A little more than half-way down, a brown cord about the size of common whip-cord, but quite smooth, surrounded what perhaps is the germen, and a little below it was another cord somewhat moniliform.

“ ‘ Now for the dimensions, which are the most astonishing part of the flower. It measured a full yard across; the petals, which were subrotund, being twelve inches from the base to the apex, and it being about a foot from the insertion of the one petal

to the opposite one; Sir Stamford, Lady Raffles and myself taking immediate measures to be accurate in this respect, by pinning four large sheets of paper together, and cutting them to the precise size of the flower. The nectarium in the opinion of all of us would hold twelve pints, and the weight of this prodigy we calculated to be fifteen pounds.

“ ‘ I have said nothing about the stamina; in fact, I am not certain of the part I ought to call stamina. If the moniliform cord surrounding the base of the pistil were sessile anthers, it must be a polyandrous plant; but I am uncertain what the large germen contained; perhaps there might be concealed anthers within it.

“ ‘ It was not examined on the spot, as it was intended to preserve it in spirits and examine it at more leisure; but from the neglect of the persons to whom it was intrusted, the petals were destroyed by insects, the only part that retained its form being the pistil, which was put in spirits along with two large buds of the same flower, which I found attached to the same root: each of these is about as large as two fists.

“ ‘ There were no leaves or branches to this plant; so that it is probable that the stems bearing leaves issue forth at a different period of the year. The soil where this plant grew was very rich, and covered with the excrement of elephants.

“ ‘ A guide from the interior of the country said, that such flowers were rare, but that he had seen several, and that the natives called them *Krúbút*.

“ ‘ I have now nearly finished a coloured drawing of it on as large drawing-paper as I could procure, but it is still considerably under the natural size; and I propose also to make another drawing of the pistil removed from the nectarium.

“ ‘ I have now, I believe, given you as detailed an account of this prodigious plant as the subject admits of; indeed it is all I know

know of it. I would draw your attention, however, to the very great porosity of the root, to which the buds are attached.

“ ‘ I have seen nothing resembling this plant in any of my books ; but yesterday, in looking over Dr. Horsfield’s immense collections of the plants of Java, I find something which perhaps may approach to it ; at any rate the buds of the flower he has represented grow from the root precisely in the same manner : his drawing, however, has a branch of leaves, and I do not observe any satisfactory dissections. He considers it as a new genus ; but the difference of the two plants appears from this, that his full-blown flower is about three inches across, whereas mine is three feet.’

Sir Stamford proceeds :

“ Dr. Arnold did not live to return to Bencoolen, nor to fulfil the intentions expressed in the above extract ; but we have finished the drawing of the whole flower, and it is now forwarded under charge of Dr. Horsfield, to whom I have also intrusted the pistil and buds.

“ I shall make exertions for procuring another specimen, with which I hope we shall be more fortunate.”

(Signed) “ T. S. RAFFLES.”

To the Right Honourable
Sir JOSEPH BANKS, Bart. G.C.B., &c. &c.

The drawing of the expanded flower, and the specimens mentioned in the preceding extract, were brought to England by Dr. Horsfield ; and, having been put into my hands, I proceeded without delay to examine the smaller flower-bud. In this examination the antheræ, although not at first obvious, were soon discovered, but no part was found which could be considered either as a perfect pistillum, or as indicating the probable nature or even the exact place of the ovarium. The remains of the expanded

panded flower exhibited the same structure ; and the larger bud, which was examined by Mr. Bauer, whose beautiful drawings of it form the most valuable part of the present communication, proved also to be male.

These materials, it must be admitted, are insufficient even for the satisfactory establishment of the proposed new genus, and in my opinion do not enable us absolutely to determine its place in the natural system.

The curiosity of botanists, however, has been so much excited by the discovery of a flower of such extraordinary dimensions, the male flower is in many respects so singular, and its structure is so admirably illustrated by Mr. Bauer's drawings, that, accompanied by them, even the present incomplete account will probably be thought worthy of a place in the Society's Transactions.

Its publication is the less objectionable, as it may still be a considerable time before the plant is met with in all its states : and however unsatisfactory our present materials may be, either for determining its affinities, or the equally important question, whether it be parasitic on the root to which it is attached, there can be no doubt that it forms a genus abundantly distinct from any that has hitherto been described.

It is proposed, in honour of Sir Stamford Raffles, to call this genus *RAFFLESIA*, the name I am persuaded that Dr. Arnold himself would have chosen had he lived to publish an account of it ; and it may in the mean time be distinguished by the following characters.

RAFFLESIA.

RAFFLESIA.

Perianthium monophyllum, coloratum; *tubo* ventricoso; *corona* *faucis* annulari, indivisa; *limbo* quinquepartito, æquali.

MAS. *Columna* (inclusa): *limbo apicis* reclinato, subtus simplici serie polyandro; *disco* processibus (concentricis) tecto.

Antheræ sessiles, subglobosæ, cellulosæ, poro apicis dehiscentes.

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RAFFLESIA ARNOLDI.

TABB. XV.—XXII.

DESCRIPTION.

E *Radice* lignea horizontali tereti, lævi, crassitie fere et structura interiore omnino radicis *Vitis viniferæ* (*tab. 22. f. 8.*) ortum ducit *Flos* unicus, ante expansionem, dum bracteis imbricatis adhuc inclusus, brassicæ minori figura et magnitudine similis (*tab. 16.*); cum radice parum dilatata connexus *Basi* (*tab. 17.*) modicè convexa, abbreviata, insignita lineolis numerosis, elevatis, nigricantibus, plerisque reticulatim confluentibus, nonnullis brevioribus distinctis, omnibus sulco longitudinali tenui per axin exaratis, apothecia *Opegraphæ* æmulantibus, superioribus desinentibus in *annulum* modicè elevatum exsulcum, ejusdem fere substantiæ, definientem basin reticulatam.

Bracteæ (*tab. 16.*) supra annulum baseos reticulatæ, numerosæ, densè imbricatæ, subrotundæ, coriaceæ, glaberrimæ, integerrimæ, venis vix vel parum emersis, ramosis, distinctis, nec anastomosantibus, infra apicem evanescentibus, lata basi insertæ ibique crassæ, versus apicem sensim tenuiores, subfoliaceæ; intimæ e latiore basi, $\frac{1}{5}$ usque ad $\frac{1}{4}$ circuli æquante.

Perianthium (*tab. 15.*) intra bracteas sessile, monophyllum, coloratum, ante expansionem depresso-sphæroideum (*tab. 18 et 19.*).

Tubus

Tubus ventricosus, abbreviato-urceolatus, extus lævis, intus ramentis filiformibus simplicibus passimque parum divisis densè tectus. *Faux*: *corona* annulari integerrima, intus ornata areolis numerosis, convexiusculis, subrotundis transversim paulo latioribus, superioribus omnino lævibus, reliquis margine inferiore aucto ramentis filiformibus brevibus. *Limbus* quinque-partitus (diametro tripedali), *laciniis* æqualibus, (patentibus reflexisve) rotundatis, integerrimis, *extus* lævibus, præter venas parum elevatas, numerosas, dichotomas, passim anastomosantes, ad apicem usque attingentes; *intus* verrucis numerosis, subrotundis, sparsis, inæqualibus, interstitiis lævibus: *æstivatione* arcè imbricatis, exterioribus interiores utroque margine equitantibus (*tab.* 19.).

Columna centralis (*tab.* 20. et 21. *fig.* 1.) staminifera, cavitatem tubi perianthii ferè omnino replens, inclusa, solida, carnosae, intus cum substantia ipsius baseos reticulatae extus cum tubi superficie ramentacea continua; prope basin aucta *annulis* duobus modicè elevatis, rotundatis, ante expansionem approximatis (*tab.* 21. *f.* 1, 2.), in expanso flore remotioribus (*tab.* 22. *f.* 2.), *inferiore* paulo crassiore, striis leviter depressis numerosis rugoso, *superiore* exsulco, punctis minutis elevatis inæquali: supra anulum superiorem lævis et sensim angustata in *collum* brevissimum, insculptum *cavationibus* (*tab.* 21. *f.* 2.) numero antherarum iisque oppositis, basi angustatis, longitudinaliter elevato-striatis, interstitiis subcarinatis, carinis marginibusque ciliatis: *apex* dilatatus, cujus *discus* planiusculus, tectus *processibus* numerosis carnosus leviter incurvis subcorniformibus, simplicibus apiceve parum divisis, in seriebus pluribus concentricis, interioribus plus minus irregulariter, dispositis, nonnullis minoribus sæpe minimis sparsim intermixtis, majorum singulis fasciculo vasculari centrali tenui instructis, omnibus lævibus, præter apices lobulorum qui sæpe hispiduli

hispiduli vel minutè penicillati; *limbus* solutus reclinatus, e basi recurvata, subtus punctis parvis elevatis quandoque piliferis inæquali, adscendens, margine erecto-conniventi, indiviso tenuiter crenulato, substantia et superficie processibus disci similis, intus fasciculis vascularibus simplici serie dispositis et ad basin antheræ singulæ flexura notabili instructis (*tab.* 21. *f.* 2, 3, 7, 8. et *t.* 22. *f.* 6.).

Antheræ (*tab.* 21. *f.* 4—8. et *t.* 22. *f.* 4—6.) simplici serie dispositæ, æquidistantes, 35 circiter, vix 40, sessiles, excavationibus dimidiæ recurvatae limbi, cum iis colli continuis, lata basi insertæ, semiimmersæ, apicibus deorsum spectantibus, in respondentibus cavitatibus colli receptis, ovato-globosæ, pisi magnitudine, apice depressione unica centrali demum aperiente umbilicatae, cellulosa, cellulis indefinitè numerosis, subconcentricis, longitudinalibus, exterioribus versus apicem conniventibus, passim confluentibus et quandoque transversim interruptis, plenis *Polline* (*tab.* 21. *f.* 9.) minuto, sphærico, simplici, lævi.

Pistilli rudimenta nulla certa; processus enim corniculati apicis columnæ staminiferæ, in circulis pluribus concentricis dispositi atque singuli fasciculo vasculari centrali donati, dubiæ naturæ sunt.

To the foregoing description of *Rafflesia* it is necessary to add some observations explanatory of structure; and I shall also offer a few conjectures on certain points of the economy of the plant, and on its affinities.

The great apparent simplicity in the internal structure of every part, especially in a flower of such enormous size, is in the first place deserving of notice.

This observation particularly applies to the *Column*, which is found to consist of a uniform cellular texture, with a very small

proportion of vessels. The *cells* or utriculi are nearly spherical, slightly angular from mutual pressure, and, in the specimens examined at least, easily separable from each other without laceration. I have not been able to detect perforations on any part of their surface; but extremely minute granules, originally contained in great abundance in the cells, and frequently found adhering to their parietes, may readily be mistaken for pores.

The structure of *vessels* either in the column, perianthium or bracteæ, in all of which they are apparently similar, has not been satisfactorily ascertained. They may be supposed to approach most nearly to the ligneous, though certainly unaccompanied by spiral vessels, which do not appear to exist in any part of the plant.

The same internal structure is continued below the origin of the bracteæ, down to the line at which the vessels of the root appear to terminate, and where an evident change takes place (*plate* 20. and 22. *f.* 1.).

The *Perianthium* and *Bracteæ* in their cellular texture very nearly agree with the column, except that in their more foliaceous parts the cells are considerably elongated.

I have not found in any part of their surface, or in that of the column, those areolæ universally considered as cuticular pores, and which, though of very general occurrence, do not perhaps exist in the imperfectly developed leaves of plants parasitic on roots.

In the external composition of the column, the part most deserving of attention is the *Anthera*; for in apparent origin, as well as in form and structure, it presents the most singular modification of stamen that has yet been observed.

It appears to me of importance to inquire into the real relation which so remarkable a structure bears to the more ordinary states of *Anthera*.

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A satisfactory determination of this point, while it would certainly assist in explaining the nature of the other parts of the column, might also in some degree lead to correct notions of the affinities of the genus; and the question is perhaps sufficiently interesting, even independent of these results.

In this inquiry, it is necessary in the first place to take a general view of the principal forms of *Antheræ* in phænogamous plants; all of which, however different they may appear, I consider as modifications of one common structure.

In this assumed regular structure or type of *Anthera*, I suppose it to consist of two parallel folliculi or *thecæ*, fixed by their whole length to the margins of a compressed filament: each *theca* being originally filled with a pulpy substance, on the surface or in the cells of which the pollen is produced; and having its cavity divided longitudinally into two equal cells, the subdivision being indicated externally by a depression or furrow, which is also the line of dehiscence*.

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* A certain degree of resemblance between this supposed regular state of *Anthera*, and that which in a former essay (on *Compositæ*, *Linn. Soc. Transact.* xii. p. 89.) I have considered as the type of *Pistillum* in phænogamous plants, will probably be admitted; and both structures have, as it appears to me, an evident relation to the *Leaf*, from whose modifications all the parts of the flower seem to be formed.

This hypothesis of the formation of the Flower may be considered as having originated with Linnaeus in his *Prolepsis Plantarum*, though he has not very clearly stated it, and has also connected it with other speculations, which have since been generally abandoned. It is, however, more distinctly proposed by Professor Link (in *Philos. Bot. Prodr.* p. 141), and very recently has been again brought forward, with some modifications, by M. Aubert du Petit Thouars.

In adopting the hypothesis as stated by Professor Link, I shall, without entering at present into its explanation or defence, offer two observations in illustration of it, founded on considerations that have not been before adverted to.

My first observation is, that the principal point in which the *antheræ* and *ovaria* agree, consists in their essential parts, namely, the pollen and ovula, being produced on the margins of the modified leaf.

The structure now described actually exists in many families of plants; and the principal deviations from it may be stated to depend either on a reduced or increased development of the parts enumerated, on differences in the manner of bursting, or on the confluence of two or more antheræ.

Reduced development may consist merely in the approximation of the thecæ, consequent on the narrowing or entire absence of the connecting portion of the filament, which is one of the most common states of anthera; in their partial confluence, generally at the upper extremity; their parallelism either continuing,

In the *Antheræ*, which are seldom compound, and whose thecæ are usually distinct, the marginal production of pollen is generally obvious.

In the *Ovaria*, however, where, with very few exceptions, the same arrangement of ovula really exists, it is never apparent, but is always more or less concealed either by the approximation and union of the opposite margins of the simple pistillum, and of the compound when multilocular; or in the unilocular pistillum with several parietal placentæ by the union of the corresponding margins of its component parts.

The few cases of apparent exception, where the ovula are inserted over the whole or greater part of the internal surface of the ovarium, occur either in the compound pistillum, as in *Nymphæa* and *Nuphar*; or in the simple pistillum, as in *Butomeæ* of Richard; and in *Lardizabaleæ*, an order of plants sufficiently distinct in this remarkable character alone, and differing also in the structure of embryo and in habit, from *Menispermeæ*, to which the genera composing it (*Lardizabala* and *Stauntonia*) have hitherto been referred.

The marginal production of ovula, though always concealed in the ordinary or complete state of the Ovarium, not unfrequently becomes apparent where its formation is in some degree imperfect, and is most evident in those deviations from regular structure, where stamina are changed, more or less completely, into pistilla. Thus, in the case of the nearly distinct or simple pistillum, it is shown by this kind of monstrosity in *Sempervivum tectorum*; in the compound multilocular pistillum, by that of *Tropæolum majus*; and in the compound pistillum with parietal placentæ, by similar changes in *Cheiranthus Cheiri*, *Cochlearia armoracia*, *Papaver nudicaule* and *Salix oleifolia*.

In all the cases now quoted, and in several others with which I am acquainted, it is ascertained that a single stamen is converted into a simple pistillum, or into one of the constituent parts of the compound organ: a fact which in my opinion establishes the proposed type of Ovarium.

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tinuing, which is also not unfrequent; or accompanied by various degrees of divergence, as in many genera of *Labiatae*; in their complete confluence while they remain parallel, as in *Eparcrideae*, *Polygaleae*, and in some genera of *Acanthaceae*; and lastly, in the imperfect production or entire suppression of one of the thecae, as in *Westringia*, *Anisomeles* and *Maranteae*.

Increased development may in like manner be confined to the dilatation, elongation, or division of the connecting portion of the filament, of which examples occur in many *Scitamineae*, *Orchideae* and *Acanthaceae*; it may consist in the elongation of

I have entered thus slightly at present into the proof of this type, derived from these deviations from regular structure, partly on account of an observation which I find in the second edition of the excellent *Théorie Élémentaire de la Botanique* of Professor De Candolle, to whom, in 1816, I had shown drawings of most of the instances of monstrosity now mentioned. To these drawings, and to my deductions from them with regard to the structure of pistillum, I suppose the ingenious author alludes in the passage in question. His views, however, on this subject differ considerably from mine, which he does not seem to have been aware were already published (*Linn. Soc. Trans. l. c.*).

My second observation relates to the more important differences between the antheræ and ovaria, independent of their essential parts.

In the Anthera the vascularity, with relation to that of the Leaf, may be said to be diminished without being otherwise sensibly modified; the pollen is formed in a cellular substance apparently destitute of vessels; and is always produced internally, or under the proper membrane of the secreting organ.

In the Ovarium, on the other hand, the vascularity, compared with that of the Leaf, is in general rather modified than diminished; the principal vessels occupying the margins or lines of production, and giving off branches towards the axis, whose vascularity is frequently reduced. The ovula constantly arise from vascular cords, and, with reference to the supposed original state of the ovarium, are uniformly produced externally; though by the union of its parts, whether in the simple or compound state, they become always inclosed, and, before fecundation at least, are completely protected from the direct action of light and of the atmosphere.

In *Coniferae* and *Cycadeae*, however, according to the view I am disposed to take of them (*Tuckey's Congo, append. p. 454.*), this is not entirely the case. But these two families will perhaps be found to differ from all other phænogamous plants in the more simple structure both of their ovaria and antheræ.

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the thecæ either above or below the connecting filament ; in an increased number of divisions of each theca by longitudinal, transverse, or oblique processes of the receptacle of the pollen, as in several genera of *Orchideæ* and *Laurinæ* ; or in the persistence of part of the cells in which the pollen is formed, as in *Ægiceras*.

Reduced and increased development of different parts may co-exist in the same organ, as in the bifid or incumbent anthera with contiguous thecæ ; in the extraordinary dilatation of the connecting portion of the filament, while one of the thecæ is abortive or imperfect, as in the greater number of *Salviæ* ; or in the thecæ being confluent, while the polliniferous cells are at the same time persistent, as in certain species of *Viscum*.

The deviations from the regular mode of bursting are also numerous ; in some cases consisting either in the aperture being confined to a definite portion, generally the upper extremity, of the longitudinal furrow, as in *Dillenia* and *Solanum* ; in the apex of each theca being produced beyond the receptacle of the pollen into a tube opening at top, as in several *Ericinæ* ; or in the two thecæ being confluent at the apex, and bursting by a common foramen or tube, as in *Tetratheca*. In other cases a separation of determinate portions of the membrane takes place, either the whole length of the theca, as in *Hamamelideæ* and *Berberideæ* ; or corresponding with its subdivisions, as in several *Laurinæ* ; or lastly, having no obvious relation to internal structure, as in certain species of *Rhizophora*.

The regular structure may also be altered or disguised by the union of two or more stamina ; the thecæ of each anthera either remaining distinct and parallel, as in *Myristica*, *Canella*, and in several *Aroideæ* ; being divaricate and united, as in *Cissampelos* ; or absolutely separate, by division of the filament, as in *Conospermum* and *Synaphea*.

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It is unnecessary for my present purpose to enter into a more minute account of the various structures of stamina, most of which appear to me easily reducible to the type here assumed.

The precise relation of the anthera of *Rafflesia*, however, to this type is so far from being obvious, that at least three different opinions may be formed respecting it.

According to one of these, each actual anthera would be considered as composed of several united stamina. But in adopting this opinion, which is suggested solely by the existence and disposition of the cells of the anthera, it seems also necessary to consider the apparently simple flower of *Rafflesia* as in reality compound, and analogous to the spike of an *Aroidea*; the pistilla, if present, being consequently to be looked for not in the centre but in the circumference. On attending, however, to the whole external structure of the flower, as well as to the disposition of vessels, this supposition will, I conclude, appear still more improbable than that in support of which it is adduced.

A second opinion, diametrically opposite to the former, would regard the anthera of *Rafflesia*, as only half a regular anthera, whose two thecæ are separated by portions of the united filaments, which, being produced beyond the antheræ, together form the crenated limb of the column.

This view, though less paradoxical than the first, will hardly be considered as affording so probable an explanation of structure as the third opinion; according to which each anthera would be regarded as complete, made up of two united thecæ, opening by a common foramen, and internally subdivided into numerous vertical cells by persistent portions of the confluent receptacles of the pollen; a structure not perhaps essentially different from that of certain antheræ more obviously reducible to the supposed type.

Even in adopting this opinion, a question would still remain
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respecting the limb of the column under which the antheræ are inserted; namely, whether it is to be viewed as an imperfectly developed stigma, or as made up of processes of the united filaments. In support of the former supposition the nearly similar relation of the sexual organs in certain *Asarinæ* may be adduced; and in favour of the latter, not only their disposition and form in other plants of the same natural family, but also the vascular structure of the column itself; the limb deriving its vessels from branches of the same fasciculi that supply the antheræ (*plate 20. f. 1.*). If this latter view, however, of the origin of the limb were admitted, it might be considered not altogether improbable, that even the corniculate processes of the disk of the column, each of which has a central vascular cord, are of the same nature. For if, on the other hand, these processes are to be regarded as imperfect styles or stigmata, their number and disposition would indicate a structure of ovarium to be found only in families to which it is not probable at least that *Rafflesia* can be nearly related, as *Annonaceæ* and the singular genus *Eupomatia**, which I have placed near that natural order.

Another point to be inquired into connected with the same subject is, in what manner the impregnation of the female flower is likely to be effected by antheræ so completely concealed as those of *Rafflesia* seem to be in all states of the flower; for it does not appear either that they can ever become exposed by a change in the direction of the limb under which they are inserted, or even that this part of the column in any stage projects beyond the tube of the perianthium.

It is probable, therefore, that the assistance of insects is absolutely necessary; and it is not unlikely, both as connected with that mode of impregnation and from the structure of the anthera itself, that in *Rafflesia* the same economy obtains as in the sta-

* Flinders's *Voyage*, ii. p. 597. *tab. 2.*

mina of certain *Aroideæ*, in which it has been observed that a continued secretion and discharge of pollen takes place from the same cell; the whole quantity produced greatly exceeding the size of the secreting organ.

The passage of the pollen to the bottom of the flower, where it is more easily accessible to insects, seems likewise to be provided for, not only by the direction of the antheræ, but also by the form of the corresponding cavities in the neck of the column, in the upper part of which they are immersed.

That insects are really necessary to the impregnation of *Rafflesia*, is confirmed by Dr. Arnold's statement respecting the odour of the plant, by which they may be supposed to be attracted, and also by the fact of the swarms actually seen hovering about and settling in the expanded flower.

The structure of *Rafflesia* is at present too imperfectly known to enable us to determine its place in the natural system. I shall, however, offer some observations on this question, which can hardly be dismissed without examination.

As to which of the two primary divisions of phænogamous plants the genus belongs, it may, I think, without hesitation be referred to *Dicotyledones*; yet if the plant is parasitic, and consequently no argument on this subject to be derived from the structure of the root, which is exactly that of the Vine*, its exclusion from *Monocotyledones* would rest on no other grounds, than the quinary division of the perianthium, which in other respects also bears a considerable resemblance to that of certain dicotyledonous orders; the number of stamina, and the ramification of vessels in the bractææ.

Assuming, however, that *Rafflesia* belongs to *Dicotyledones*,

* Compare the magnified section of the Root, *tab. 22. f. 8.* with that of the Vine in Grew's *Anat. tab. 17.*

and considering the foliaceous scales which cover the unexpanded flower, both from their indefinite number and imbricate insertion as bracteæ, and consequently the floral envelope as simple, its comparison with the families of this primary division would be limited to such as are apetalous; either absolutely, as *Asarinæ*; those of a nature intermediate between the apetalous and polypetalous, in which the segments of the perianthium are generally, though not always, disposed in a double series, as *Passifloreæ*, *Cucurbitaceæ* and *Homalinæ*; or those which have a simple coloured floral envelope, but are decidedly related to polypetalous families, as *Sterculiaceæ*.

With *Asarinæ*, the only truly apetalous order to which it seems necessary to compare it, *Rafflesia* has several points of resemblance, especially in the structure of the central column. In *Aristolochia* the antheræ, though only six in number, are in like manner sessile, and inserted near the apex of a column formed by the union of stamina and pistillum. The mere difference in the number of stamina seems to be of no importance in the present question, there being twelve in *Asarum*; and in *Thottea*, a genus certainly belonging to this family, though referred by Rottböll to *Contortæ**, the stamina are not only still more numerous, but are disposed in a double circular series one above the other; an arrangement which may perhaps be considered analogous to the concentric series of processes in the apex of the column of *Rafflesia*.

In all these genera of *Asarinæ* and in *Bragantia* of Loureiro, which is also referable to the same order, the flowers are hermaphrodite; but in *Cytinus*, which, if not absolutely belonging to this order, is at least very nearly related to it, they are diclinous.

The affinity is also in some degree confirmed by the appearance of the inner surface of the tube of the perianthium of some

* *Thottea grandiflora*. Rottböll in *Nov. Act. Soc. Reg. Hafn.* ii. p. 529. tab. 2.

Asarinæ,

Asarina, especially *Aristolochia grandiflora*, and by the thickening or annular projection of the faux in the same plant, as well as in a new species of *Bragantia* discovered in Java by Dr. Horsfield.

It may also be noticed in support of it, that some of the largest flowers which were known before the discovery of *Rafflesia* belong to *Asarina*, as those of *Aristolochia grandiflora*, and particularly *Aristolochia cordiflora* of Mutis, which, according to M. Bonpland, are sixteen inches in diameter, or nearly half that of our plant*.

The first objection that occurs to this approximation is the ternary division of the perianthium in the regular flowered genera of *Asarina*, opposed to its quinary division in *Rafflesia*: but in *Cytinus* it is divided into four segments, a number more generally connected in natural families with five than with three.

A second objection would exist, if it be considered more probable that the ovarium of *Rafflesia* is superior, or free, than inferior, or cohering with the tube of the perianthium.

There is indeed nothing in the structure of the column itself indicating the particular position of the ovarium. But if it be admitted, that a base of a form equally calculated for support should exist in the female flower, as is found in the male, it might perhaps be considered somewhat more probable that such a base should be connected with a superior than with an inferior ovarium.

Even admitting this objection, however, it would be considerably weakened, on the one hand, by allowing that *Nepenthes*, which has a superior ovarium, is related to *Asarina*, as I am inclined to believe; and on the other, by considering *Homalina*, whose ovarium is inferior, as allied to *Passifloreæ*, the order with which I shall now proceed to compare *Rafflesia*.

This comparison is suggested by the obvious resemblance between the perianthium of our genus, and that of certain species

* Humboldt Bonpl. et Kunth Nov. Gen. et Sp. ii. p. 118.

of *Passiflora* itself ; or of other genera of the order, as *Deidamia*, in which the inner series of segments is wanting. Thus, they agree essentially, and even remarkably, in æstivation of perianthium : the corona of *Rafflesia* may be compared with that of *Murucuia*, and the two annular elevations at the base of the column with the processes of like origin and nearly similar form in some species of *Passiflora*. The affinity is also supported by the position of the stamina on a central column.

The peculiar structure of antheræ in *Rafflesia* can hardly be regarded as an objection of much weight to the proposed association ; and it will at least almost equally apply to any other family with which this genus may be compared.

If the concentric processes on the disk of the column in our plant are to be regarded as indications of the number and disposition of pistilla, or of the internal structure of ovarium in the female flower, they present a formidable objection to its affinity with *Passifloreæ*, in all of which the ovarium is unilocular with parietal placentæ. If, however, these processes were considered as inner series of imperfect stamina, the objection derived from their number and arrangement merely, would be comparatively slight ; for in some genera of *Passifloreæ*, particularly in *Smeathmannia**, the stamina are also numerous and perhaps even indefinite. It

* As *Smeathmannia* forms a very remarkable addition to the order in which I have proposed to place it, and is still unpublished ; I shall here give its characters, and add a few remarks in support of this arrangement.

SMEATHMANNIA. Soland. Mss. in Biblioth. Banks.

Ord. Nat. Passifloreæ. Br. in Tuckey's Congo, p. 439.

Syst. Linn. Polyandria Pentagynia.

CHAR. GEN. *Perianthium* duplex, utrumque 5-partitum ; *exterius* semicalycinum persistens ; *interius* petaloideum marcescens. *Urceolus* simplex, membranaceus, ex ipsa basi perianthii. *Stamina* numerosa, distincta, apici columnæ brevissimæ genitalium inserta. *Styli* 5. *Stigmata* peltata. *Capsula* inflata, quinquevalvis. *Semina* axibus valvularum inserta.

Frutices

It has been already remarked, that there is nothing in the structure of the column in *Rafflesia* to enable us to determine the

Frutices (*forsan decumbentes*). Folia alterna simplicia subdentata, stipulis lateralibus (utrinque solitariis geminisve) distinctis, callosis. Flores axillares subsolitarii, pedunculis, quandoque brevissimis, basi bracteolatis. Urceolus abbreviatus, ore denticulato. Filamenta simplici serie, viginti circiter. Antheræ incumbentes, lineares. Capsula chartacea. Semina axibus filiformibus valvularum subsimplici serie inserta, pedicellata, punctata, omnino Passifloræ.

PATRIA. Africa æquinoctialis.

1. *S. pubescens*, ramis tomentosis, foliis oblongo-ovatis basi obtusis: adultis pube rara conspersis, urceolo barbato.

Smeathmannia pubescens. Solander l. c.

Loc. Nat. Guinea, prope Sierra Leone, *Smeathman*, *Afzelius*.

2. *S. lævigata*, ramis glabris, foliis oblongis ovatisve basi acutis: adultis glaberrimis utrinque nitidis, urceolo imberbi inciso.

Smeathmannia lævigata. Soland. l. c.

Loc. Nat. Guinea, prope Sierra Leone, *Smeathman*, *Afzelius*, *Purdie*.

3. *S. media*, ramis glabris, foliis obovato-oblongis basi obtusis: adultis utrinque glabris subopacis.

Loc. Nat. Guinea, prope Sierra Leone, *Smeathman*.

Forsan varietas *S. lævigata*.

The affinity of *Smeathmannia* to *Paropsia* of M. du Petit Thouars will probably be admitted without hesitation; and its exact agreement in fruit in every important point, both with this genus and with *Modecca*, seems to leave no doubt of its belonging to *Passifloræ*, with which it agrees in habit even better than *Paropsia*, and certainly much more nearly than *Malesherbia*, considered by M. de Jussieu (in *Flor. Peruv.* iii. p. xix.) as belonging to the same family.

Smeathmannia differs then from the other genera of *Passifloræ* solely in its greater number of stamina, which, however, may not be really indefinite; and an approach to this structure is already known to exist in an unpublished genus (*Thompsonia*) discovered in Madagascar by Mr. Thompson, of which the habit is entirely that of *Deidamia*, and whose stamina are equal in number to the divisions of both series of the perianthium.

But from *Smeathmannia* the transition is easy to *Ryania*, which differs chiefly in its still greater number of stamina, in the want of petals or inner series of perianthium, in the single style being only slightly divided, and in the form of its placentæ.

And *Ryania*, although it has a superior ovarium, may even be supposed to be related to *Asteranthos* and *Belvisia*, if the fruit of these two genera should prove to be unilocular with several parietal placentæ.

position

position of the ovarium in the female flower; but that from another consideration there seems a somewhat greater probability of its being superior. If, however, it were even inferior, the objection to the affinity in question would not be insuperable, the relationship of *Homalinæ* to *Passifloreæ* being admitted.

If *Napoleona* or *Belvisia* be really allied to *Passifloreæ*, which is very doubtful, however, and can only be determined by an examination of the fruit, it may also be compared with *Rafflesia*. At first sight this singular genus seems to resemble our plant in several respects, particularly in the manner of insertion of its sessile flower into the branch, in the bractæ surrounding the ovarium, the confluence and dilatation of its filaments, and in the existence of a double corona. But some of these points are obviously unimportant; and the comparison between the corona of the great flower and the double corolla of *Belvisia* will probably be considered paradoxical*.

It seems unnecessary to compare *Rafflesia* with *Cucurbitaceæ*, to which it could only be considered as approaching, if its affinity to *Aphyteia* should appear probable, and the relationship of that genus to *Cucurbitaceæ*, suggested chiefly by the structure of antheræ, were at the same time admitted. The

* M. de Beauvois, in his account of *Napoleona* (*Flore d'Oware* ii. p. 32.), has mentioned a genus allied to it, which has been since published by M. Desfontaines under the name of *Asteranthos*. These two genera are without doubt nearly related; and, even independent of the structure of fruit, which in both remains to be ascertained, possess sufficient characters to separate them from every known family, as M. de Jussieu is disposed to think; and certainly from *Symploceæ*, where M. Desfontaines has placed them.

In adopting the generic name proposed by M. Desvaux for *Napoleona*, this order may be called

BELVISEÆ.

Calyx monophyllus, limbo diviso, persistens. *Corolla*? monopetala, plicata, (multiloba vel indivisa; simplex v. duplex) decidua. *Stamina* vel definita v. indefinita; basi corollæ

The points of agreement between *Rafflesia* and *Sterculiaceæ* are the division and form of the coloured perianthium, the sessile antheræ terminating a column, and the separation of sexes.

On these resemblances, however, I am not disposed to insist; and I am even persuaded that there is here no real affinity; though I confess I have no other objections to state to it than the valvular æstivation of the perianthium, and the absence both of the corona and of the annular elevations at the base of the column in *Sterculiaceæ*.

To conclude this part of my subject, I am inclined to think that *Rafflesia*, when its structure is completely known, will be found to approach either to *Asarinæ* or *Passifloreæ*; and that, from our present imperfect materials, notwithstanding the very slight affinity generally supposed to exist between these two orders, it cannot be absolutely determined to which of them it is most nearly allied.

The only question that remains to be examined respecting *Rafflesia* is, whether the flower with its enveloping bractæ and reticulate base do not together form a complete plant parasitic on the root from which it springs?

corollæ inserta. Ovarium inferum. Stylus 1. Stigma lobatum v. angulatum. Pericarpium baccatum, polyspermum.

Frutices (Africæ æquinoctialis; an etiam Brasilæ?) foliis alternis integerrimis exstipulatis, floribus axillaribus lateralibusve solitariis.

BELVISIA, Desvaux in *Journal de Botanique appliq.* iv. p. 130.

Napoleona, Palisot de Beauvois *Flore d'Oware* ii. p. 29.

Calyx 5-fidus. Corolla? duplex; exterior indivisa; interior (e staminibus sterilibus connatis formata?) multifida. Stamina: Filamenta 5 dilatata biantherifera.

ASTERANTHOS, Desfont. in *Mem. du Mus.* vi. p. 9. tab. 3.

Calyx multidentatus. Corolla? simplex multiloba. Stamina indefinite numerosa distincta.

That

That such was probably the case, occurred to me on first inspecting the flower-bud; the opinion being suggested not only by the direct origin of the flower from the root, but more particularly by the disposition, texture and colour of the bracteæ; in which it so nearly resembles certain plants known to be parasites, as *Cytinus*, *Cynomorium*, *Caldasia* of Mutis*, *Balanophora*, and *Sarcophyte*.

In this opinion I was confirmed on seeing the figure of the plant mentioned in Dr. Arnold's letter, as probably related to the Great Flower, though not more than three inches in diameter.

The plant in question, which had been found in Java by Dr. Horsfield several years before the discovery of *Rafflesia Arnoldi*, only, however, in the unexpanded state, is represented in the figure referred to as springing from a horizontal root in the same manner as the Great Flower; like which also it is enveloped in numerous imbricate bracteæ, as having a perianthium of the same general appearance, with indications of a similar entire annular process or corona at the mouth of the tube, a pustular inner surface, and a central column terminated by numerous acute processes. It is therefore unquestionably a second species of

* In the Journal of Science, vol. iii. p. 127, from El Semanario del Nuevo Reyno de Granada, for 1810. To this genus belong *Cynomorium jamaicense*, and perhaps *cayanense* of Swartz, an unpublished species from Brazil, and some other plants of equinoctial America. Before the appearance of *Caldasia* in the Journal of Science, I was aware that these plants formed a genus very distinct from *Cynomorium* (Journal of Science, iii. p. 129.), but I had not given it a name, which is still wanting, that of *Caldasia* having long been applied to a very different and well known genus.

The new name, however, may be left to M. Richard, who is about to publish, and who will no doubt illustrate with his usual accuracy, the plants formerly referred to *Cynomorium*, of one of the species of which (*C. cayanense*) he is himself the discoverer.

the

the same genus* : but the branch with leaves which, though separately represented in the drawing, is considered as proceeding from the same root, appears to me, on an examination of the specimen figured, to belong to a species of *Vitis* : and on mentioning my supposition respecting the Great Flower to Dr. Horsfield, he informed me he had observed this second species of the genus also connected with leaves of a different kind, and which seemed likewise to be those of a *Vitis*†.

Even with all the evidence now produced, I confess I was inclined, on a more minute examination of the buds of *Rafflesia Arnoldi*, to give up the opinion of its being a parasite ; on considering, first, the great regularity of the reticulate base, which yet, externally at least, seemed to be merely a dilatation of the bark of the root : secondly, the nearly imperceptible change of structure from the cortical part of the base to the bractæ in contact with its upper elevated margin : thirdly, the remarkable change of direction and increased ramification of the vessels of the root at the point of dilatation ; a modification of structure which must probably have taken place at a very early stage of its growth : and lastly, on finding these vessels in some cases penetrating the base of the column itself (*plate 22. f. 1.*).

But to judge of the validity of these objections, it became necessary to examine the nature of this connection in plants known

* This second species may be named *Rafflesia Horsfieldii*, from the very meritorious naturalist by whom it was discovered. At present, however, the two species are to be distinguished only by the great difference in the size of their flowers ; those of the one being nearly three feet, of the other hardly three inches in diameter.

† Isert (in *Reise nach Guinea*, p. 283.) mentions a plant observed by him in equinoctial Africa, parasitic on the roots of trees, consisting, according to the very slight notice he has given of it, almost entirely of a single flower of a red colour, which he refers to the Linnean class Icosandria, and compares in appearance, I suppose in the young state, to the half of a Pine-cone. It is not unlikely that this plant also may be really allied to *Rafflesia*, the smaller species of which it probably resembles in appearance.

to be parasitic on roots; in those especially, which in several other respects resemble *Rafflesia*, as *Cytinus*, *Aphyteia*, *Cynomorium*, and *Balanophora*. On this subject I cannot find that a single observation has hitherto been made, at least with respect to the genera now mentioned. Sufficient materials, indeed, for such an investigation are hardly to be expected in collections, in which the parasite is most frequently separated from the root; and even when found in connection with it, is generally in a state too far advanced to afford the desired information. I consider myself fortunate, therefore, in having obtained specimens of several species where the union is preserved; and the result of the examination of these, though not completely satisfactory, has been to lead me back to my first opinion, namely, that the Great Flower is really a parasite, and that the root on which it is found probably belongs to a species of *Vitis*.

An account of some of the more remarkable of this class of parasitic plants, to which a few years ago I had paid particular attention, may hereafter form the subject of a separate communication. At present I shall confine myself to such general observations on the class as relate to the question respecting *Rafflesia*.

In the first place, plants parasitic on roots are chiefly distinguishable by the imperfect development of their leaves, and the entire absence of green colour; an observation which, as applying to the whole tribe, was I believe originally made by Linnæus*. In both these points they agree with *Rafflesia*.

A second observation which may be made respecting them is, that their seeds are small, and their Embryo not only minute, but apparently imperfectly developed; in some cases being absolutely undivided, and probably acotyledonous, even in plants which, from their other characters, are referable to dicotyledonous, or at least to monocotyledonous families.

* *Fungus Melitensis*, p. 3. *Amæn. Acad.* iv. p. 353.

In these points the structure of *Rafflesia* remains to be ascertained. In the mean time, however, if it be considered as a parasite, and as likely to agree with the other plants of the tribe in the state of its embryo, it may be remarked, with reference to the question of its affinities, that such a structure would approximate it rather to *Asarina* than to *Passifloreæ*.

My principal and concluding observation relates to the modes of union between the stock and the parasite. These vary in the different genera and species of the tribe, which may be divided into such as are entirely dependent on the stock during the whole of their existence, and such as in their more advanced state produce roots of their own.

Among those that are in all stages absolutely parasitic, to which division *Rafflesia* would probably belong, very great differences also exist in the mode of connection. In some of those that I have examined, especially two species of *Balanophora**, the nature of this connection is such, as can only be explained on the supposition that the germinating seed of the parasite excites a specific action in the stock, the result of which is the formation of a structure, either wholly or in part, derived from the root, and adapted to the support and protection of the undeveloped parasite; analogous therefore to the production of galls by the puncture of insects.

On this supposition, the connection between the flower of *Rafflesia* and the root from which it springs, though considerably different from any that I have yet met with, may also be explained. But until either precisely the same kind of union shall have been observed in plants known to be parasitic, or, which would be

* *Balanophora fungosa* of Forster, and *B. dioica*, an unpublished species, lately sent by Dr. Wallich from Nepaul, where it was discovered by Dr. Hamilton, and also found in Java by Dr. Horsfield.

still more satisfactory, until the leaves and fructification belonging to the root to which *Rafflesia* is attached shall have been found, its being a parasite, though highly probable, cannot be considered as absolutely ascertained*.

ADDITIONAL OBSERVATIONS.

Read November 21, 1820.

SINCE my paper on *Rafflesia*, or the Great Flower of Sumatra, was read to the Society, further information respecting it has been received from Sir Stamford Raffles and Mr. Jack, which will form an important addition to my former account.

Sir Stamford, in a letter to Mr. Marsden, states the following particulars :

“ I find the *Krúbút* or Great Flower to be much more general and more extensively known than I expected. In some districts it is simply called *Ambun Ambun*. It seems to spring from the horizontal roots of those immense Climbers, which are attached like cables to the largest trees in the forest. We have not yet met with the leaves. The fruit also is still a desideratum. It is said to be a many-seeded berry, the seeds being found in connection with the processes on the summit of the pistillum. I have had buds brought in from Manna, Sillibar, the interior of Bencoolen and Laye ; and in two or three months we expect the full-blown flower. It takes three months from the first appearance of the bud to the full expansion of the flower ; and the flower appears but once a year, at the conclusion of the rainy season.”

* Annals of Philosophy for September 1820, p. 225.

The first communication from my friend Mr. Jack consisted of a description of recent flower-buds, at that time regarded by him as hermaphrodite, but which he has since ascertained to be male. It is unnecessary to introduce this description here, as it essentially agrees with that already given, and may also be considered as superseded by the important information contained in the following letter, which I have more recently received from the same accurate botanist.

“ MY DEAR SIR,

“ Bencoolen, June 2, 1820.

“ Since I wrote you last I have ascertained several particulars respecting the Gigantic Flower of Sumatra, additional to those contained in the account forwarded by Sir Stamford Raffles to Mr. Marsden, and by him communicated to you, which it may be interesting to you to know.

“ Numerous specimens, in every stage of growth, have been sent from various parts of the country, which have enabled me to ascertain and confirm every essential point. The first and most unexpected discovery is, that it has no stem of its own, but is parasitic on the roots and stems of a ligneous species of *Cissus* with ternate and quinate leaves : I have not ascertained the species*. It appears to take its origin in some crack or hollow of the stem, and soon shows itself in the form of a round knob, which, when cut through, exhibits the infant flower enveloped in numerous bracteal sheaths, which successively open and wither away as the flower enlarges, until, at the time of full expansion, there are but a very few remaining, which have somewhat the appearance of a broken calyx. The flowers I find to be unisexual, which I did not before suspect, and consequently diœcious. The male I have already described. The female differs very

* Mr. Jack has since determined it to be *Cissus angustifolia* of Roxburgh. *Fl. Ind. i.* p. 427.

little in appearance from it, but totally wants the globular anthers, which are disposed in a circle round the lower side of the rim or margin of the central column of the male.

“ In the centre of this column or pistillum in the female are perceived a number of fissures traversing its substance without order or regularity, and their surfaces are covered with innumerable minute seeds. The flower rots away not long after expansion, and the seeds are mixed with the pulpy mass.

“ The male and female flowers can be distinguished by a section not only when mature, but at every stage of their progress. I have made drawings of every essential part, which I hope soon to be able to send home, together with a further account than I have yet had leisure to make.

“ I remain, &c.

“ WILLIAM JACK.”

The two principal desiderata respecting *Rafflesia*, namely, the satisfactory proof of its being a parasite, and the discovery of the female flower, are now therefore supplied.

Additional information, however, on several points is still wanting to complete the history of this extraordinary plant.

Thus, it would be interesting, by a careful examination of the buds in every stage, to trace the changes produced in the root by the action of the parasite, and especially to ascertain the early state of the reticulate base, which I have ventured to consider as a production of an intermediate nature, partly derived from the root itself, and which I suppose will be found to exist before the bractæ become visible.

Further details are also wanting respecting the circumstance of its being found both on the roots and stems of the *Cissus* or *Vitis**,

* As these two genera differ from each other merely in number of parts, I have formerly proposed to unite them under the name of *Vitis*. (*Tuckey's Congo*, p. 465.)

no instance being, I believe, at present known of parasites on roots, which likewise originate from other parts of the plant.

Many important particulars remain to be ascertained respecting the *Pistillum*.

From Mr. Jack's account it appears that the seeds are found in the substance of the column ; in other words, that the ovarium is superior. But as I have formerly remarked, that in the male flower the same internal structure seems to be continued below the apparent base of the column, it is possible that in the female the production of seeds may extend to an equal depth : the ovarium would then become essentially inferior, as far at least as regards the question of the affinity of the plant. This point would be determined by a description of the unimpregnated ovarium, a knowledge of whose structure is also wanting to enable us to understand the nature of the ripe fruit, and especially the origin and direction of the fissures, on the surfaces of which the seeds are produced.

It is desirable likewise to have a more particular description of the *Stigma*, to which Mr. Jack seems to refer both the corniculate processes of the disk, and the undivided limb of the column. These parts in the male flower have no evident papulose or secreting surface ; for the hispid tips of the processes can hardly be regarded as such. But it is not likely that in the female flower they are equally destitute of this, which is the ordinary surface of a stigma ; and it appears to me more probable that such a surface should be confined to a definite portion, probably the tips, of the corniculate processes, than that it should extend over every part of the apex of the column.

Whatever may be the fact, my conjecture respecting these processes being possibly imperfect stamina is completely set aside ; though it is still difficult to connect their number and arrangement with the supposed structure of ovarium.

Until

Until these points are ascertained, and the seeds have been examined, the question of the affinities of the genus will probably remain undetermined. In the mean time it may be remarked, that as far as the structure of the fruit of *Rafflesia* is yet understood, it may be considered as in some degree confirming the proposed association of the genus with *Asarina*; especially with *Cytinus*, in which the ovarium is unilocular, with numerous parietal placentæ extending nearly to the centre of the cavity, and having their surfaces covered with minute ovula.

From the appearance of the ripe fruit of *Aphyteia*, a similar structure may be supposed to exist also in that genus, of which, however, the unimpregnated ovarium has not been examined. But these two genera are parasitic on roots, and have also their stigmata remarkably developed; and although *Rafflesia* probably differs from both of them in having a superior ovarium, I have endeavoured to show that this difference alone would not form an insuperable objection to their affinity.

EXPLANATION OF THE PLATES

RELATING TO

RAFFLESIA ARNOLDI.

PLATE XV.

The expanded Flower reduced to somewhat less than $\frac{1}{3}$ of its natural size; the scale given on the plate being too long by nearly $\frac{1}{7}$.

XVI.

A Flower-bud covered with its bractæ, of the natural size.

PLATE

PLATE XVII.

The underside of the same Bud ; to show the root, the reticulate base with the circular elevation in which it terminates, and the origin of the outer bracteæ. Natural size.

XVIII.

A Flower-bud, of which the bracteæ, whose insertions are shown, are removed. Natural size.

XIX.

A different view of the Bud in the same state, to show the æstivation and veins of the segments of the perianthium. Natural size.

XX.

Fig. 1. A vertical section of the Bud deprived of its bracteæ : exhibiting the principal vessels of the column and perianthium, and the structure of the root, especially the change in the direction, increased ramification and termination of its vessels at the base of the parasite. Natural size.

2. One half of the vertically-divided perianthium of the same Bud, in which the internal surface of the tube, corona and segments is shown. Natural size.

XXI.

Fig. 1. A Flower-bud, its bracteæ and perianthium being removed, to show the column with the two annular processes at its base. Natural size.

2. A portion (about $\frac{1}{5}$) of the column, of which part of the limb is removed, to show the cavities of the neck, into which the antheræ are received. Natural size.

3. The portion of the Limb removed from fig. 2. with its antheræ immersed in their proper cavities. Natural size.

Fig. 4. An Anthera, magnified three diameters, as are figures 5, 6, 7 and 8.

5. A transverse section of the same above the middle.

6. A transverse section of the same below the middle.

7, 8. Vertical sections of the same.

9. Pollen, magnified 200 diameters.

PLATE XXII.

Fig. 1. A vertical section of part of the base of the smaller Flower-bud, showing the vessels of the root, some of which appear to penetrate the substance of the parasite. Natural size.

2, 3. Portions of the column of the expanded Flower, nearly corresponding with those of the Bud, in *Pl. 21. f. 2 & 3.* Natural size.

4. Anthera of the expanded Flower, magnified 3 diameters, as are figures 5 and 6.

5. Transverse section of the same below the middle.

6. Vertical section of the same.

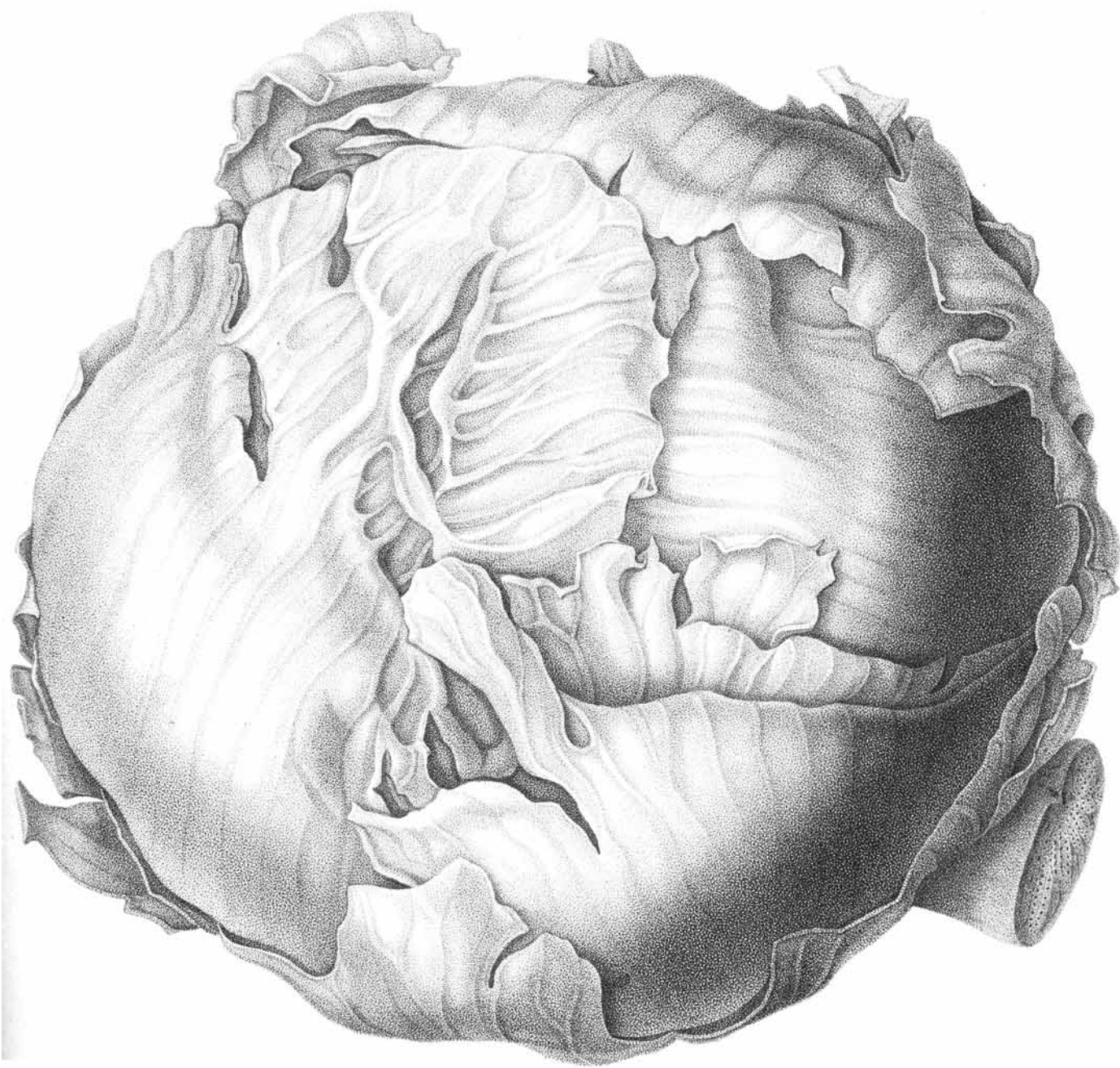
7. Pollen of the expanded Flower, magnified 200 diameters.

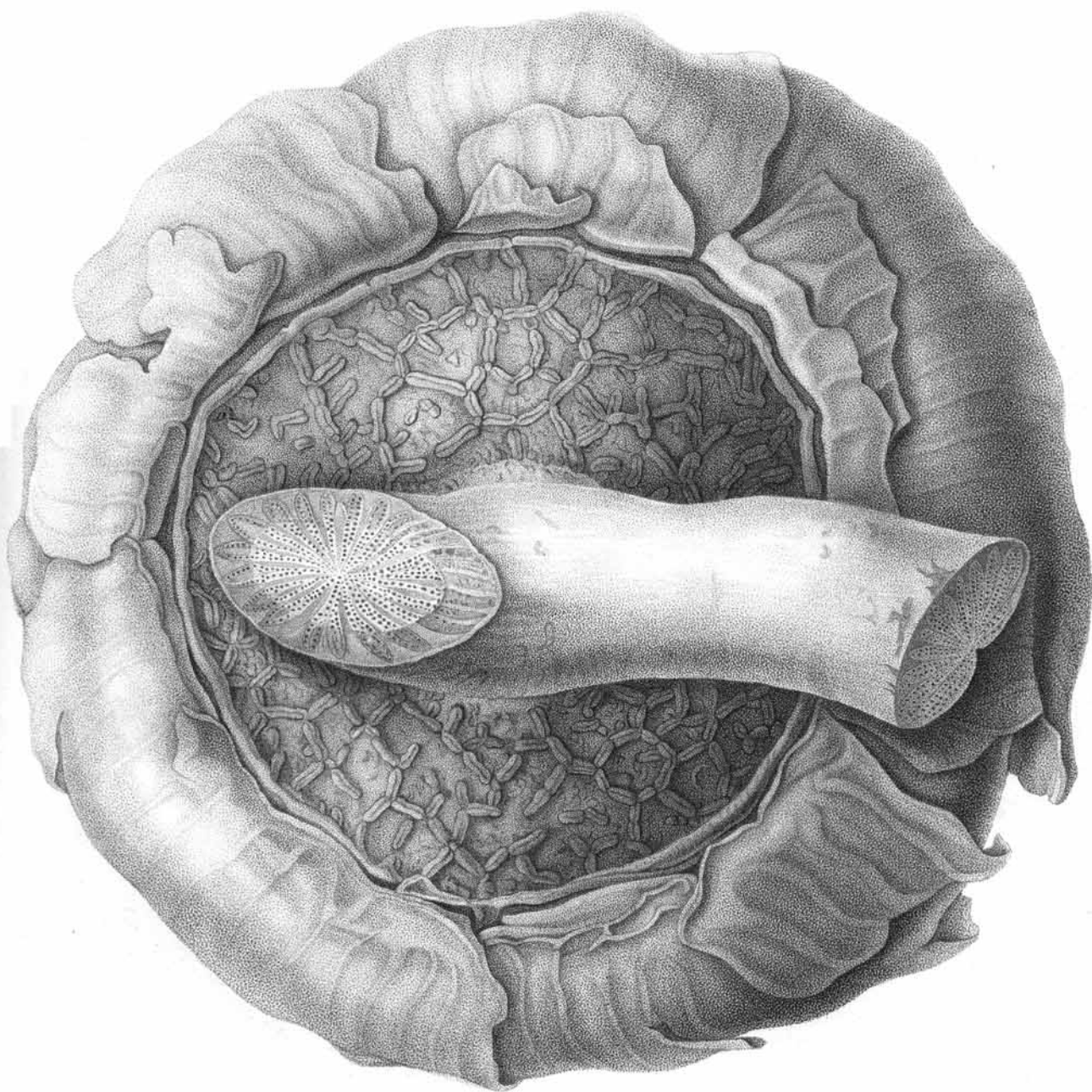
8. A transverse section of the Root, magnified 3 diameters.

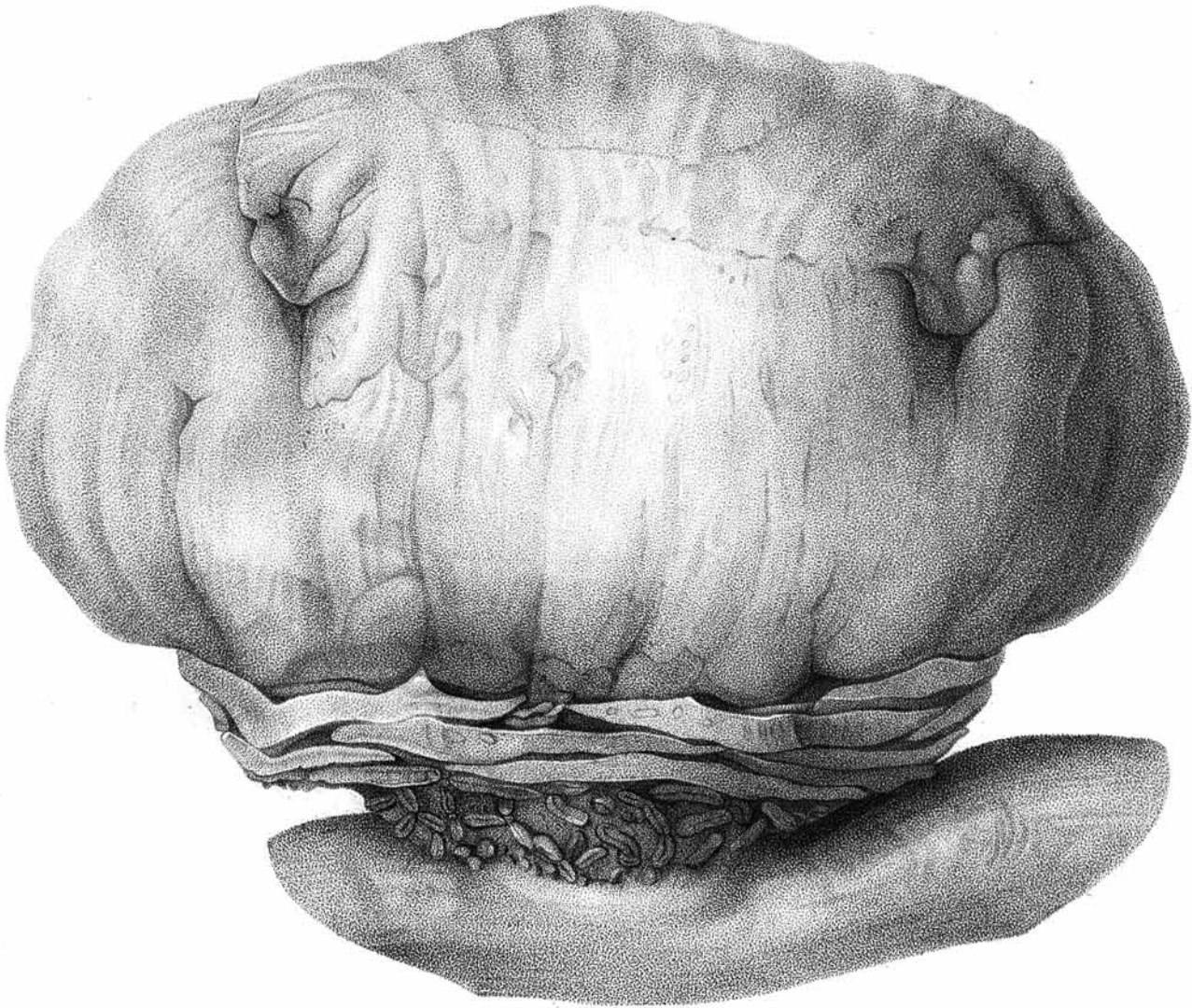
Richard, Duke of Devon, 1794

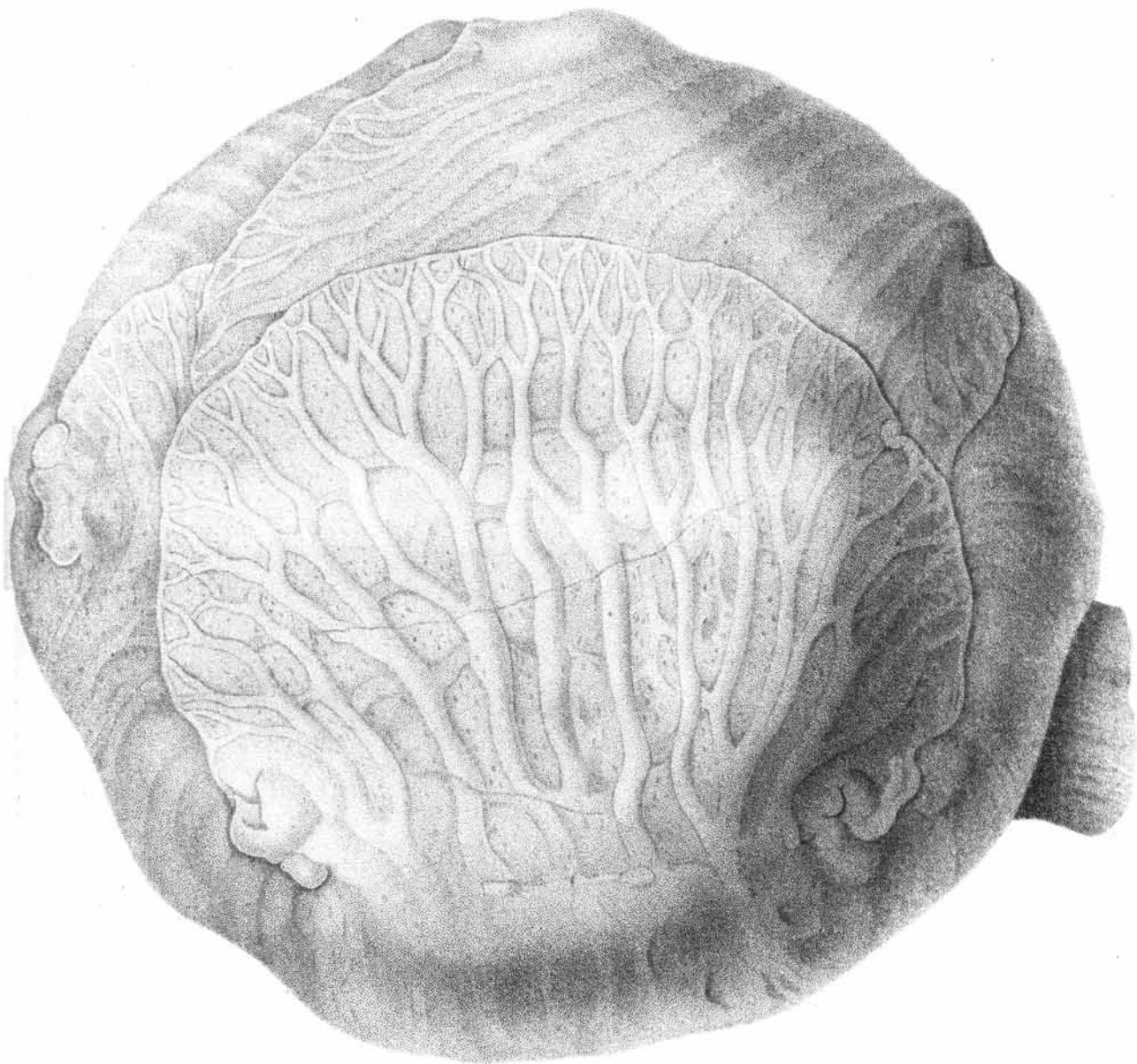


Begonia, knudde.

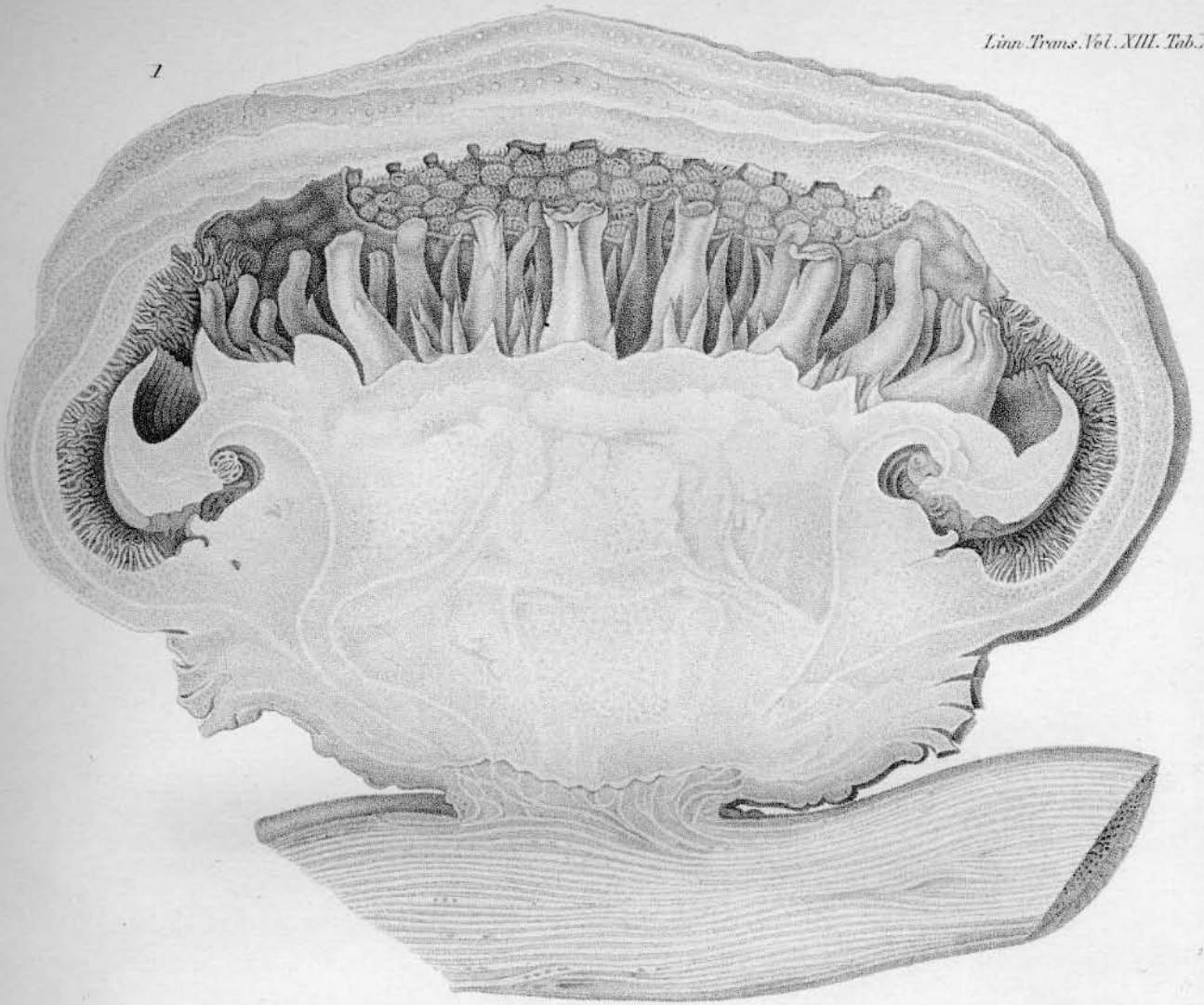




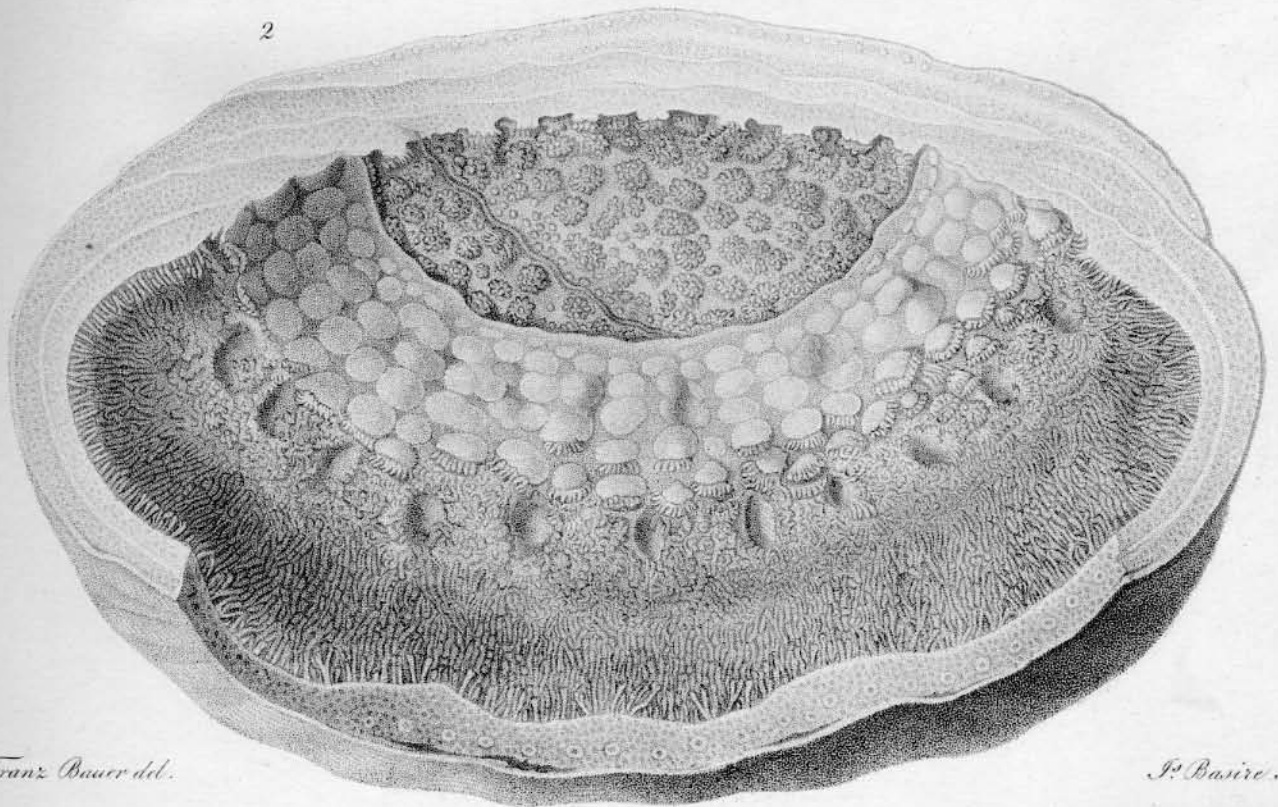


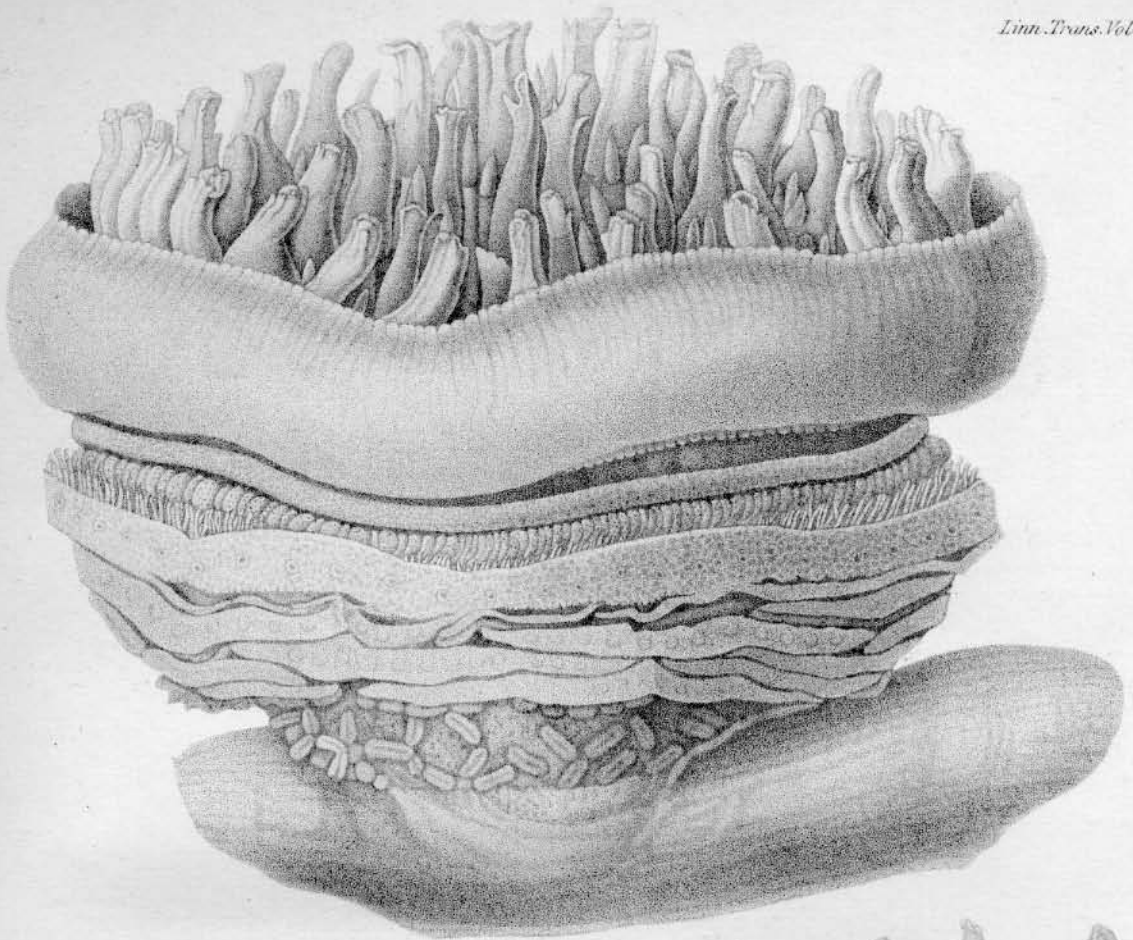


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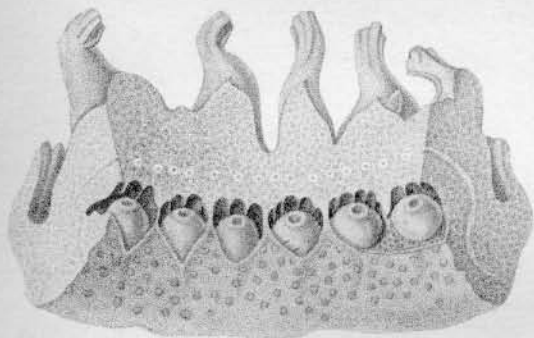


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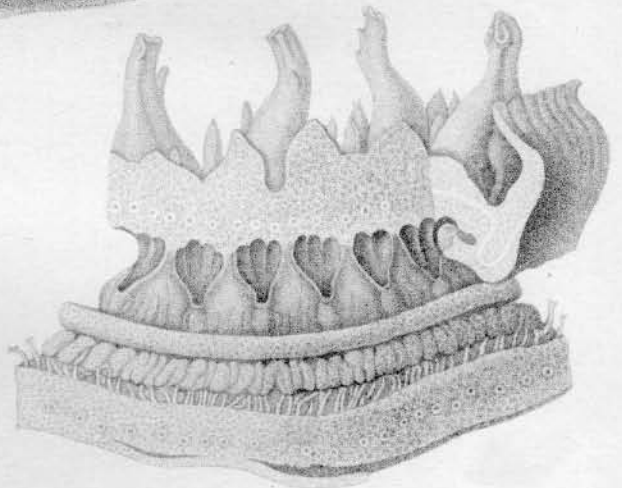




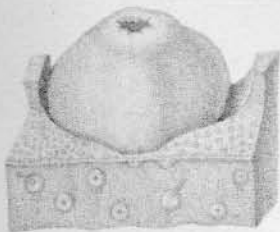
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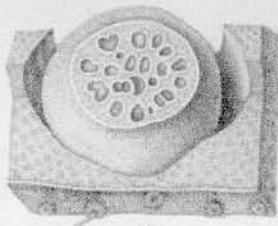
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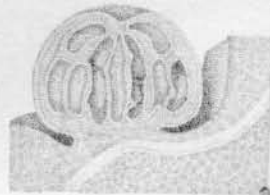
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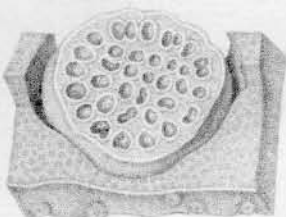
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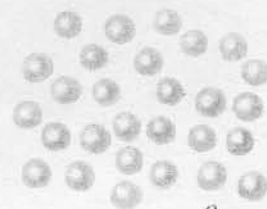
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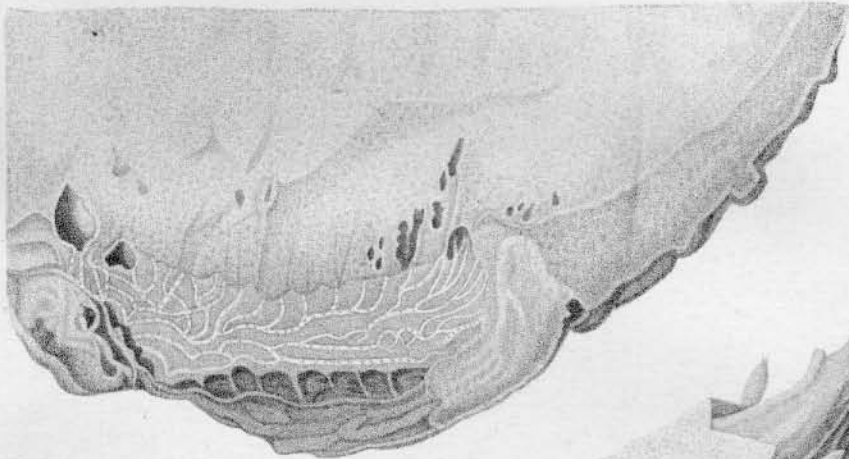
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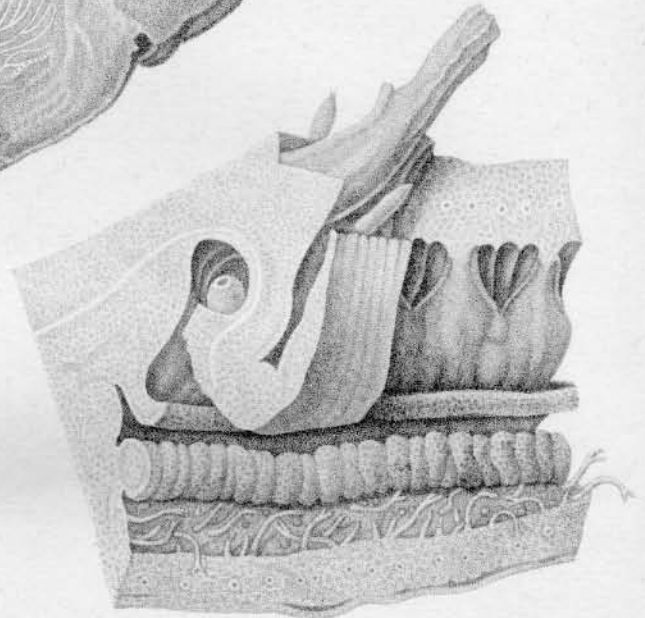
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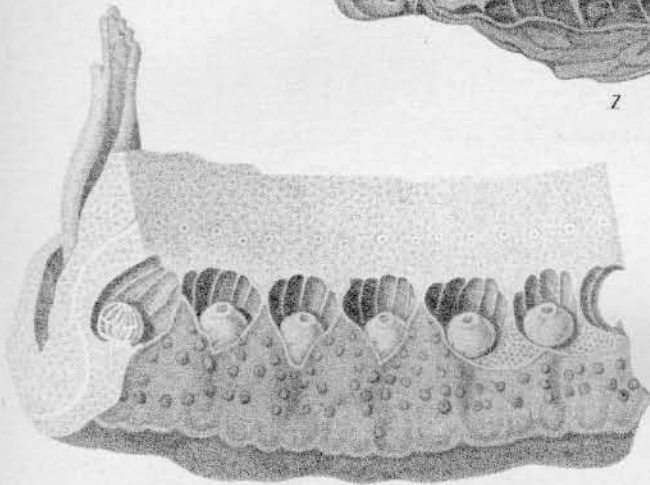
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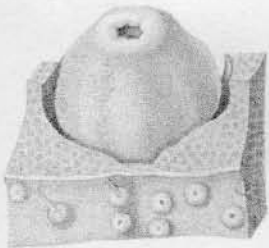
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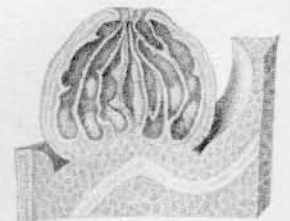
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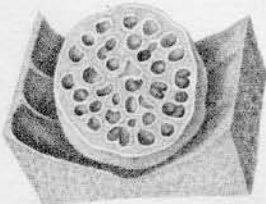
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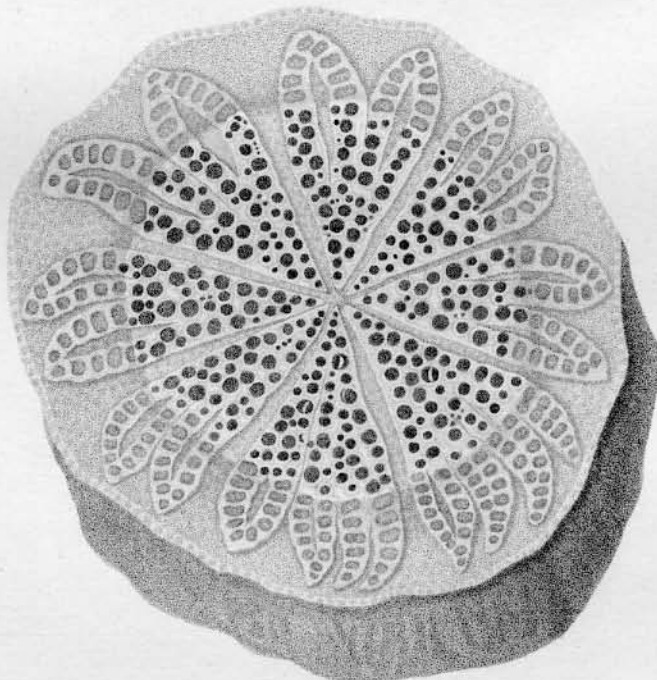
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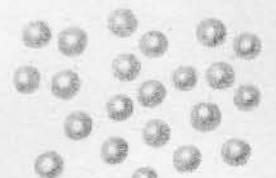
6



5



8



7