Morphological Notes.

BY

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With Plates XIV and XV.

VII. EVOLUTION OF PITCHERS IN DISCHIDIA RAFFLESIANA.

IT is a great many years ago since I derived my first knowledge of the pitchers of *Dischidia rafflesiana* from the pages of Lindley's Introduction to Botany (i, 302) and of Carpenter's classical Comparative Physiology (4th ed., 1884, 152). It had long been my ambition to have so interesting a plant under cultivation at Kew, and this, as stated in the Kew Bulletin (1892, 284), was at last accomplished in 1890 through the kindness of Dr. Treub, the Director of the Botanic Gardens, Java. Since then it has been grown at Kew continuously and with success.

Dischidia rafflesiana has been the subject of a copious literature. At first sight it might seem improbable that after the admirable and exhaustive monograph of Dr. Scott and Miss Sargant (Annals of Botany, 1893, 243–262, tt. xi, xii) any new fact could be added to our knowledge of the morphology of the pitchers. It is, however, one of the results of the change of conditions effected by cultivation to rouse latent tendencies and to develop atavistic forms which are often

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extremely instructive. Such deviations from specific stability are usually the result of seminal reproduction. In the case I am about to describe it is purely vegetative and therefore of even greater theoretical interest.

The structure of the pitcher in *Dischidia rafflesiana* is well known. Characteristic examples grown at Kew are shown on Plate XIV. As demonstrated by Treub, it is 'a modified leaf in which the inner surface corresponds to the lower surface of the normal foliage leaf' (Scott, l. c. 245). Lindley (l. c.) had erroneously conjectured that the pitchers were 'leaves, the margins of which are united.' This view was conclusively disposed of by Treub. And it is important to observe that normally the form of the future pitcher is, as it were, laid down from the first and there is no indication of any passage from the form of the normal foliar leaf to that of the pitcher. Such intermediate stages have, however, made their appearance after some ten years' cultivation in the Kew plants. A portion of one of these bearing both normal and transitional forms is shown on Plate XIV. Another shoot is represented on Pl. XV; Fig. 1, showing the under, and Fig. 2 the upper side. These indicate a complete transition from the ordinary leaf by an increasing concavity of its under surface to a pitcher, which however still differs, in its open mouth, uninflexed margins and small size, from the fully developed organ. It can hardly be doubted that these indicate the path by which the latter has been arrived at from the ordinary leaf. I can find no trace of anything of the kind having been observed in nature unless the 'partly abortive pitcher,' figured by Griffith in the Transactions of the Linnean Society, xx, t. 17, f. 2, be susceptible of this explanation.

As suggested by Sir Joseph Hooker (Flora of British India, iv, 49) 'the species of *Dischidia* all want careful study.' But as far as our knowledge extends, from a comparatively copious supply of herbarium material, supplemented by the observation of several species under cultivation, the production of pitchers is only characteristic of a small part of the

genus. From this the inference may be fairly drawn that the property of producing pitchers is rather an individual adaptation, than bound up with a particular generic type as it is apparently in *Sarracenia* and *Nepenthes*. In *D. borneensis*, Becc., and *D. Collyris*, Wall. (*Conchophyllum imbricatum*, Bl.), the leaves are convex and therefore foreshadow the atavistic form described in this note. The comparison with *Dischidia rafflesiana* has not escaped Beccari, Treub, and Goebel. Scott and Sargant remark (l. c. 268) with much sagacity: 'We can scarcely doubt that from some such leaves as those of *D. Collyris*, the more highly modified root-sheltering pitchers of *Dischidia rafflesiana* have been evolved.'

I think it may be fairly claimed that this anticipation has now been realized. The interesting question, however, arises as to the teleological object achieved. Carpenter, quoting (l. c.) from Wallich the original describer, says 'The bags [pitchers] generally contain a great quantity of small and harmless black ants, most of which find a watery grave in the turbid fluid which half fills the cavity, and which seems to be entirely derived from without.' Carpenter continues: 'Thus it would seem as if the failure of the ordinary means of support in this curious plant has been compensated by the addition of an organ which, like the stomach of animals, serves as a receptacle for the supplies it may occasionally obtain.' These extracts are interesting because they show that *Dischidia rafflesiana* was from the beginning recognized as a myrmecophilous plant. This was, however, rather lost sight of when it was generally adduced some half century ago in popular physiological expositions as affording an analogue to an animal stomach.

Beccari regarded the pitchers as 'galls' which have become useful as sheltering defensive insects. This was putting their myrmecophilous origin in the most extreme form. And it is clear that it cannot be sustained. Delpino's obvious theory that the pitchers are carnivorous seems equally disposed of by the fact that their inner walls are coated with wax.

Treub's view that the pitchers are water-economizers appears most nearly to correspond with the facts. As he points out, it is only in certain, and by no means inevitable, positions that the pitchers collect rain-water. I can only conclude that on the average they pay. But under all circumstances they serve to preserve water lost by transpiration, which is one of the severest taxes the plant has to meet.

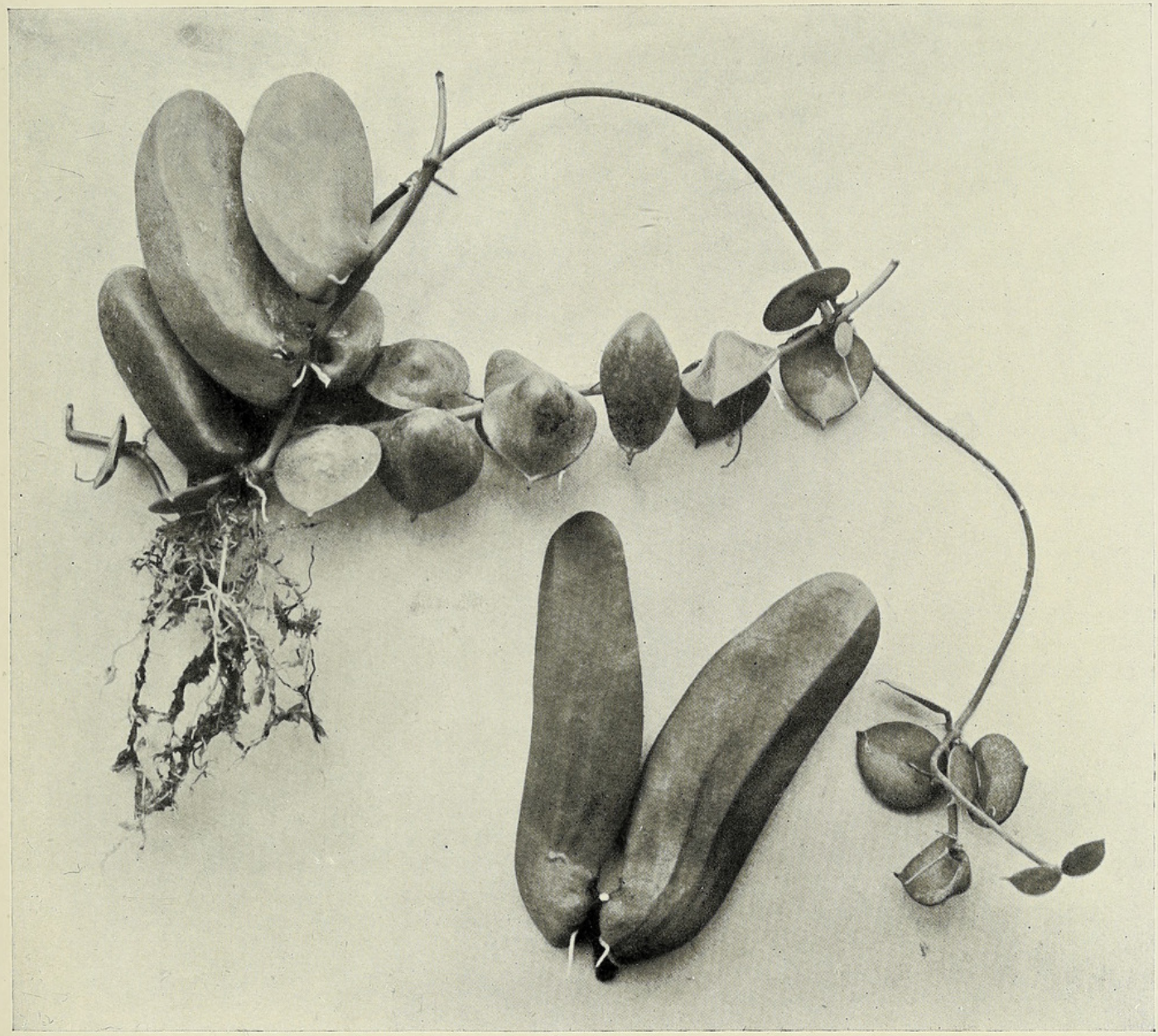
As is well known, the pitchers of *Dischidia rafflesiana* contain a copious root system. This is derived from one or more of a pair of aerial roots, which are either derived from the petiole or from the stem in close adjacence (S. and S., l. c. 259). The whole root system of the plant is adventitious. And I venture to hazard the theory that in so far as adventitious roots are not merely organs of support, their production is a response to a demand for water. In Plate XV, Fig. 1, it will be noticed that each petiolar root is applied to the concavity of its corresponding leaf, and in Fig. 3 it will be seen that as soon as the concavity becomes a pitcher the roots are included within it.

The whole, if I may say so, evolutionary data, tend to prove then that the primary object of the pitchers is the supply, or at any rate economy of water. But the copious development of the enclosed root system, which is often matted with organic débris, seems to go beyond this. The researches of Groom (Annals of Botany, 1893, 223, 242), I think, leave no doubt that the roots utilize this as if it were ordinary soil (l. c. 227). From whence is the organic matter derived? There can be no doubt that, except when in the erect position, the pitchers are usually almost dry. We are driven then to accept the suggestion of Groom based on the observations of Mr. H. N. Ridley, that the organic matter is carried in by ants (l. c. 229).

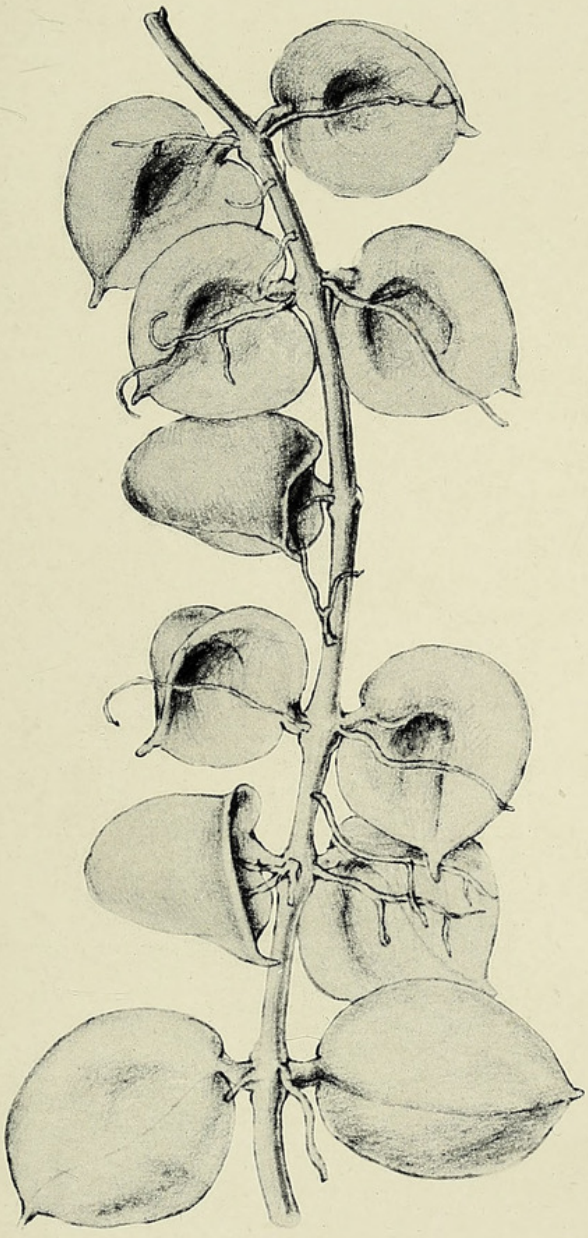
We have therefore to deal with an adaptation of a singularly complex kind. Originally destined to store and economize water the pitchers often imperfectly perform that function, and are then taken possession of by ants which supply solid in the place of liquid nutriment. Having begun as 'water-

cans' they, by a change of function and by the aid of ants, became 'flower-pots.'

And there is a sequel to the story scarcely less interesting. Looking through the descriptions of *Dischidia* in the Flora of British India, I came on that of *D. complex* based on a note of Griffith, which no one seems to have taken the trouble either to investigate or confirm. What excited my curiosity was that in this species a second pitcher is described internal to the primary one. This seemed to me so extraordinary that finding Griffith's solitary and imperfect specimen in the Kew Herbarium I ventured to take some liberties with it. The result seemed to me so surprising that I have asked Mr. H. H. W. Pearson to work out the promising problem which it presents.



THISELTON-DYER: ON DISCHIDIA.



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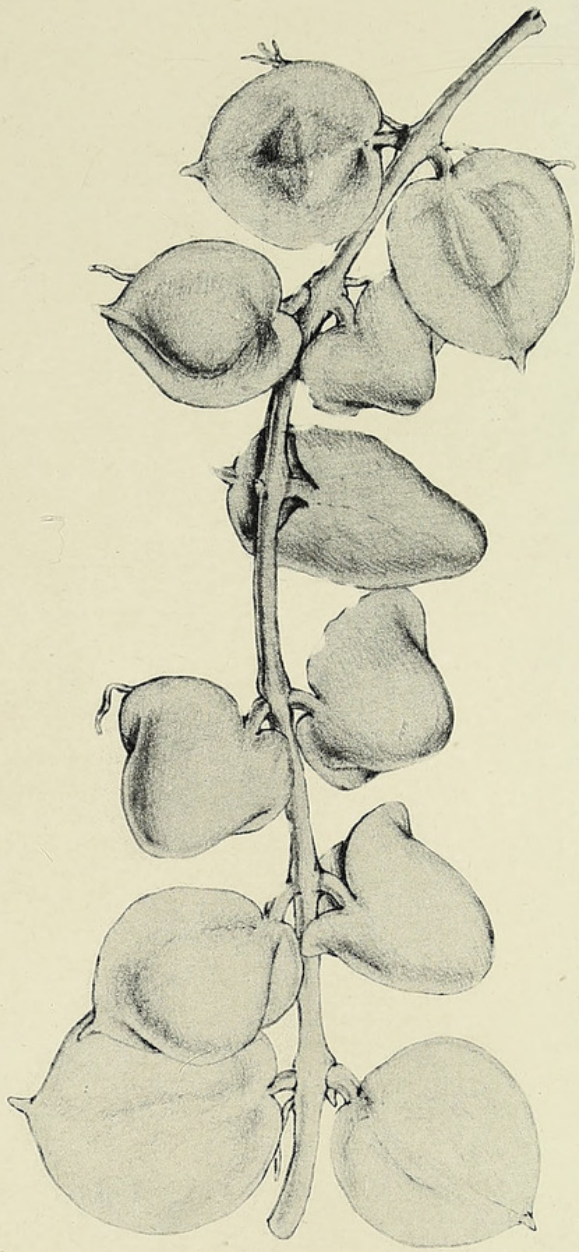

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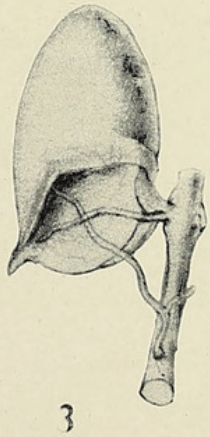

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