

## THE SEED OF *CARDIOSPERMUM HALICACABUM* L. A CRITICISM

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VAN DER PIJL (1957) has criticized my paper (1946) on the "Embryology of *Cardiospermum halicacabum* L." in different points. I feel it is my duty to discuss the ideas which van der Pijl put forward with regard to my figures, which were drawn with the aid of a camera lucida. I wish to make three remarks in this respect.

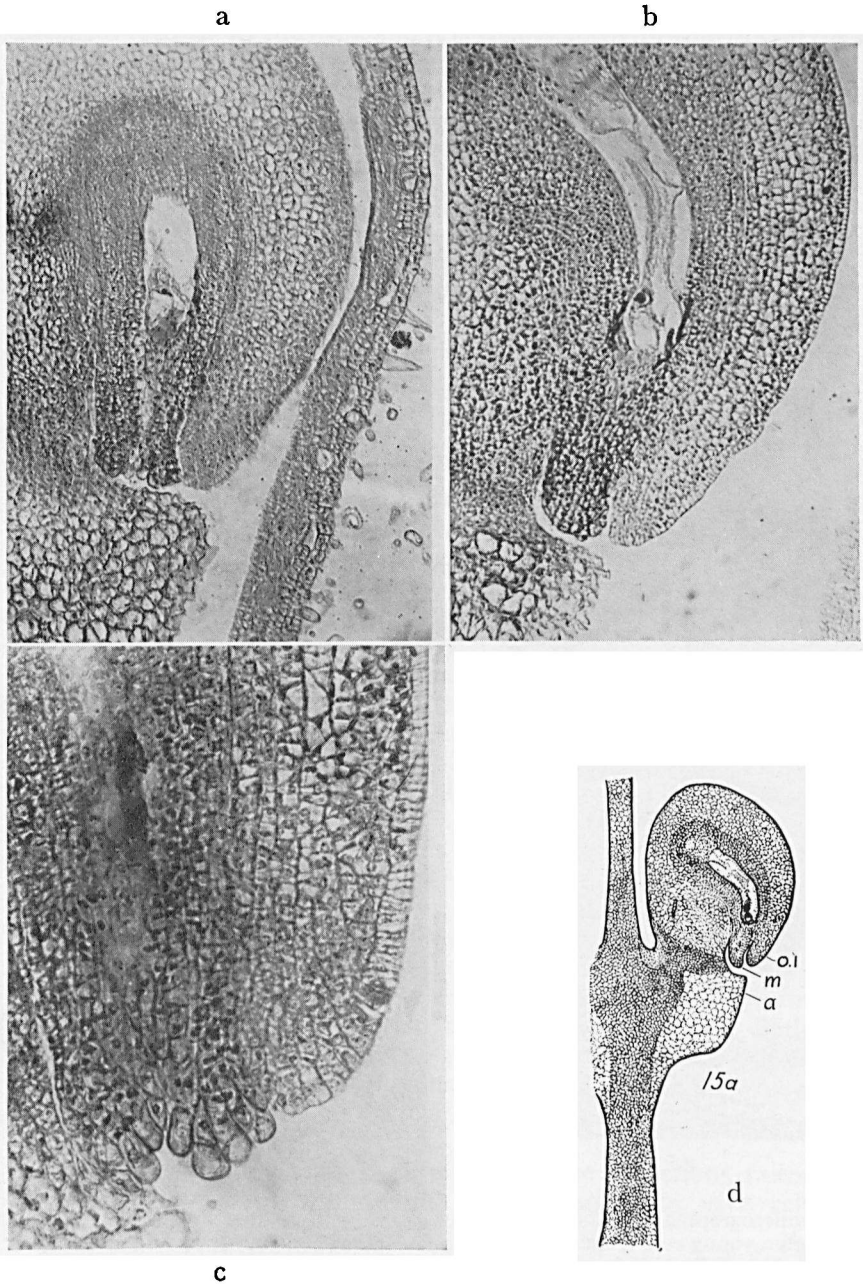
1. Van der Pijl says on page 625 that "Kadry interpreted his Fig. 15a as showing a micropylar beak, a massive mucilaginous tissue originating from the tip of the nucellus and from part of the inner integument. Kadry contested the correctness of Guérin's opinion that this beak surrounds a micropylar canal. Guérin's Fig. 1, the structure generally found in the ovules of the family and my own sections through these ovules make it clear that this beak is nothing but the tip of the solid looking inner integument, and that the nucellus has been resorbed by this time (Fig. 6b)". I have expounded my view on page 116 of my paper (1946) where it was stated that "After the organisation of the embryosac, the cells at the tip of the nucellus and some of the cells of the inner integument which encircle the micropyle, form a mucilaginous mass through which the pollen tube enters. In consequence of that, the micropylar canal becomes entirely closed. This latter view is in contrast to GUÉRIN's observation (1901). The author made continuous series of longitudinal and transverse sections of different stages of advanced ovules passing through the region of the micropyle (Fig. 15). A careful examination of these sections leaves no doubt that the pollen tube passes through a continuous micropylar tissue". Van der Pijl objects to my interpretation. Very recently I have prepared photomicrographs which undoubtedly show the incorrectness of van der Pijl's views.

Photomicrograph 1 shows mature ovules in the period of fertilization; the massive tissue of the nucellus, which has undergone a fusion with the cells of the inner integument, forms a mucilaginous tissue. Neither in these sections nor in the rest of the series obtained from the same ovules, any trace of a micropylar canal was observed. The same result was obtained with numerous other ovules that were studied during and after fertilization. Photomicrograph (1a) was taken from a section passing through the axis of the ovule, and here, therefore, the micropylar canal ought to be visible if it were present as van der Pijl suggested.

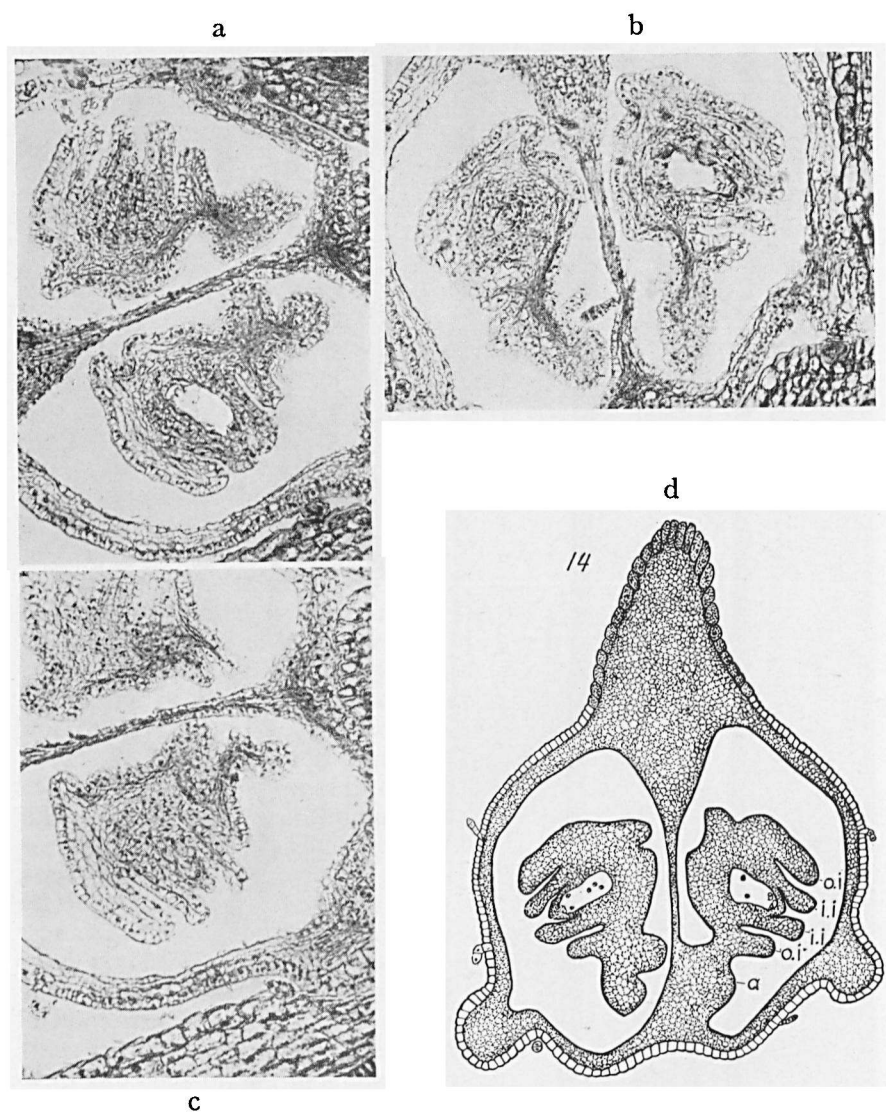
2. Van der Pijl says (on page 625); "At this place inside the curvature the outer integument, though recognizable in young ovules,

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Photomicrograph. I. *Cardiospermum halicacabum*. a-d. Longitudinal sections through three different ovules made at the time of fertilization and photographed at different magnifications, showing the massive nucellus fused with the cells of the inner integument and forming with the latter the mucilaginous tissue, and the absence of a micropylar canal, the inner part of the outer integument appears to be indistinguishable, a, showing the axial part of the ovule in which the micropylar canal should be visible if it were present, b, showing a pollen tube with its two male nuclei, c, a higher magnification of b. The latter corresponds to Fig. 15a of my paper (1946) and is reproduced to prove its correctness.



Photomicrograph 2. *Cardiospermum halicacabum*. a-c. A series of longitudinal sections through a young ovary, showing two ovules each with the inner as well as the outer integument fully developed, d. photomicrograph corresponding to Fig. 14 of my paper (1946). It undoubtedly shows that the interpretation of van der Pijl is wrong.

is said to become indistinguishable in older ovules. We can, however, discern it in Kadry's drawing and it is clearly recognizable in Guérin's drawings as well as in my own sections (Fig. 6)". I have described in detail the development of the outer integument during the different stages of the ovule. I said (on page 114), "During the formation of the four-nucleate stage of the embryo-sac, the two integuments become more visible on both sides, and the ovule represents an intermediate stage of the anatropous type (Figs. 8 and 14). At this stage, the lower part of the outer integument on the side towards the funiculus become very distinct. This latter part of the outer integument was already seen in all examined cases of the same stages, though COULTER and CHAMBERLAIN (1912) stated (on page 57) that, in anatropous ovules with two integuments, the outer one is not developed on the side toward the funiculus." I have distinguished the inner part of the outer integument of the young ovules very clearly and it is clearly shown in my drawings. But with regard to the older ovules, I said (on page 116), "During the curvature of the ovule the inner part of the outer integument fuses with the adjacent tissue and cannot be easily distinguished on this side, while its outer part is fully developed and is more visible on the free side of the ovule". This means that in the older ovules the inner part of the outer integument becomes indistinguishable, and it is therefore not shown in my drawings of the older ovules.

Photomicrograph (1c) shows a longitudinal section of an anatropous ovule which strongly support this view. Van der Pijl's section may have been cut in some distance from the axis.

3. Van der Pijl states (on page 626) that, "There is no thin, true funicle as figured in Kadry's Fig. 14. The figures in Payer's *Organogénie* (1857) already proved this". Although I have not discussed the funicle in my paper (1946), yet I may point out that we can not overlook the fact that Fig. 14 is drawn from a true section, and we cannot discard any feature shown in it, even if it contradicts the findings of other authors. This figure was drawn with the aid of a camera lucida (the same as all the drawings in my paper (1946). In corroboration of this Fig 14 which van der Pijl doubts, I reproduce a photomicrograph of the section through this ovary (2). Both the camera lucida drawings and the photomicrographs are absolutely identical, and support completely the conclusions I have drawn before.

#### CONCLUSION

The present criticism aims at removing the objections raised by van der Pijl. The accompanying photomicrographs give reliable evidence in support of the following conclusions.

1. In the mature ovule there is no micropylar canal, its place being occupied by nucellar cells and cells of the inner integument which together form the mucilaginous tissue.

2. In the older ovules the inner part of the outer integument becomes indistinguishable.

3. Fig. 14 of my paper (1946) is an exact reproduction of a section.

## REFERENCES

- COULTER, J. M. and CH. J. CHAMBERLAIN. 1912. Morphology of Angiosperms, New York.
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