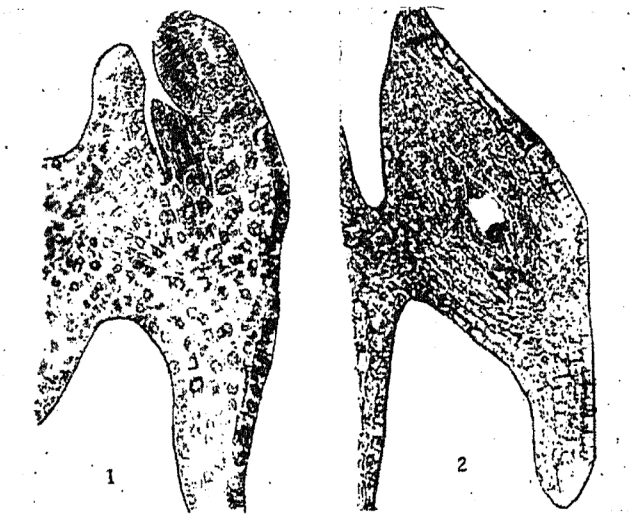
A Note on the Morphology of the Ovule of Rubiaceæ with Special Reference to Cinchona and Coffee.

In a recent paper on "Endosperm and Perisperm of Coffee with notes on the Morphology of the Ovule and Seed Development", Houk (1938) has revived a view about the structure of the Rubiaceous ovule that had been long given up. As coffee seed is a product of great economic value and a correct knowledge of its structure is very important for genetical studies, it is desirable to review his work.

The mature ovule in the family Rubiaceæ generally consists of many layers of uniform parenchymatous tissue surrounding the embryo-sac. It is not possible to make out a nucellus distinct from the integument. The micropyle is very slender and somewhat indistinct. It can be made out only in perfectly median longitudinal sections and with the help of high magnifications. It is no wonder, therefore, that the morphology of the ovule of Rubiaceæ became a subject for discussion in the last century and Schleiden (1837) stated that it consists of nucellus without integument, while of 1902 Llyod introduced the concept in 'integument-nucellus'. The correct position, however, has been indicated by Schnarf (1931) in his recent review of the embryology of the angiosperms. It is that the ovule of the Rubiaceæ consists of a poorly developed nucellus and a single integument. This view is based on the development of the ovule. It is seen that in the early stages the nucellus and the integument are quite distinct from each other. The micropyle also is quite prominent, but the amount of nucellus, as in the Gamopetalæ in general, is very small. It consists only of a single layer surrounding the megaspore-mother cell. As the embryo-sac develops, this layer of nucellar cells is crushed ; and the embryo-sac comes to be situated directly to the inside of the integument. In the meanwhile by the growth of the integument the micropyle becomes nearly obliterated. This ovule thus begins to give the deceptive appearance described above.

This point is well illustrated by the accompanying figures from *Cinchona succirubra*. Fig. 1 represents a longitudinal

section of an ovule at the megaspore-mother cell stage. The single integument, a distinct though poorly developed nucellus and the micropyle are clearly seen. Fig. 2



Cinchona succirubra.

Longitudinal sections of ovules.

FIG. 1, at the megaspore-mother cell stage; FIG. 2, at the mature embryo-sac stage. Fig. 1 is more highly magnified than Fig. 2. The microphotographs have been slightly touched to make the boundary of the ovules more distinct.

shows a similar section of an ovule containing a mature embryo-sac. The integument now has completely surrounded the nucellus. The latter has completely disappeared and the micropyle has been nearly obliterated. It could be made out in this section by using a higher magnification.

The ovule of coffee passes through the same stages of development as that of *Cinchona* and should be interpreted in the same way. Faber (1912) who studied the morphology of the coffee flowers more than twenty years ago, has very clearly sketched these changes and correctly described the ovule to possess a weakly developed nucellus and a massive integument. Houk (1938), however, rejects this generally accepted view about the morphology of the Rubiaceous ovule for coffee. He asserts that Faber's interpretation is untenable and supports the older Llyod's 'integument-nucellus' concept but gives no reasons for any of these conclusions. In a paper dealing with the morphology of the ovule, which he takes to be different from that of other flowering plants, he makes no reference to the early stages of ovule development. His views are thus not based on any strong evidence and should be rejected. If he had just studied the development of the ovule, he would have undoubtedly found the stages in its development described by Faber and agreed with his findings.

Another point discussed by Houk is the nature of the nutrient tissue surrounding the embryo. He shows that the endosperm formed is very small in amount and evanescent, and therefore regards the nutrient tissue as perisperm. In the light of what has been said above about the morphology of the ovule, this is only a part of the integument of the ovule and is thus a part of the testa. The small nucellus which is present in the young ovules is crushed early by the growing embryo-sac and does not persist in the seed. The general statement, "Embryo small, in rich endosperm" (Willis, 1931), found in books on systematic botany about the structure of the Rubiaceous seed appears to require modification. It is very likely that what has been regarded as endosperm in many cases is only a part of the testa.

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