

# OVULE AND SEED OF *SECHIUM* *EDULE* Sw.—A REINVESTIGATION

*Sechium edule* Sw., a native of tropical America, is widely cultivated, usually between 4,000 and 7,000 ft. altitude, in Eastern Himalayas, Assam, Uttar Pradesh, and some parts of Southern India. The plant is a tendril climber with tuberous root and pyriform fruit. Each fruit contains a large, ovate, compressed and pendulous seed which shows many uncommon features for the Cucurbitaceae, e.g., leathery testa, hypogeal germination and vivipary. Kratzer<sup>1</sup> studied a few ovules of *S. edule*, while Reiche<sup>2</sup> gave a rather detailed account of its seed and fruit development. The latter author observed that unlike all other Cucurbitaceae,<sup>4,5</sup> the ovular epidermis in *S. edule* remains undivided and fuses with the inner layers of the pericarp. The organisation of seedcoat in *Sechium edule*, thus, shows a fundamental departure from an otherwise remarkably uniform pattern of seedcoat development of the family. It was, therefore, considered worthwhile to reinvestigate ovule and seed of *S. edule*, material of which was collected from Darjeeling.

The pyriform ovary bears a single bitegminal pendulous ovule with its micropyle facing the stigma. The nucellus has a long beak which reaches the orifice of the micropyle (Fig. 1). Each ovule receives three or, rarely, four vascular traces which are clearly seen in transections (Figs. 2, 3). All the vascular traces come close to each other as they travel down the raphe and eventually fuse to form a single strand in the chalaza (Figs. 4, 5). The fused bundle extends into the outer integument up to its tip (Fig. 1). Individual vascular strands, as well as their fused product, give out branches which traverse the inner layers of the outer integument.

The outer integument consists of 15 to 20 cell-layers at the mature embryo-sac stage (Fig. 6) while the inner integument is only 4 or 5-layered at the sides and 6 to 10-layered toward the chalazal end. The latter degenerates and is completely lost as the embryo assumes the globular shape.

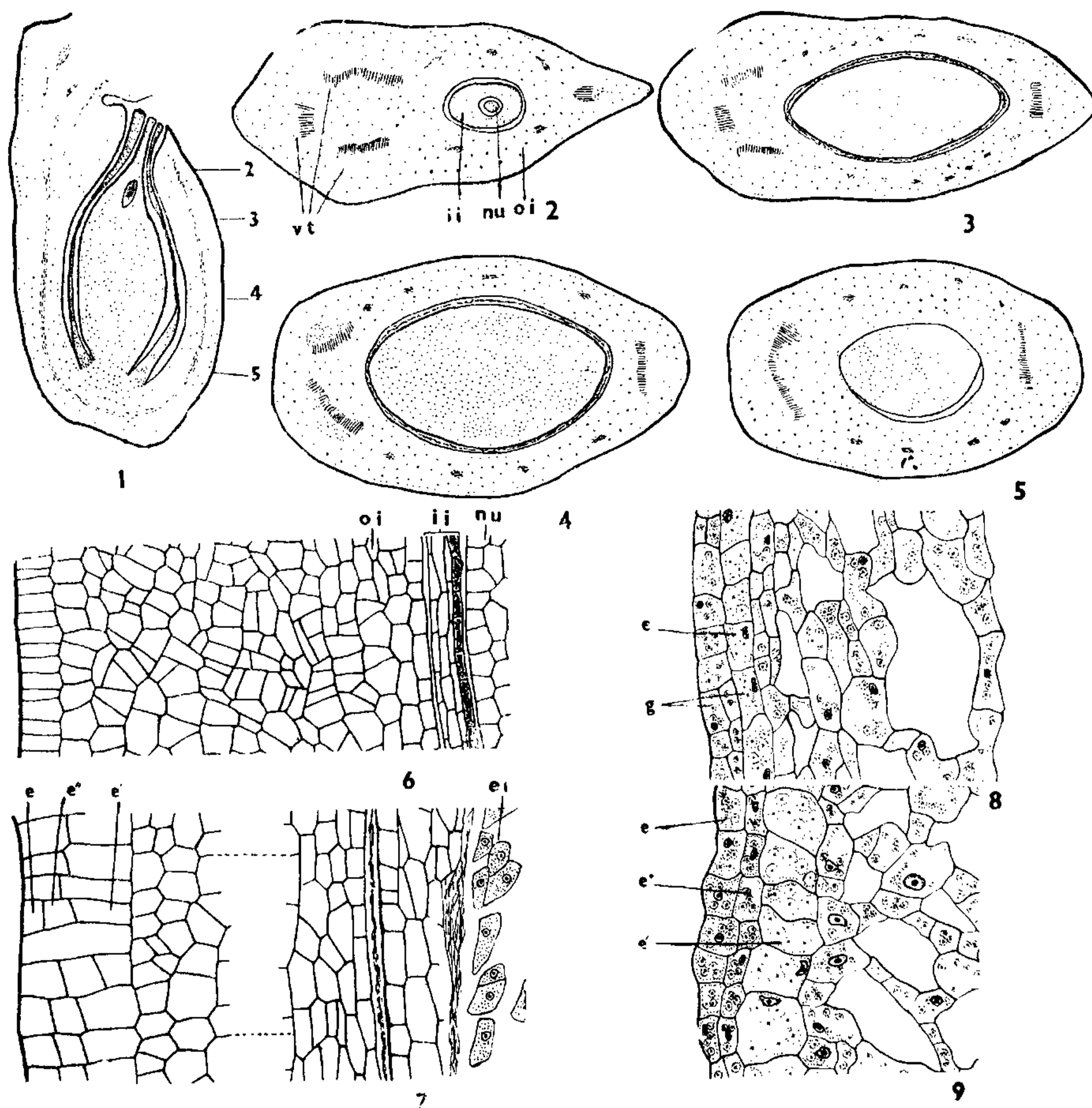
After fertilization the epidermal cells of the outer integument begin to divide periclinally. The divisions initiate at the micropylar and chalazal ends and gradually progress towards the middle portion. The first division of the ovular epidermis cuts off an inner layer (*e'*) which does not divide further as known for other Cucurbitaceae.<sup>4,5</sup> The cells of the outer

layer divide again forming an outer (*e*) and an inner (*e''*) layer (Fig. 7). The second division takes place in almost all cells at the micropylar and the chalazal ends, and along the lateral faces of the compressed seed but on its flat surfaces the cells divide only at some places. The subepidermal layer is, therefore, discontinuous on the flattened sides of the seed. During further development of seeds, the cells of *e*, *e''* and *e'* enlarge and become filled with starch grains. The remaining layers of the outer integument also store starch grains and become aerenchymatous. The air-spaces are more conspicuous in the outer layers while the inner layers are progressively more compact. The seedcoat remains parenchymatous and is closely adpressed to the inner epidermis of the pericarp.

The seedcoat encloses the remnants of the nucellus, 2-4 layers at the sides and more layers at the ends of a seed, the remains of the endosperm between the cotyledons only, and the embryo. The hypocotyledonary root axis of the embryo is conical and the primordia for the seminal roots are organised in the seed. The epicotyl bears seminal leaves. The seed germinates within the fruit and the seedling shows epicotyl carrying the primary leaves growing out of the fruit. The cotyledons remain inside the seed and fruit.

*Sechium* belongs to Sicyoideae, a tribe having only uniovulate genera. Puri<sup>2</sup> reported that the single ovule in *Sicyos angulatus* receives its vascular supply from three different sources in the ovary. These bundles in *Sicyos* fuse in the funiculus before passing into the ovule. The ovule in *Sechium* also receives 3 or 4 vascular traces but their fusion is deferred till they reach the chalazal end. The vascular supply to the ovules of *Sechium* and *Sicyos* suggests that due to reduction in the number of placentae and ovules, perhaps all the ventral carpellary traces of different carpels in these plants are passing into the single ovule of the uniovulate ovary which, thus, represents a derived condition.

The seedcoat development in *S. edule* is in complete conformity with that of other Cucurbitaceae.<sup>4,5</sup> Interestingly, the cells of the testa in *Sechium* remain unlignified. This coupled with its fusion with pericarp obscures a clear differentiation of various zones which are characteristic of the mature cucurbitaceous seed, i.e., seed epidermis, subepidermal tissue of lignified cells usually, sclerenchymatous layer of strongly lignified cells, aerenchyma, and chloren-



FIGS. 1-9. *Sechium edule* Sw. Fig. 1. L.s. ovule,  $\times 29$ . Figs. 2-5. Transections of ovule at levels 2-5 in Fig. 1,  $\times 29$ . Fig. 6. L.s. part of integuments,  $\times 350$ . Fig. 7. L.s. part of seedcoat, note the periclinal divisions in the outer epidermis,  $\times 350$ . Fig. 8. L.s. part of almost mature seedcoat from the flattened sides,  $\times 260$ . Fig. 9. T.s. part of seedcoat from lateral sides,  $\times 260$ . *en*, endosperm; *g*, starch grains; *ii*, inner integument; *oi*, outer integument; *vt*, vascular traces.)

chyma. The lack of lignification of the testa can be attributed to its adopted method of germination, vivipary. Reiche<sup>3</sup> who described that the ovular epidermis remains undivided in *Sechium* gave only one figure (his Fig. 2) showing inner layers of pericarp and the outer layers of seedcoat. He evidently did not follow the changes in the outer integument in detail and as mentioned above was, therefore, led to the erroneous conclusion.

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3. Reiche, V. K., *Flora*, 1921, 14, 232.
4. Singh, Bahadur, *Phytomorphology*, 1952, 2, 201.
5. —, *Ibid.*, 1953, 3, 224.