

plant with the additional supernumerary chromosome it seems that the presence of B-chromosome is implicated in the partial suppression of multivalent formation. Such 'diploidizing' effect of B-chromosome is reported in *Triticum aestivum*⁴ and also in amphidiploid of *Lolium perenne* × *L. temulentum*⁵. Stability and intraplant numerical uniformity of B-chromosome identified in *M. inodora* can be envisaged from the absence of non-disjunction or of lagging at anaphase.



The B-chromosome might have originated from A-chromosome due to misdivision of a nucleolar chromosome, and by structural modification conceals the pairing affinity with its progenitor¹. No conclusive evidence is yet available to suggest that they confer any adaptive value in relation to environmental conditions.

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FEMALE GAMETOPHYTE IN *ANCHUSA OFFICINALIS* L.—A REINVESTIGATION

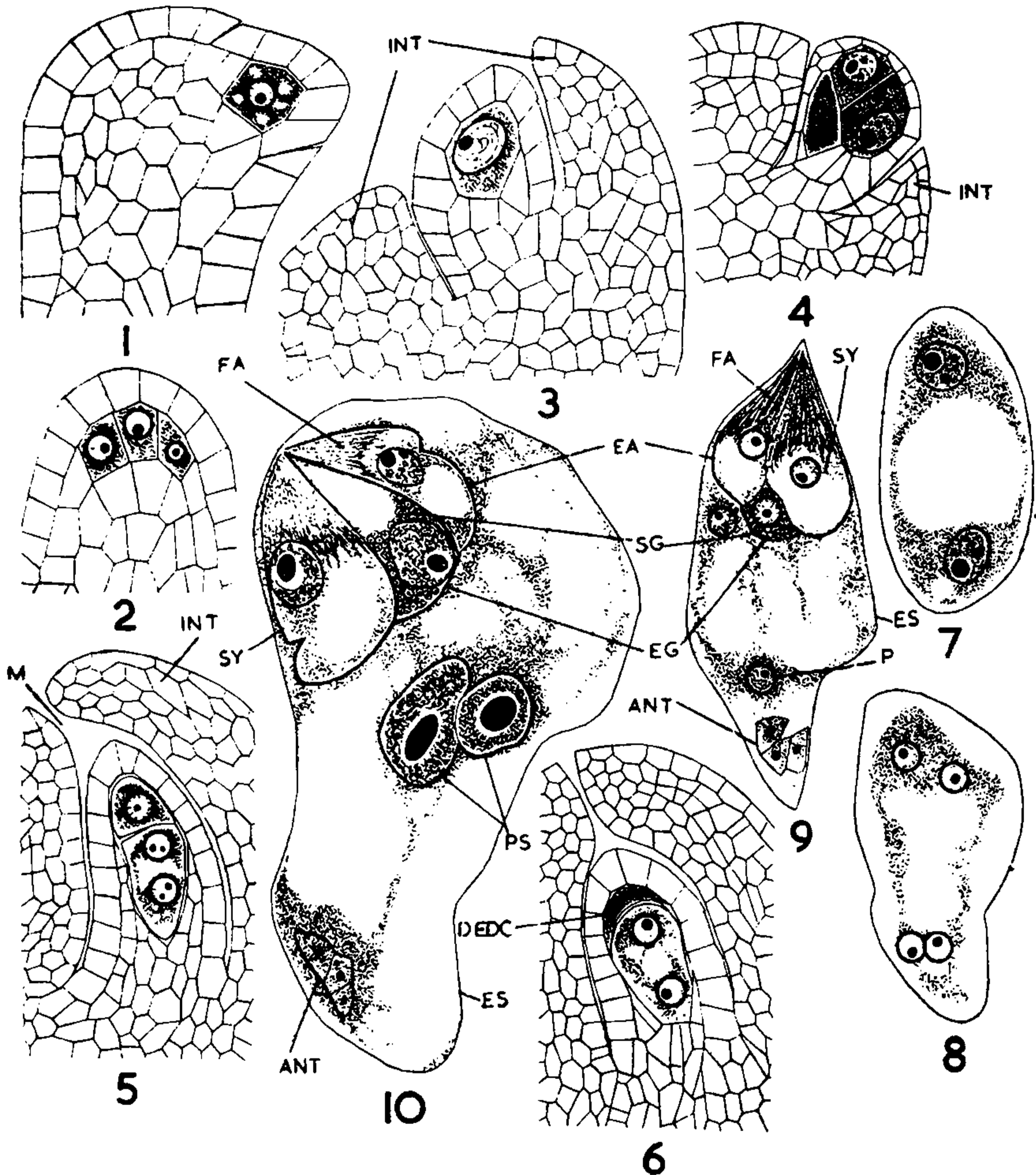
In most of the boraginaceous taxa a Polygonum type of female gametophyte development prevails (see Davis¹, Fathima^{3,4}; Nagaraj and Fathima^{5,6}; Khaleel^{5,6}; Sukhadani and Deshpande¹⁰; Deshpande and Sukhadani⁹), while in *Anchusa officinalis* and *Lycopsis arvensis* (Svensson¹¹) a bisporic type is known. In *Ehretia laevis* (Johri and Vasil, 1956), *Cordia alba* and *C. obliqua* (Khaleel⁶) and *Ehretia acuminata* (Khaleel, 1977) both bisporic and monosporic developments coexist. As the bisporic embryo-sac is recorded in the aforesaid taxa only, it was felt desirable to reinvestigate some of these taxa with a view to verify the course of events described in the earlier literature. The present note on *Anchusa officinalis* L. is in the same context. Both the ontogenetic features of the female gametophyte as well as some interesting features not observed by Svensson¹¹ are recorded.

The tetralocular ovary is superior, bicarpellary and syncarpous and each loculus bears an anatropous, tenuinucellate and unitegmic ovule on axile placentae. The archesporium becomes discernible in the scanty nucellus earlier than the initiation of the integumentary primordia (Fig. 2). The hypodermal archesporium is single to three-celled (Figs. 1-4), but finally one of

FIGS. 1-4. Fig. 1. Somatic complement, 36 + 1B, × 800. Figs. 2-3. Diakinesis, 2IV + 14II and 17II + 2I + 1B (former of normal plant; each contain 2 nucleoli). Fig. 4. Metaphase I (note the sticky A-chromosomes). Arrow indicates B-chromosome. 2-4 ca. × 1,150.

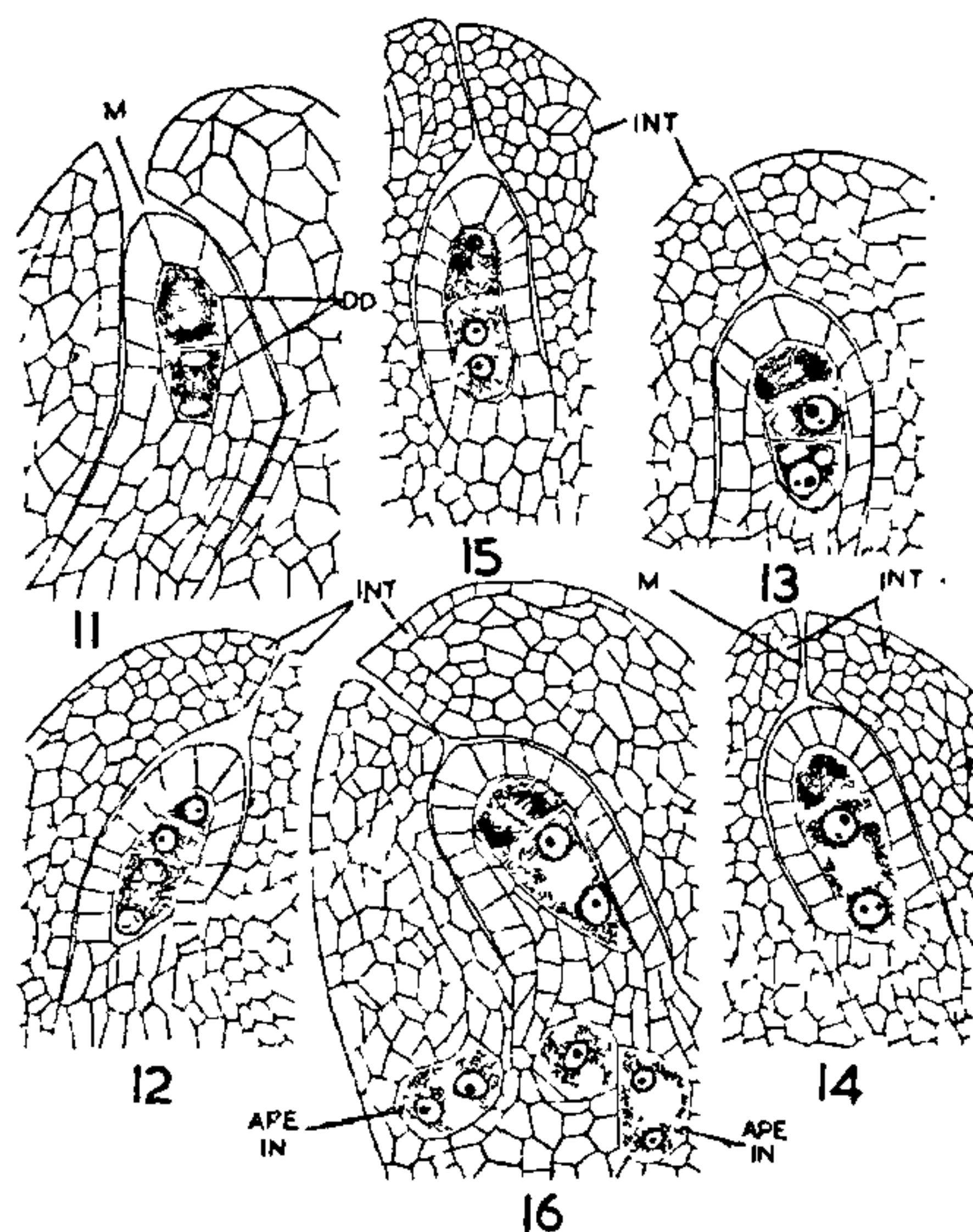
them functions further (Figs. 5, 11-16). However, cases of ovules with two archesporial cells under division have as well been met with to initiate twin dyads (Fig. 4).

The archesporial cell enlarges considerably in size and becomes the megaspore mother cell without cutting off a parietal cell (Figs. 4-6, 11-16). The megaspore



FIGS. 1-10. Female gametophyte in *Anchusa officinalis* L. Fig. 1. L.s. ovular primordium with single hypodermal archesporial cell. Note integumentary primordia just initiating $\times 369$; Fig. 2. L.s. ovular primordium with three hypodermal archesporial cells, $\times 369$; Fig. 3. L.s. part of tenuinucellate ovule. Note the enlarged archesporial cell and the integuments, $\times 369$; Fig. 4. L.s. part of tenuinucellate ovule showing the nucellus with a dyad and an archesporial cell under division, $\times 369$; Figs. 5, 6. L.s. part of tenuinucellate ovules showing the nucellus with the lower dyad cell already developed into a 2-nucleate embryo sac. Note healthy and degenerated upper dyad cells in the respective figures, $\times 369$; Figs. 7, 8. L.s. 2-nucleate and 4-nucleate embryo sacs, $\times 500$; Fig. 9. L.s. just organised embryo sac, $\times 500$; Fig. 10. L.s. mature embryo sac. Note enlarged micropylar part, $\times 500$.

mother cell undergoes the first meiotic division engendering two dyad cells. The upper dyad cell either degenerates as it is (Fig. 6) or undergoes one more division (Figs. 11-16) and the derivatives promptly degenerate. The nucleus of the lower dyad cell divides and since no cross wall is laid down the two megaspore nuclei undergo two more successive divisions tracking to the formation of an 8-nucleate female gametophyte corresponding to the *Allium* type (Figs. 5-10, 12, 14, 16). In a few preparations (about 5% of the ovules)



FIGS. 11-16. Female gametophyte in *Anchusa officinalis* L. Fig. 11. L.s. part of tenuinucellate ovule showing nucellus, megasporogenesis and dyad cells in division tracking to the formation of a linear tetrad of spores, $\times 369$; Fig. 12. L.s. part of tenuinucellate ovule showing the nucellus and the upper dyad cell already divided and lower dyad cell in division, $\times 369$; Fig. 13. L.s. part of tenuinucellate ovule showing the nucellus with T-shaped tetrad formation, $\times 369$; Figs. 14, 15. L.s. part of ovules. Note the lower dyad already organised into a 2-nucleate embryo sac, $\times 369$; Fig. 16. L.s. part of ovule. Note the 2-nucleate embryo sac and aposporic embryo sac initials, $\times 369$.

(ANT—antipodal cells; APE IN—aposporic embryo sac initials; DD—dyad cells in division; DEDG—degenerated dyad cell; EA—egg apparatus; EG—egg cell; ES—embryo sac; FA—filiform apparatus; INT—integument; M—micropyle; P—polar nucleus; PS—polars (nuclei/cells); SG—starch grains; SY—synergid).

the megaspore mother cell has divided resulting in a linear and T-shaped tetrad of megaspores (Figs. 11, 13). During the development of the embryo sac there is considerable enlargement of its micropylar part (Figs. 9, 10). The mature and well organised embryo sac has egg apparatus comprising a densely cytoplasmic egg gorged with starch grains, two pear-shaped synergids with indentation and conspicuous filiform apparatus; two polar nuclei located at the centre and three antipodal cells (Fig. 10). Svensson¹¹ made no mention of the presence of filiform apparatus and hooked nature of the synergids and starch grains in the egg cell. To start with the three antipodal cells are located in the narrow chalazal end (Fig. 9), but during subsequent stage of growth they occupy more or less a lateral position (Fig. 10) where they seem to degenerate. A point of special interest is the tendency of some of the chalazal cells as well as those of the integument to become enlarged and initiate the development of aposporic embryo sacs (Fig. 16). However, the development of these aposporic embryo sacs did not seem to proceed beyond the two-nucleate stage, as observed in about 25 ovules. A similar situation has also been reported in *Cynoglossum denticulatum*, *Cordia alba* and *C. obliqua* (Khaleel^{5,6}).

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