enzymes and the role of these enzymes in establishment of partial parasitism of *C. filiformis* L.

Haustoria embedded in the host tissue of *C. filiformis* were carefully separated with the help of a pair of sterilized forceps. Five gm of haustoria were ground in a tissue homogenizer at 4° C in a chilled mortar with 25 ml of Mc Illvain's buffer (pH 5·5). The extract was centrifuged at 5,000 × g and immediately used for assay. C_1 activity was assayed by incubating 0·5 ml of enzyme with 3·5 ml of 1% cellulose powder (Carl Schleicher and Schull, Dassel Chromatography grade) and 1 ml of citrate buffer (pH 5·5) and 3 drops of toluene. At the end of 6 hrs of incubation the amount of glucose liberated was estimated by using dinitrosalicylic acid (DNS) as suggested by Miller[3]. C_x activity was assayed viscometrically using Oswald–Fenseke viscometer. The reaction mixture consisted of 15 ml of 0·5% CMC solution, 5 ml of enzyme and 1 ml of citrate buffer (pH 5·5). The results are presented in Table I.

TABLE I

Cellulase (C_x and C_1) enzyme activity in haustoria of Cassytha filiformis *L.*

Strain	C_x*	C_1**
Azadirachta indica Juss.	9·80	9·0
Hibiscus rosa-sinensis L.	19·75	80·0
Nerium indicum Mill.	21·43	180·0
Punica granatum L.	27·47	100·0

*C_x Expressed in the relative enzyme activity (REA) $= 1000/tv_{50}$.

**C_1 Expressed as the amount of glucose liberated in μg/ml during 6 hours of incubation.

From Table I it is evident that all the strains of *Cassytha filiformis* showed cellulase activity which, however, varied with the strains. *Punica granatum* isolate showed maximum C_x activity, and the *Azadirachta indica* least. The remaining two showed intermediate activity. On the other hand, C_1 activity was witnessed more in *Nerium indica* strain, while no C_1 activity was traced in *A. indica* strain. As there was no increase in reducing sugars in the absence of substratum, the increase in the reducing sugars in the presence of substratum may be attributed to the C_1 activity of haustorium. Comparison of C_1 and C_x activity of strains reveals no definite correlations. C_1 activity was more in *N. indica*, while C_x was more in *P. granatum* strain. How far these enzymes play a role in the establishment of partial parasitism needs more intensive investigations involving histochemical study and other cell wall degrading enzymes. Work in this direction is in progress.

Thanks are due to Prof. U. B. S. Swami, Head, for kind encouragement and providing facilities. A. S. R. and M. K. are thankful to Dr. S. Ram Reddy for his help.

Department of Botany,
University College,
Kakatiya University,
Warangal 506 009,
February 9, 1980.

A. S. REDDY.
M. KOMARIAH.
S. M. REDDY.

1. Tracy, M. V., *Biochem. J.*, 1910, **47**, 431.
2. Sreenivas Rao, S. and Thirupathaiah, V., *Geobios*,, 1977, **4**, 214.
3. Miller, G. L., *Analyt. Chem.*, 1959, **31**, 426.

CLASSIFICATION OF SUBSIDIARIES ACCORDING TO INTERSTOMATAL SPACE RELATIONSHIPS

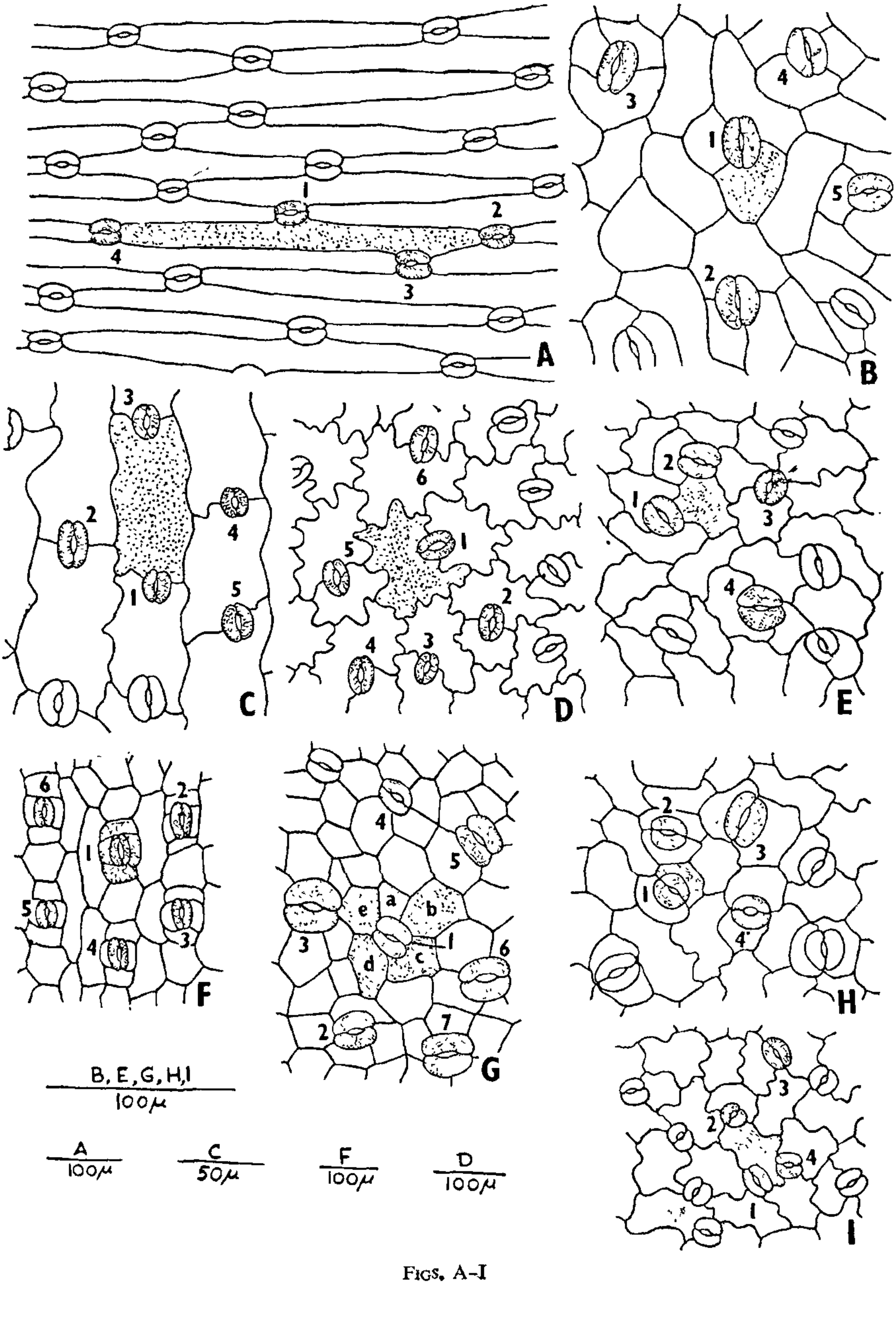
VARIATIONS can be discerned amongst the subsidiaries of a stoma according to their position with reference to adjacent stomata. On this basis the authors[3] had described a category of subsidiary called as the "common subsidiary" and its ontogenesis. In the course of further studies it was realised that several other categories of subsidiaries are recognisable, and together all these are not only useful for taxonomic purposes, but they are also of morphological interest. Since an approach of this kind has so far not been made in the past, the authors present the different subsidiary categories (including the "common" type presented earlier), their classification and importance.

In this paper certain terms have been used as defined below :

(i) *Stoma* : A pair of guard cells enclosing an aperture.

(ii) *Subsidiaries* : Cells surrounding a stoma in one or more cycles ; subsidiaries of the cycle abutting on the stoma may or may not be distinct from the adjacent epidermal cells, but of the other cycle(s) (if present) distinct. Subsidiaries are of three categories depending on whether they are of the same stoma or of different stomata (irrespective of spatial relationships) : (*a*) *Cosubsidiaries* : Subsidiaries of the same stoma and which obviously abut one another. (*b*) *Allosubsidiary* : Subsidiary of another stoma ; (*c*) *Co-allosubsidiary* : Subsidiary which simultaneously abuts more than one stoma.

(iii) *Costal cells* : Cells which overlie veinular areas ; they may be distinct or indistinct from the adjacent cells.



B, E, G, H, I — 100μ

A — 100μ C — 50μ F — 100μ D — 100μ

FIGS. A–I

FIGS. A–I. A. *Urgenia indica* (Roxb.) Kunth : leaf adaxial surface. B. *Scaevola toccada* (Gaertn.) Roxb. : leaf abaxial surface. C. *Dianthus* sp. : leaf abaxial surface. D. *Stachytarpheta indica* Vahl. : leaf abaxial surface. E. *Terminalia catappa* L. : leaf abaxial surface. F. *Cyanotis tuberosa* Schult. f. : leaf abaxial surface. G. *Nymphoides cristata* (Roxb.) Kutze : leaf adaxial surface. H. *Michelia champaca* L. : leaf abaxial surface. I. *Ludwigia perennis* L. : leaf abaxial surface.

The stomata referred in the text are numberd, whereas the subsidiary types are stippled.

(iv) *Epidermal cells of the leaf* : Cells of the leaf epidermis occurring in the intercostal areas other than those represented by stomatal apparatuses, trichomes and other specialised cell elements.

In the context of our study in about 500 angiosperms, the subsidiaries are classified according to their spatial relationships into the following seven types:

1. *Common subsidiary* (C-type) : Co-allosubsidiary which abuts on one or more adjacent stomata, but not any other cell (Fig. A).

2. *Abutting subsidiary* (A-type) : Subsidiary which abuts on one or more allosubsidiaries of one or more adjacent stomata (Fig. D).

3. *Free subsidiary* (F-type) : Subsidiary which neither abuts on another stoma nor any allosubsidiaries (Fig. F).

4. *Common-free subsidiary* (CF-type): Subsidiary which is of C-type to certain and also of F-type to other stomata (Fig. G–*e*).

5. *Common-abutting subsidiary* (CA-type) : Subsidiary which is of C-type to certain and of A-type to other stomata (Fig. E).

6. *Abutting-free subsidiary* (AF-type) : Subsidiary which is of A-type regarding some, and of F-type to other stomata (Figs. B, H).

7. *Common-abutting-free subsidiary* (CAF-type) : Subsidiary which is simultaneously of C-type, A-type and F-type in relation to various adjacent stomata (Fig. E).

Cosubsidiaries of a stoma may all be of one type or of more than one, depending on the plant. For example in the leaves (both surfaces) of *Urginea indica* the subsidiaries of most stomata are of C-type (Fig. A). On the other hand in *Nymphoides cristata* towards the leaf abaxial the cosubsidiaries of a stoma generally represent different types ; as shown in Fig. G, in stoma-1 the subsidiary *a* is of F-type (with reference to the adjacent stomata), subsidiary *b* is of AF-type (compare with stomata 4, 5, 6), subsidiaries *c* and *d* are of AF-type (compare with stomata 2, 6, 7) and subsidiary *e* is of CF-type (compare with stomata 1, 3, 4, 5).

On the basis of the above classification, a preliminary analysis of the foliar dermotypes studied by the authors and of the data available from the literature[1,2], indicates that amongst the dicots, the leaf adaxial surface possesses largely subsidiaries of F-type as the stomata are less frequent ; only rarely subsidiaries of other types occur due to increase in stomatal frequency. The above types of subsidiaries are observed irrespective of the kind of stomatal apparatuses.

But on the leaf abaxial, in species possessing only paracytic or diacytic stomata, the subsidiaries are mostly of F-type, few being of A-type (Fig. H). In some taxa with diacytic stomata also, as in *Dianthus*, the subsidiaries are, however, of CA-type (Fig. C). On the other hand, where the stomata are anomocytic (Figs. E, G), anisocytic (Figs. B, I) or a mixture of several types, the subsidiaries may be of more than one type described.

Amongst the monocots, whole families like Commelinaceae[4] (Fig. F) and Agavaceae have stomata with subsidiaries of F-type on both leaf surfaces. Similarly in taxa like Liliaceae (Fig. A) and Amaryllidaceae, which are usually with indistinct costal cells, the subsidiaries on both leaf surfaces are mostly of C-type ; if the costal cells are distinct, the subsidiaries facing the costal cells would be of CF-type.

Morphologically an interesting situation is suggestive from the present analysis. In the above examples of Liliaceae and Amaryllidaceae, since (apart from stomata) all cells are subsidiaries, no true epidermal cells exist in the leaf epidermis, which is unusual according to our current understanding.

Work is in progress on the present lines embracing a larger number of vascular plants.

The present work forms a part of the project 'Floristics and Foliar dermotypes of the angiosperms of Hyderabad district', financed by U.G.C. which is gratefully acknowledged.

Plant Anatomy and Taxonomy Laboratory, Departmnt of Botany, Osmania University, Hyderabad 500 007, India, *December* 26, 1979.

N. RAMAYYA.
T. RAJAGOPAL.

1. Metcalfe, C. R. and Chalk, L., *Anatomy of the Dicotyledons—I and II*, Clarendon Press, Oxford, 1950.
2. —, (Ed.), *Anatomy of the Monocotyledons—I–VI*. Clarendon Press, Oxford, 1960-1972.
3. Ramayya, N. and Rajagopal, T., *Curr. Sci.*, 1970, 39, 363.
4. Tomlinson, P. B., "Commelinales" in *Anatomy of the Monocotyledons*, Ed. by C. R. Metcalfe, Clarendon Press, Oxford, 1969.