Evolution of the Vegetative Form in the Gesneriaceæ.

THE present note has been inspired by a recent paper of Sir Arthur W. Hill[1] on "The monocotyledonous seedlings of certain dicotyledons, with special reference to the Gesneriaceæ". This paper opens with a discussion of certain dicotyledonous genera whose seedlings normally possess only a single cotyledon instead of the normal pair. The author shows that in every one of these

cases there is no evidence in favour of Sargant's theory that the single cotyledon represents two fused cotyledons. He believes that in every case the single cotyledon has resulted by the suppression of the second. This conclusion in the light of our present knowledge seems to be well-founded. The greater part of Hill's paper, however, is devoted to a consideration of the seedlings and vegetative form of certain plants of the Gesneriaceæ, belonging to the tribe Cyrtandroidæ—*Streptocarpus*, *Boea*, *Didymocarpus*, *Chirita*, *Klugia*, *Saintpaulia*, *Haberlea*, *Moultonia*, *Monophyllæa*, *Didissandra* and a few more—, in which one of the two cotyledons exhibits continued growth by means of a basal meristem, while the other generally aborts at an early stage of development. Here the author draws certain important conclusions about the evolution of these plants, but these are based on very slender evidence. They depart fundamentally from our conception of evolution in the angiosperms in that those forms which differ most from normal dicotyledons are regarded to be the most primitive. If they are not refuted, there is danger that they may be adopted by some taxonomists in the preparation of a phylogenetic classification of the family. The following remarks are, therefore, made with a view to present the evidence against these conclusions.

The author distinguishes three types in the material studied by him. The first includes the unifoliate forms like many species of *Streptocarpus* (*Dunnii*, *Wendlandi*, *polyanthus*, etc.), a few species of *Chirita*, *Didissandra sesquifolia*, *Didymocarpus pygmæa*, and the genera *Platystemma*, *Moultonia*, *Monophyllæa*, *Trachystigma* and *Acanthonema*. These possess only one leaf throughout their life, which is the persistent cotyledon greatly enlarged by basal intercalary growth. There is no trace of a plumule in the seedlings of such plants, and the flowers often arise from the leaf midrib.

The second group, Rosulatæ, is characterised by the plants developing a rosette of a few leaves. It includes other species of *Streptocarpus* (*Rexii* and *parviflorus*), *Chirita Trailliana*, and the genera *Saintpaulia*, *Ramondia*, *Haberlea*, etc. In these one cotyledon is retained, as in the unifoliate series, and is usually the largest leaf of the rosette. No plumular axis is developed in this group also.

The third group, Caulescentes, includes several species of *Streptocarpus*, most Chiritas *Briggsia*, *Klugia* and some other genera, consisting of herbaceous plants with well-developed leafy shoots. These differ from normal herbaceous dicotyledons only in the seedling structure, which is quite similar to that of unifoliate forms, and the development of a functional bud in the axil of the persistent cotyledon which often grows as vigorously as the main axis and makes the plant markedly one-sided.

The distinction between the three groups, however, is not absolute. Some species of *Chirita* (*bifolia*, *monophylla*, etc.), which are normally unifoliate, develop under certain conditions a second small leaf. Some others like *C. capitis* and *C. hamosa* are unifoliate when growing on rocks or under other unfavourable conditions and caulescent when growing in more favourable habitats.

From a comparison of these types the author concludes that the unifoliate genera and species represent the primitive conditions and the caulescent forms are derivates from ancestors which had assumed the unifoliate habit. This conclusion is based chiefly on three arguments. (i) In *Chirita lavandulacea* the large cotyledon and the lower foliage leaves have fairly long petioles, and the lower flowers are truly axillary. The upper floriferous leaves are almost or completely sessile and produce flowers from their midribs, exactly as the flowers are borne along the cotyledonary midrib in monophyllous species of *Streptocarpus*. For this reason one of these flower-bearing leaves of *Chirita* is regarded by the author as equivalent to that of a unifoliate *Streptocarpus* and it is suggested, when a herbaceous *Chirita* reaches the flowering stage, it exhibits a reversion to the ancestral condition. (ii) it explains the anisophylly of the cotyledons even in the caulescent forms. (iii) The appearance of monophylly in dimorphic species of *Chirita* when grown under unfavourable conditions is a reversion to the ancestral state.

A careful consideration of these arguments shows that there is not much force either in the first or the third, and the second by itself cannot have much value. That floriferous shoots in their form show reversion to the ancestral condition is a quite unproved assumption. Jeffrey,[2] who did much to clearly formulate the principles of

comparative morphology, has clearly warned about the application of the doctrine of conservative parts to the reproductive shoots of the angiosperms. Similarly, in the dimorphic species of *Chirita*, the caulescent form can as well be regarded as a reversion as the unifoliate form.

The greatest objection to Hill's conclusions, however, is that these are not based on a broad foundation of comparative morphology, nor is evidence presented from any other source to support them. In considering the evolution of these atypical plants of the Gesneriaceæ, he has paid no attention at all to the structure of the related forms. His conclusions might have been correct, if the Gesneriaceæ had been the only family of flowering plants on this earth. It is, however, only one of many. It is further closely related to the families Scrophulariaceæ, Orobanchaceæ and Bignoniaceæ; and the order Personales in which these families are placed is believed to have been derived from the orders Boraginales and Solanales. Such specialised unifoliate forms as are found in the Gesneriaceæ are absent in these orders and families. To regard them primitive for the Gesneriaceæ, therefore, is quite unsound.

From a comparison with the related families, the course of evolution in these atypical Gesneriaceæ appears to be as follows. The first change from normal forms appears to have been the development of the anisophylly of the cotyledons. At first the two cotyledons might have been merely unequal in size. Later the larger one of them became more specialized. It developed an intercalary meristem at its base and a functional bud in its axil. In this manner, the above-described caulescent forms came into existence. Further reduction and specialization of these, perhaps under the influence of unfavourable habitats, may be supposed to have led to the origin of the rosette and finally the extraordinary unifoliate types.

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September 9, 1938.

[1] *Ann. Bot., New Series*, 1938, 2, No. 5.

[2] *The Anatomy of Woody Plants*, Chicago, 1917.