

BRIEFER ARTICLES.

SUGGESTIONS ON THE CLASSIFICATION OF SEEDS.

MODERN botanical text-books do not present a classification of seeds in accordance with modern ideas of their structure and function. It comes as a distinct surprise to the average student of plants when he, for the first time, appreciates that some familiar herb, shrub, or tree may bear during a single season a score or more different types of seeds. Nor does the great complexity underlying the concept of the seed seem to be fully comprehended by the plant breeders and seed growers. Indeed, no method has been devised for recognizing the types of seeds that theoretically exist, nor, so far as I am informed, has a nomenclature been provided by which one type may be delimited from another. Under these circumstances it seems desirable to set down a simple classification of the more fundamental types of seeds in the hope that future experiment will indicate marks by which they may be recognized, and that some new light may thus be thrown upon the problems of hybridization, seed control, variation, mutation, and evolution of varieties and species.

To define the word "seed" in a manner technically accurate is exceedingly difficult. Underneath the seed lie the following conditions, in the absence of any of which the seed does not exist as such :

1. Alternation of generations. No seed is ever produced by non-alternating types of plants.
2. Heterospory. Among alternating types seeds are not produced by homosporous forms.
3. Intraspecific symbiose. Heterosporous types devoid of intergenerational symbiosis do not produce seeds.

The seed is in no exact sense an organ of the plant that bears it ; it is rather an aggregate in the family life of the species. In it tissues and structures belonging to three consecutive generations are uniformly present either transitorily or permanently. While its significance for the persistence of the species may be very great, it cannot be

regarded as a reproductive organ in the sense in which an antheridium, archegonium, or sporangium is so regarded.

A common definition of the seed describes it as a "ripened ovule." The full value of this is appreciated when one finds the ovule defined as an "immature seed." Seeds, however, occur in plants destitute of ovules, in the ordinary sense, and in any event a thorough definition is desirable. The following statement covers, to some degree, the modern concept of the seed: "A seed is an ultimate, trigenerational, symbiotic unit in the plant life-history, integrated from tissues and structures belonging to two sporophytic generations and the intervening gametophytic phase." By a somewhat vague and imperfect analogy the seed might be compared with the "household" in human society. Like the average household it comprises organisms linked by consanguinity and consecutive in development.

Thus defined, seeds may be classified into the following groups, the significance of which is essentially phylogenetic.

I. GENERAL CLASSIFICATION.

Seeds facultative.

Example, *Selaginella*.

Seeds obligatory.

1. Embryos monomorphous.

a. Pteridophytic seeds.

Example, *Lepidostrobus*.

b. Archespermic seeds.

2. Embryos dimorphous.

a. Metaspermic seeds,

A. Pseudosperms.

B. Eusperms.

I. Pteridosperms.

II. Archesperms.

III. Metasperms.

In the above it will be observed that the basis for the separation of seeds into the two fundamental groups is determined by their appearance as (1) unnecessary or (2) necessary aggregates in the life of the species. In by far the great majority of seed-bearing plants seeds are characteristic and are normally developed as such. In *Selaginella* certain megasporangia have been observed to remain for a long time indehiscent, and in this condition, their spores having germinated, and the eggs having been fecundated, to assume the character of seeds. This is, however, not the rule in the genus but the exception, hence such seeds have here been named facultative seeds or Pseudosperms, to distinguish them from the obligatory seeds or Eusperms of plants in which indehiscence of the megasporangium has become the rule, and the seed is thus fixed as a normal unit in the life-history.

It will also be observed in the limitations of the classes of Eusperms that the double fecundation of Nawaschin and Guignard is accepted as a true fecundation. This position is capable of defense, but even if later proved untenable the two classes of Archesperms and Metasperms are sufficiently distinct to justify the nomenclature.

II. STRUCTURAL CLASSIFICATION.

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| Seeds integrated with placenta. | A. Synsperms. |
| (Inseminées of Van Tieghem, ¹ <i>e. g.</i> , Loranthaceae.) | |
| Seed integrated separately from placenta. | B. Aposperms. |
| (Seminées of Van Tieghem.) | |

Under the head of structural classification should be mentioned also the division of seeds into monocotyledonous and dicotyledonous according to the character of the embryo, into albuminous and exalbuminous, according to the persistence of the endosperm, into ategminées, unitegminées, and bitegminées (Van Tieghem), according to the presence and number of the integuments, etc., but these classes are after all of comparatively secondary importance. They do not bring into view fundamental differences between seeds, but only incidental. For example, the difference between the monocotyledonous and the dicotyledonous embryo is probably by no means of fundamental importance, but represents different adaptations of haustorial organs during intraseminal life; the difference between albuminous and exalbuminous seeds arises through nutritive adaptations between embryo and endosperm and is of secondary importance; the difference between seeds with one or two integuments is after all a question of indusial development and need not be given great weight. It is true that these distinctions are of great value to the taxonomist and enable him to classify plants to advantage. Yet in comparison with the distinctions brought out below they are probably less significant in the specific life.

¹ The classification of flowering plants constructed by Van Tieghem principally upon the basis of seed structure contains much of interest. Unfortunately it is not natural, the characters taken for primitive being in many instances either vestigial or derived. Thus it results in an inversion of relationships. This is well illustrated by the position given to such a family as the Loranthaceae. On account of the high ecological specialism of the plants herein included degenerate structures would be certain to appear. It is precisely these that Van Tieghem accepts as primitive. This fact in itself is perhaps a sufficient commentary on the taxonomic value of the Van Tieghem sequences.

III. GENETIC CLASSIFICATION OF METASPERMS.

A. Seeds with parthenogenetic embryos.

A. Parthenosperm.

I. Both embryo and endosperm parthenogenetic.

I. Euparthenosperm (1)

II. One plant, either embryo or endosperm, not parthenogenetic.

II. Hemiparthenosperm

a. Endosperm result of fecundation, embryo parthenogenetic*a.* Parthenembryosperm

1. Effective pollen arising in same flower with seed.

1. Autembryosperm (2)

2. Effective pollen arising in neighboring flower on same stock.

2. Geitonembryosperm (3)

3. Effective pollen arising in flower of another stock.

3. Xenembryosperm (4)

4. Effective pollen arising upon stock of another species or variety.

4. Bastardembryosperm (5)

b. Embryo the result of fecundation, endosperm parthenogenetic.*b.* Parthenendosperm

1. Effective pollen arising in same flower with seed.

1. Autendosperm (6)

2. Effective pollen arising in neighboring flower on same stock.

2. Geitonendosperm (7)

3. Effective pollen arising in flower of another stock.

3. Xenendosperm (8)

4. Effective pollen arising upon stock of another species.

4. Bastardendosperm (9)

B. Seeds with no parthenogenetic embryos.

B. Gamosperm

a. Embryos arising through autogamy.*a.* Autosperm (10)*b.* Embryos arising through allogamy.*b.* Allosperm

1. Embryos arising through geitonogamy.

1. Geitonosperm (11)

2. Embryos arising through xenogamy.

2. Xenosperm (12)

c. Embryos hybrid.*c.* Bastardosperm (13)

The figures 1-13 following the names designate fundamental seed types all of which theoretically might arise upon a single plant. Naturally, however, seeds of one or two types will be produced in abundance by the individuals of a species, while others will be extremely

rare. In the genus *Viola*, for example, plants with cleistogamous flowers will normally produce both autosperms and xenosperms. In *Polygala*, species exist capable, from the ecological relations of their flowers, of producing a greater variety of seeds. These would differ essentially in their manner of development, while resembling each other structurally to such a degree that they would be indistinguishable by any of the ordinary tests. Furthermore, it may very well be that the xenosperm borne on a stock which is itself the development from a xenosperm will differ intrinsically from the xenosperm which is borne upon a geitonospermous or autospermous stock. Thus a new element of complexity is brought in and an explanation is perhaps afforded of so-called "sports" or mutations. Here also may be an explanation of certain genera which include large numbers of closely related "species." May it not be possible that in a species there will be distinctive xenosperm, autosperm, geitonosperm, and parthenosperm varieties, the continual production of which gives an appearance of *related species* rather than of special seed varieties? For example, would this explain *Crataegus*, *Rubus*, and *Hieracium*? And may not the mutation forms of *De Vries* be plants which have arisen from rare and unusual seed-types, developed, however, in accordance with the laws of plant reproduction?

In any event the consideration of the regular causes that underlie the observed individuality of seeds may lead to useful results in plant-breeding. It seems very certain that to regard seeds as necessarily equivalent because borne upon the same stock is a grave and positive error. They may even pass all the ordinary tests and yet be extremely unlike, so much so that they will upon development give rise to plants so different that they may rightly be classed as different species. Returning to the analogy mentioned above, it would seem as if there were no more reason to deny individuality to the seeds borne in a head of grain, upon *prima facie* evidence, than there would be to deny the individual character of each household in a city.
—CONWAY MACMILLAN, *University of Minnesota*.

THE SENSITIVE PLANT AS A WEED IN THE TROPICS.

(WITH ONE FIGURE)

EVERYONE who has traveled much in the tropics knows that *Mimosa pudica* is a weed which gives considerable trouble to the