increase with population size, (3) the build-up rate of smaller populations is slow. It is well known that vegetative mode of reproduction is the safest and surest means of survival.

In the third stage, after colonies attain a certain size, their plants begin to flower, their incompatibility apparently breaks down, and they begin to produce berries, probably by selfing also. This is inferred from the following: (1) Populations having about 60 plants or more produce flowers, and the largest of populations (Institute) produce plenty of berries and seeds; (2) pollen was more than 75% stainable; (3) when selfed, about 40% of plants in largest populations produced berries and a single plant (one of 20 plants tested) of second largest population also produced a berry.

It is an established fact that self-compatibility gives more assured seed production than self-incompatibility. It is reasonable to assume that the largest population has now been going through this third stage, and the second largest population is just entering it. When once any population becomes well established, it is possible that it might revert back to its original self-incompatible nature, thus ensuring outbreeding. This maximizes the potentialities of sexual reproduction and is thus the most desirable breeding system. The Institute population seems to have established itself firmly in the area and has been spreading fast. They produce flowers and seeds in plenty, and since the last two seasons, have even begun to appear as weeds in potato fields.

The tuber-bearing *Solanum* species are a large group of over 150 species characterized by inter- and intraspecific variability. A number of them are weedy and ruderal in nature. *S. chacœnse* is a highly polymorphic weedy species and has the widest distribution in this group of species.[1,2]

It would be interesting to see why this species alone has been able to establish itself in this area, though the Institute has been growing most of the species, and perhaps growing and using even more widely, another weedy, widely occurring self-fertile species *S. demissum*. The material offers a good opportunity to observe the genetic mechanisms responsible for the establishment, colonization and spread of a self-incompatible species that is capable of both sexual and asexual reproduction in a new region half-way round the world. This is under way.

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ORIGIN OF "COMMON SUBSIDIARIES" OF STOMATA IN THE ANGIOSPERMS

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OCCURRENCE of stomata separated from one another by several epidermal cells in leaves and other plant parts can be attributed to less frequent stomatal origin. But so often, stomata, irrespective of their structure and development, are spaced out by single epidermal cells or what could be called the "common subsidiaries". Presence of common subsidiaries, specially in high frequency, is significant in that it may not only affect the pattern of spacing of stomata but also their density; besides, it contradicts the notion that inhibitory organogenetic fields[1] operate during stomatogenesis. It was, therefore, considered that a study of the origin of common subsidiaries should yield some basic data on stomatal origin in space and time. As far as the authors are aware, there has been no work in the past on this aspect. Therefore, they present here results of their study on the origin of common subsidiaries in the leaves of three species, *Brassica oleracea* L., *Clematis gouriana* Roxb., and *Dioscorea bulbifera* L., where common subsidiaries are frequent. The investigation involved examination of epidermal peels from early stages of leaf primordia to those of mature blade. For convenience the abaxial leaf epidermis was only studied. Acetocarmine staining helped in following stomatogenesis in whole mounts of early stages of leaf development of which dermal peels are difficult to obtain. The mesogenous subsidiaries of the stomata are referred to as M1, M2, and M3 respectively following the sequence of their origin.

The frequencies of stomata and common subsidiaries of the three species are given in Table I, for comparison. A cell is counted as

TABLE I

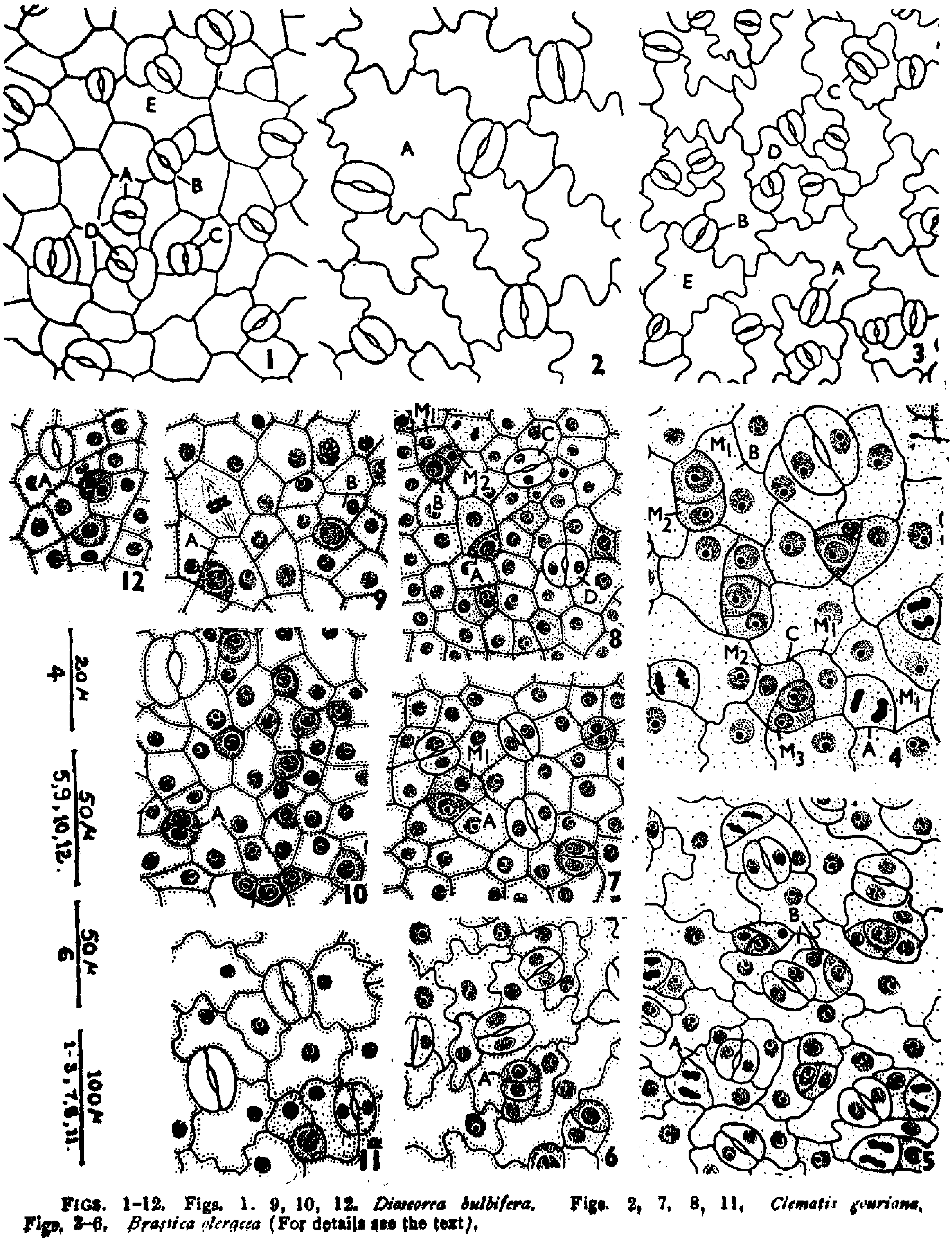
Species		Leaf abaxial surface	
		Common subsidiaries per square millimeter Ca.	Stomata per square millimeter Ca.
Clematis gouriana Roxb.	..	24	49
Dioscorea bulbifera L.	..	90	188
Brassica oleracea L.	..	208	318

a common subsidiary if it is shared by a minimum of two stomata (Figs. 2 A and 3 E). Common subsidiaries flanked by three or four stomata are rare (Figs. 1 E and 3 D) as compared to those by two in the three species. From the data (Table I) it is clear that the more the common subsidiaries, the more are stomata per square millimeter in the species studied. It is, however, necessary to state here that frequency of stomata is not governed merely by the common subsidiaries. It is affected by the size of the epidermal cells as well as of the stomata, the details of which are to be published elsewhere. Information on the origin of the common subsidiaries in the three species is as follows:

Brassica oleracea.—The leaves bear about 208 common subsidiaries per millimeter square. The stomata are anisocytic, monocylic, diffusely distributed, oriented at random (Fig. 3). The subsidiaries and normal epidermal cells are alike being sinuous and smooth-surfaced. As seen from Fig. 3 A-C, often 2 or 3 subsidiaries of a stoma act as common subsidiaries. The stomata are mesogenous and trilabrate in origin (*see* Fig. 4 A-C) with the last subsidiary being the smallest (Fig. 4 C, M 3). The stomata produced in the very early stages are independent from one another as seen in peels from leaf primordia, 2·5 cm. long (Fig. 4); but in those from about 5 cm. long, origin of common subsidiaries can be observed (Fig. 5). In the latter peels one (Fig. 5 A), or more (Fig. 5 B) subsidiaries of the stomata, earlier differentiated, act as meristemoids dividing unequally, of which the larger cell becomes the common subsidiary, whereas the smaller one, through further divisions, gives rise to a new stoma. The common subsidiary differentiated is thus mesogenous to both its stomata. It will be flanked by three or more stomata, if additional stomata appear abutting on it from the other sides (Fig. 6 A). But it is difficult to determine whether these stomata originate from the common subsidiary already formed or from the adjacent cells. Origin of stomata and common subsidiaries in this manner continues till the leaves have grown to about 10·5 cm. long when the stomatal mesogenes and other epidermal cells all appear completely differentiated possessing deeply sinuate walls (Fig. 6) as in mature leaves (Fig. 3). From the observations it is clear that it is due to the labile nature of largely the stomatal mesogenes that common subsidiaries originate in the species.

Clematis gouriana.—The common subsidiaries are about 24 per millimeter square (Table I). The stomata are anomocytic, diffusely distributed and randomly oriented (Fig. 2). The subsidiaries and epidermal cells are all alike. The stomata are mesoperigenous and dolabrate in their ontogeny as only two of the subsidiaries are mesogenous (the first subsidiary—M 1, however, vacuolates quite early, *see* Fig. 8 B), whereas the rest are perigenous (Fig. 8 A, B). The initially formed stomata, which are seen in peels of leaf primordia about 0·5 cm. long, are without common subsidiaries (Fig. 8 C, D), but in peels of primordia over a cm. long, subsidiaries of certain stomata, already formed, become activated as stomatal meristemoids (Fig. 7 A). Since the mesogenes of the stomata mature early, it is difficult to judge whether the subsidiary acting as stomatal meristemoid is mesogenous or perigenous. As described in the previous species, the larger mesogene (M 1), produced through the unequal division of the meristemoid, becomes the common subsidiary (Fig. 7 A). If the subsidiary acting as meristemoid is mesogenous, the common subsidiary formed is obviously mesogenous to both the stomata concerned; otherwise it will be perigenous to the first formed stoma, and mesogenous to the later one. Subsidiaries shared by three or four stomata also appear at this stage, but the ontogenetic relationship of such common subsidiaries with the stomata concerned is difficult to determine due to their belated origin. Origin of stomata giving rise to common subsidiaries may continue for long, as in *Brassica* (*see* Fig. 11).

Dioscorea bulbifera.—The epidermis shows about 90 common subsidiaries per millimeter square, but the stomata possessing the common subsidiaries occur in aggregates (Fig. 1 A-D). The stomata are mostly anomocytic, diffusely distributed and randomly oriented. The subsidiaries and normal epidermal cells bear straight to curved walls and the two are not mutually distinctive (Fig. 1). The stomatal meristemoids start appearing when the leaf primordia are about 2 cm. long (Fig. 9). Through an unequal division, a protodermal cell divides into two cells (Fig. 9 A), of which the larger forms a mesogene, whereas the smaller one develops into a stoma by undergoing a division (Fig. 10 A). The larger cell is recognisable as a mesogene in the early ontogeny only topo-



Figs. 1-12. Figs. 1, 9, 10, 12. *Dioscorea bulbifera*. Figs. 2, 7, 8, 11, *Clematis gouriana*, Figs. 3-6, *Brassica oleracea* (For details see the text).

graphically (Fig. 9 A), for its contents exhaust quite rapidly. The first formed meristemoids are distanced from each other by two or more cells (Fig. 9 A, B), but by the time the leaf primordia are about 6·5 cm. long, clusters of abutting protodermal cells start functioning as meristemoids and produce stomata as described above (Fig. 10). From the figure it is clear that the stomata so originate (as indicated by the meristemoids) that one stoma will come to abut on the mesogene of the other, so that the mesogene becomes a common subsidiary. Subsidiary of this kind will be obviously mesogenous to its own stoma, but perigenous to the one adjacently formed. Occasionally, however, a common subsidiary is seen which is perigenous to all its abutting stomata as seen from Fig. 12 A. In the latter, a common subsidiary is flanked by a guard cell mother cell (which will turn into a stoma by the next division) on one side and a young stoma on the other. From the topography of the guard cell mother cell and the young stoma it is clear that they are derived from adjacent cells.

The observations lead to several interesting conclusions. Common subsidiaries are associated with stomata irrespective of their ontogenetic pattern (whether mesogenous, mesoperigenous or perigenous). The first formed stomata do not possess any common subsidiaries, the latter appearing only in the subsequent period due to origin of fresh stomata either from or close to the subsidiaries of stomata already formed. Formation of common subsidiaries may last nearly upto the maturation of the leaf as in *Brassica*. No evidence is noted in favour of Bunning's[1] hypothesis that stomata originate at points beyond the range of inhibitory fields of previously formed stomata (as seen from Figs. 10, 12 and 5 B). In terms of their ontogenetic relationship, common subsidiaries are recognisable into three types; they may be (1) mesogenous to the stomata concerned or (2) mesogenous to some and perigenous to the others or (3) perigenous to one and all.

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ENVIRONMENTAL POLLUTION

To recognize a problem is the first step towards its solution but it is certainly not enough. This was clearly expressed by Dr. M. G. Candau, Director-General of the World Health Organization in the presentation of his annual report to the World Health Assembly. This is what he said: "We have to develop a simple and effective international detection and warning system designed for studying at the level of the city, nation and even continent the factors which modify our environment thus enabling us to overcome a problem which is, indeed, ours but which we must resolve not to hand on to our children. Such a detection system may be considered as the application of epidemiology to ecology. Its development would require a structural and quantitative analysis of all the essential factors of the environment—physical, chemical, biological and psychological—in order to determine the indicators that can serve as alarm signals. This means that the international community must come to some agreement on the levels or thresholds beyond which hazards exist.

This, in Dr. Candau's opinion, would be the first stage of the project to be followed by other developments, as he went on to explain: "The data collected will in any case be useful, since they will improve the quality and quantity of the information already available to us. But beyond even a detection system such as I have just described in broad outline, we have to look ahead in the more distant future, as a subsequent step in this project, to a world information centre directly linked by computers to national and regional health services.

For many years now, WHO has been developing surveillance and monitoring activities in such fields as adverse reactions to drugs, the communicable diseases (including malaria and smallpox), pesticides, air and water pollutants and the micro-chemicals and their toxic and genetic effects on man. These and a host of other problems are very complex in nature and the critical data are lacking in practically every area. For the past several months we have been studying how to develop plans, short and long-term in nature, that will enable WHO to proceed more effectively in the task of defining and interpreting environmental influences on the health of man, and to take appropriate action.—(*Courtesy*: *WHO Press Release.*)