included lamina was carried into the air. The 'first-leaf' thus performed the functions of a cotyledon.

This may be considered to be the converse of the state of affairs met with in the geophilous *Peperomias*.

On the other hand, although without doubt there is an inversion in fact, this case of abnormal germination in *Arisarum* appears to lend support to the argument put forward in connexion with the germination of the *Peperomias*, since the 'first-leaf' is shown to be physiologically capable of performing cotyledonary functions. Whether or not it is legitimate to argue that in an abnormal case of this kind the 'first-leaf' is really showing a recapitulation of lost functions, and that it is in fact also morphologically the second cotyledon, is an open question.

The morphological relations of the cotyledon and 'first-leaf' in the *Araceae* were pointed out in the paper already referred to,¹ and it does not seem improbable that the 'first-leaf' and the suctorial cotyledon really stand to one another as a pair of cotyledons with different functions. From this point of view the example described by MM. Buchet and Gatin, as far as it may be held to be of value in this connexion, lends support to the views put forward that the 'first-leaf' of Monocotyledons may represent the second cotyledon of the monocotyledonous embryo.

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ON THE OCCURRENCE OF DIFFERENT TYPES OF HAIR IN THE WALLFLOWER.—The well-known hairs on the leaves of the wallflower are spindle-shaped, with a short stalk at the middle attaching them to the leaf. They may be described as two-armed (malpighian) hairs having the two arms in the same straight line and parallel to the surface of the leaf.² Each hair, including its stalk, consists of a single cell, and the surface of the spindle-shaped portion is studded with knobs containing carbonate of lime. Fig. 1, *a* shows the outline of a hair of this type as seen from above, i. e. in a surface-view of the leaf. In a lower focus the stalk would be represented as a small circle in the middle of the hair.

No other type of hair appears to have been recorded in the wallflower, or to occur on the leaf or stem of the mature plant, except on the lower leaves of some lateral branches. On the cotyledons, however, other forms are found, viz. three-armed hairs (Fig. 1, *b*) and hairs with four (Fig. 1, *c*, *d*), five (Fig. 1, *e*) and, rarely, six arms. The two-armed type of hair, characteristic of the mature plant, occurs also on the cotyledons, but is usually far outnumbered by hairs with three or more arms.

On the upper side of the cotyledons the hairs may be many or few, but the proportional number of malpighian hairs (Fig. 1, *a*) is nearly always small. Three-armed hairs appear to be the commonest, but on some cotyledons hairs with four or five arms predominate. On the lower side of the cotyledons the hairs are usually few, and often mostly of the two-armed type, but hairs with three or four arms also occur.

¹ Hill, A. W. in *Ann. Bot.* xx, pp. 417-422.

² Some of the hairs have their arms bent slightly (or, rarely, sharply) upwards, away from the surface of the leaf.

The first two leaves after the cotyledons, when roughly examined with a lens, may appear to bear nothing but malpighian hairs, like the leaves of the mature plant, but more careful examination under a low power of the microscope generally reveals the presence of a small number of three-armed hairs. Some facts connected with the distribution of these hairs are worth recording.

Usually one or more three-armed hairs are to be found on one or both of the first two foliage-leaves, but on the third, fourth, and fifth leaves they are rare, and none were found on later leaves borne by the main axis. A noticeable feature in the distribution of the three-armed hairs is that they are nearly always restricted to the distal half of the leaf, and generally (especially when there are only two or three of them) they lie quite near the apex of the leaf.

Another point of interest lies in the fact that the nature of the soil apparently influences the number and distribution of the three-armed hairs. Twenty seedlings grown in loam were compared with twenty seedlings grown in sand, and the following results were obtained. On the first two leaves, three-armed hairs were decidedly more numerous on the plants grown on sand, the total numbers being 218 for the twenty plants on sand, and 97 for the twenty plants on loam.¹ These figures give an average of about 5.4 three-armed hairs per leaf in the first case, and 2.4 in the second; but the actual numbers vary greatly for different seedlings, thus, while on more than 50 per cent. of these leaves the number of three-armed hairs was 0, 1, or 2, the largest number observed was 34 on sand, and 18 on loam.

On the two kinds of soil an equally marked difference in the distribution of the three-armed hairs was shown. On loam they were more numerous on the upper side of the leaf (66 upper side, 31 lower), while on sand the numbers on the two sides were nearly equal (110 upper side, 108 lower).

On the third and fourth leaves of the forty seedlings, eleven three-armed hairs were found, three on loam, and eight on sand, while the fifth leaf of twenty plants yielded four of these hairs. Out of the forty seedlings only four (all from loam) showed no three-armed hairs on leaves after the cotyledons.

The conclusion, perhaps, most naturally suggested by the facts described above is that the presence of hairs with three or more arms is an ancestral character preserved in the early stages of the ontogeny of the wallflower, and formerly common to all the foliage-leaves of the plant. This view gains some support from the fact that

FIG. 1. Some of the types of hair found on the cotyledons of the wallflower. The general outlines are shown without indicating the irregularities caused by the knobs. $\times 60$.

¹ On sand the leaves were considerably smaller than on loam, but from some rough estimates it appeared that the total number of hairs (malpighian and three-armed) per leaf was about the same in the two cases, the hairs being more crowded on the smaller leaves.

hairs (with three, four, or more arms) quite similar to those on the cotyledons of the wallflower occur on the leaves of the mature plant in several species of *Erysimum*, a genus very closely related to *Cheiranthus*.¹

I hope to publish later some observations on the hairs of the seedlings and mature plants of certain species of *Erysimum*. Further considerations of the results obtained in the wallflower are therefore better postponed.

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¹ According to Wettstein's observations (Die Gattungen *Erysimum* u. *Cheiranthus*, Oesterreich. Bot. Zeitschrift, 1889, p. 243) the separation of the two genera cannot be upheld.

Boodle, Leonard Alfred. 1908. "On the occurrence of different types of hair in the wallflower." *Annals of botany* 22, 714–716.

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