stopcock between them. For best operation this rate should be slightly slower than that in the burette during rapid flow of the mercury. This will tend to prevent overshooting in the burette and the absorption pipettes when the valve is returned to the "off" position, since, after rapidly raising the mercury in the burette and then stopping, the mercury must fall slightly to come in equilibrium with the side tube. Likewise, the mercury must rise slightly in the burette (and consequently the fluid must drop slightly in the absorption pipette) after a rapid drop.

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Heteroplastic Grafts

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At the present time it is generally believed that grafts between unrelated plants are impossible. Very little literature is available on this subject. Funck (*1*) in 1929 made many successful grafts within the Solanaceae and within the Cactaceae. Since then, intrafamily grafts have received much attention, especially those within the Solanaceae. The significant work of Camus in 1943 has been well reviewed by Gautheret (*2*). By successfully grafting buds of chicory on root fragments of the same species grown *in vitro*, Camus demonstrated the histogenic action exerted by the buds on subjacent tissues. Funck (*1*) and Simon (*3*) secured a graft between *Solanum melongena* (Solanaceae) and *Iresine Lindenii* (Amaranthaceae) which, so far as can be determined, is the only record of a successful graft between unrelated plants up to the present.

Stock-scion grafts using white sweet clover, *Melilotus alba* (Leguminosae), and sunflower, *Helianthus annuus* var. Giant Russian (Compositae), were made using the clover as scion and the sunflower as stock. Six cleft grafts were made on two-month-old sunflower plants at the following positions: (a) below the cotyledon attachments, (b) immediately above the cotyledon attachments, (c) above the first pair of true leaves, and (d) above the second pair of true leaves. The scions were cut from the current growth of two-year-old clover plants, using both stem tips and lower regions which included at least one node. The scions, as shown in Fig. 1, were grafted into the pith parenchyma of the stock, thereby preventing juxtaposition of cambial or vascular elements.

Within a week, leaves of the scion unfolded on all 6 grafts, and after 3 weeks all had the appearance of normal healthy plants. Since the valid criterion of a true graft depends upon vascular connection between stock and scion, histological examination of one of the grafts was made after 3 weeks to determine if this had taken place. This examination showed (Fig. 1) the differentiation of xylem and phloem strands in the pith parenchyma of the stock from one point on the contact surface toward the vascular elements of the stock, thus forming a true vascular connection. A second graft, which had been allowed to develop for 11 weeks, showed that, with further growth of the two graft partners, a more extensive development of the vascular connection resulted. In the older graft, vascular connections were present at many places along both contact surfaces of the graft.

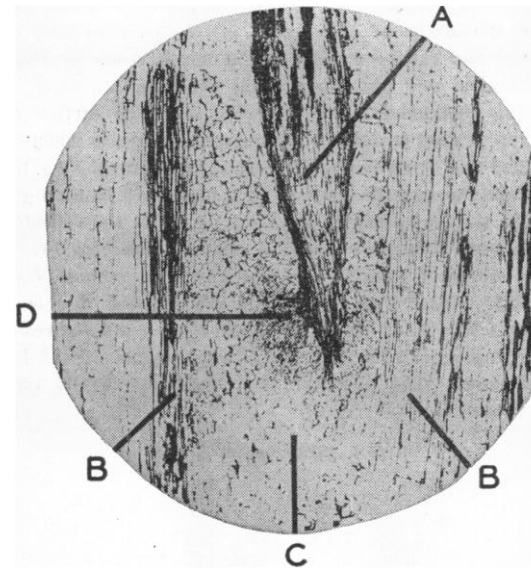

FIG. 1. A, scion; B, vascular bundles of the stock; C, pith parenchyma of the stock; D, region of vascular differentiation.

In the case of clover and sunflower it would thus appear that successful grafts can be obtained. A true vascular connection between the graft partners is initiated at an early stage, and scions have continued to grow with normal vigor for over 5 months. Experiments designed to ascertain how widespread are the possibilities of heteroplastic grafts have been started. Thus far it has been found that *Melilotus alba* can be successfully grafted on *Nicotiana Tabacum* (Solanaceae). Sections taken from this graft after 11 days show divisions in pith parenchyma cells of the stock proceeding from the contact line of the graft toward the vascular elements of the stock. Other heteroplastic grafts have been made including cowpea on tomato, clover on geranium, and tomato on geranium. Although these have not yet been examined histologically, they appear to be successful.

These results clearly show that we may abandon the idea that grafts between unrelated plants cannot be made. In addition, the method of grafting the scion into the relatively undifferentiated pith parenchyma cells of the stock becomes a useful technique in the study of vascular differentiation.

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