Hydraulic Device for Raising and Lowering Mercury in Gas Analyzers

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The Shepherd apparatus (*1*) is used almost exclusively for gas analysis in this laboratory. As marketed, this employs the conventional leveling bulb method for raising and lowering the mercury in the burette. The rate of flow of the mercury is controlled with a double-bore stopcock at the bottom of the burette. The large bore of the stopcock is used for rapid passage of the mercury and the small bore for fine control.

When a large number of samples are analyzed, the raising and lowering of the mercury-filled leveling bulb becomes tiring. There is also the possibility of spilling the mercury from the leveling bulb during this action.

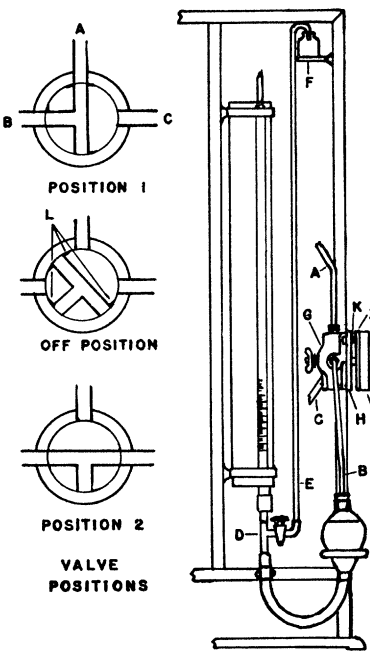

FIG. 1

A satisfactory modification of the leveling arrangement has been designed in this Laboratory for use with the Shepherd apparatus. House water pressure is utilized for raising the mercury, and a three-way valve controls the flow. This principle is generally applicable to other types of gas analysis apparatus in which mercury is used for displacing the gases.

The following is a description of this arrangement as illustrated in Fig. 1:

The double-bore stopcock at the bottom of the burette is replaced with a glass T (D), the side arm of which contains a stopcock which, in turn, is connected to a glass tube (E) rising parallel to the burette and extending slightly above the highest outlet in the apparatus. At this point the tube is turned down, and an open bottle (F) is supported under the opening to catch the overflow. The lower end of the T is connected to the leveling bulb with a short piece of rubber tubing. The leveling bulb is secured on an approximate level with the T.

A three-way control valve (G) is mounted by means of a flat support plate (H) to the frame of the apparatus at a convenient height directly above the leveling bulb. One outlet of the valve (B) is piped and sealed into the top of the leveling bulb, the other outlet (C) being piped to a drain or catch basin. The inlet of the valve (A) is connected to the house water system. For this purpose, copper tubing with an outside diameter of $\frac{1}{4}''$ was used from the water supply line to the apparatus and then reduced to $\frac{3}{16}''$ O.D. at the valve inlet.

The three-way valve used was a Minneapolis Honeywell "Type SO 47 B" diverting switch (three-pipe). Although normally used as an air switch, it has proved to be entirely satisfactory for this application. The plastic hand-lever of the valve was replaced with a $\frac{1}{4}''$ brass disc (I), approximately $2\frac{1}{2}''$ in diameter. The splined brass bushing of the plastic hand-lever was removed and soldered into the center of the brass disc. A plastic ring (J) approximately $\frac{1}{2}''$ thick was mounted on the brass disc to afford a better hand grip for control of the valve. The hex nut over the tension spring on the end of the valve core was replaced with a wing nut to facilitate removal of the core for lubrication. The valve core is limited to a 90° arc by stops on the valve body and a pin projecting from the valve core. The two open positions of the valve are at the extreme ends of the arc, and the halfway mark at 45° is the "off" position. In order to establish the "off" position while operating the valve, a $\frac{3}{8}''$ "bullet catch" (K) is mounted through the support plate so that the plunger of the "catch," slightly depressed, rides against the brass surface of the hand control disc at a point approximately $\frac{1}{4}''$ from the periphery. With the valve in the "off" position, a slight depression is made in the surface of the control disc directly under the plunger of the catch. When this position is reached during operation, the plunger will drop into the depression with an audible sound. This position can also be "felt" as the plunger drops into the depression.

The leveling bulb should hold sufficient mercury to fill both burette and side tube, with enough remaining to form a trap between the leveling bulb and the burette. When the valve is rotated clockwise from the "off" position to position 1, the water pressure forces the mercury up both the burette and the side tube. When the valve is rotated counterclockwise from the "off" position to position 2, the pressure of the mercury column forces the water through the drain outlet in the valve.

For fine control of the flow, very narrow V cuts (L) are made into the body of the valve core leading into the holes, as indicated on the valve core positions.

The rate of rise and fall of the mercury in the side tube relative to that in the burette is adjusted by the 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.

Reference

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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.

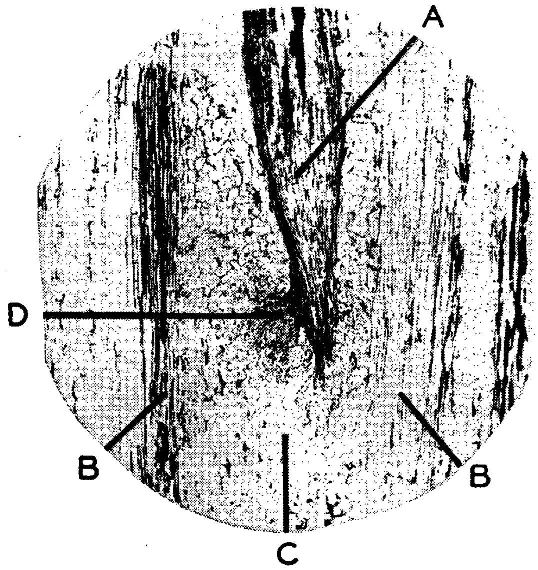

Fig. 1. A, scion; B, vascular bundles of the stock; C, pith parenchyma of the stock; D, region of vascular differentiation.

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.

References

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2. Gautheret, R. J. Sixth Growth Symposium, 1947, 21–43.
3. Simon, S. V. *Jb. wiss. Bot.*, 1930, **72**, 137–160.