lead, but samples collected more than 500 feet from a road contain an average of only 20 ppm lead. The analytical data are shown in Table 1.

Thus our studies confirm the findings of Warren on the concentration of lead in vegetation near highways. We hope that the data presented here will encourage further study of the problem by interested members of the medical profession (*4*).

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Sorbitol Translocation in Apple

Abstract. A report of glucose translocation, an apparent exception to the hypothesis that sucrose is the major carbohydrate translocated in plants, was investigated. Carbon-14 studies of the carbohydrates in the bark of apple suggest that rather than glucose the sugar alcohol, sorbitol, in addition to sucrose, is a principal compound translocated in this species.

There is general agreement that sucrose is the most important translocatory carbohydrate in most higher plants (*1*). Few reports exist in which glucose and fructose are proposed as transport molecules (*1*). The work of Dana (*2*) constitutes one of the few clear-cut examples of apparent translocation of a hexose sugar.

In 1952 Dana (*2*) reported that when $C^{14}O_2$ was supplied to leaves of dwarf yellow Delicious apple trees, most of the radioactivity recovered from bark samples was present in glucose. A secondary amount of labeling was detected in sucrose, and very little activity was present in fructose. Since Dana's results were unique, it was decided that a more complete investigation of carbohydrate translocation in apple should be undertaken. Our data are the results of that investigation.

Carbon-14 labeled carbon dioxide was supplied to the terminal leaves of a 2-year-old Malling IX dwarf yellow Delicious apple tree; a closed generating system was used (*3*). Then the stem below the supply area was sectioned, and the bark was separated from the wood. The bark and wood samples were prepared and analyzed essentially by Burley's method (*4*).

These procedures involved one-dimensional paper chromatography with the solvent system of n-butanol, ethanol, and water in volumes of 45:5:50; this system is used routinely to separate sucrose, glucose, and fructose. The amounts of activity corresponding to known sucrose, glucose, and fructose agreed with the data of Dana. Most of the radioactivity appeared to be present in glucose, with a secondary amount in sucrose and very little in fructose. Table 1 presents the results from this experiment, which is one of a series showing similar results.

While our investigations were progressing, we noted findings by Zimmermann (*5*) that sieve-tube exudate of ash contained large amounts of the sugar alcohol, mannitol. While this observation was essentially unexplained at the time, the presence of mannitol in the sieve-tube exudate did indicate its possible role as a transport compound (*6*). In an effort to find suitable analytical procedures for the separation and quantitative determination of mannitol, we noted that R_f values of sugar alcohols were similar to glucose in the solvent system used for the apple analysis. Sorbitol was subsequently identified by rigorous chromatographic procedures as the compound containing the major portion of activity in the stem of apple after exposure of the leaves to $C^{14}O_2$. This identification is in basic agreement with the observation that sorbitol is a major constituent of various genera of the Rosaceae, including apple (*7*).

The solvent system of butanone, acetic acid, and water saturated with boric acid, in volumes of 9:1:1, proved to be satisfactory for the separation of sucrose, sorbitol, glucose, and fructose. Duplicate samples of the experiment reported in Table 1 were analyzed by using this solvent system (Table 2). It is apparent that most of the activity originally thought to be in glucose was actually in sorbitol.

The carbohydrates occurring in the sieve-tube exudate of several varieties of apple were analyzed. Sorbitol and sucrose were the major components, and small concentrations of raffinose together with traces of stachyose were tentatively identified. We consider the evidence ample to regard sorbitol along with sucrose as principal carbohydrate transport material in the phloem of apple and perhaps in other species of the Rosaceae (*8*, *9*).

Table 1. Relative radioactivity of C^{14}-labeled sugars in the bark of yellow Delicious apple after chromatography with the butanol, ethanol, and water solvent system.

Distance of translocation* (cm)	Activity (count/min mg dry weight)†		
	Sucrose	Glucose (and sorbitol)	Fructose
Supply leaf	3136	14,137	236
2.5	673	1,947	103
46	482	1,581	84
60	114	325	17

* Distances are from node of C^{14} supply leaf to center of sample. † All counts ± 2 percent at the 95 percent confidence level.

Table 2. Relative radioactivity of C^{14}-labeled sugars in the bark of yellow Delicious apple after chromatography with the butanone, acetic acid, and boric acid solvent system.

Distance of translocation* (cm)	Activity (count/min mg dry weight)†			
	Sucrose	Sorbitol	Glucose	Fructose
Supply leaf	2967	9426	693	278
2.5	711	2276	137	90
46	500	1671	71	57
60	127	346	23	21

* Distances are from node of C^{14} supply leaf to center of sample. † All counts ± 2 percent at the 95 percent confidence level.

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