

correct that calcium is not mobile in the phloem, then developing fruits should not receive any of this element by this second route. In other words the proportion of calcium relative to other elements in developing fruits should be less than in the leaves. If we follow the accumulation of different elements in a growing fruit it can certainly be seen that the rate of build-up of calcium is much slower than the build-up of other elements. Perhaps, however, the most striking way of illustrating this is to compare the ratios of the concentration of elements in leaves to their concentration in fruits at different times during the growing season. With some elements such as nitrogen or potassium the ratio does not alter much during the season. The proportion of calcium, however, steadily increases in the leaves relative to the fruits. This supports the idea that the only supply of calcium reaching a developing fruit is that coming in the xylem stream. In other words, fruits on an apple tree are probably nearer calcium deficiency than are the leaves. It is possible that an actual deficiency of calcium may exist in certain organs on a plant that itself may be adequately supplied with calcium.

Is this a purely theoretical consideration or does it have any practical relevance? It is now believed that this situation occurs in certain crops to an important economic extent. For many years apples have been known to suffer from a disorder known as bitter pit. This consists of disfiguring pits that develop in the flesh of fruits as they approach maturity on the tree or after picking while in storage. Some years ago it was found out, more or less by accident, that trees sprayed with a solution of calcium nitrate produced fruit with much less pitting. The reasons for this effect are now, I think, apparent, and it would seem clearly that the affected fruits are suffering from a localised deficiency of calcium even though leaves on the same trees may have an abundance. We are now also beginning to appreciate that certain disorders in other developing fruits, such as tomatoes, may also be due to a localised shortage of calcium.

4. The fourth aspect of transport I would like to mention is the overall control of nutrient transport in a growing plant. What controls the movement of nutrients from one plant part to another? Why, for example, do nutrients, move from older to younger leaves? Plant physiologists have long recognised the existence of what they have called "physiological sinks"—these being simply regions or organs to which nutrients are apparently attracted. For example such developing organs as a growing fruit, or a swelling pea pod, or a developing potato tuber are all recognised as strong "sinks" to which nutrients move preferentially from other organs such as leaves, roots, etc.

Until recently we had no clue as to the mechanism of such attraction of nutrients. We now know that some of the plant hormones may be involved in this mobilisation of nutrients. For example it can be readily demonstrated with radioactive isotopes that the placing of a small amount of one of the cytokinins on a plant leaf results in substantial movement of nutrients to that region. I think it is likely that in the near future we will see much more research on this topic of control of nutrient movement in the plant.

RELATIONSHIPS BETWEEN THE VARIOUS PLANT ORGANS: PLANT HORMONES

It is quite obvious that there is specialisation of nutritional function among the various plant organs. Thus photosynthesis can proceed only where chlorophyll is present, and so the green parts of a plant must make enough sugar for the entire plant. The sugar needed by the roots, for example, must be transported there from the upper green parts. What do the roots contribute to the nutrition of the whole plant? Are they simply a mechanical device for anchoring the plant and for the passive transport of water and mineral nutrients from the soil? I have already discussed the fact that some of the nutrients passing up the plant have already been considerably metabolised in the roots. Other information on the inter-relations of