run of crop plants there are marked differences in ability to grow in a partially saline environment. This phenomenon is recognised by those concerned with reclamation of marine areas, where it is well known that only certain species may be grown in the earlier stages of reclamation. Again, the soil may be unfavourable by being too acid or too alkaline. Some plants favour acid growing conditions, others more alkaline conditions. Plant ecologists have long recognised some species of plants as calciphiles, or lime-loving species, while other species are calciphobes, or lime-hating species. Different species of the one genus may differ in this way, and differing ecotypes of the one species have also been found. A third type of unfavourable mineral environment occurs where there is something approaching a toxic level of some element in the soil. For example, in mine tailings there may be quite toxic levels of some heavy metals such as zinc, copper, or lead. Normally little if any plant growth will occur in such material, but occasionally strains of plants have been found that will grow there at reasonable rates. The basic questions that cannot yet be answered to any extent concern the physiological mechanisms whereby these various species of plants, or strains of the same species, can tolerate these several sorts of mineral environment, whether these be saline, acid, or alkaline, or simply generally toxic. Nor of course is there any knowledge of the steps by which these plants adapt to such unfavourable conditions.

TRANSPORT OF NUTRIENTS IN THE PLANT

Nutrients absorbed from the soil have to be transported upwards through the stems and distributed to the various growing plant organs, and the products of photosynthesis have to be transported from the leaves and distributed through the entire plant. There are two distinct transport systems within a plant. Firstly there is the xylem system consisting essentially of open tubes of varying diameter. These carry the sap upwards from the root, through the stem and into the leaves and growing points. This is simply the movement of a fluid through an open system of pipes. At its many distal termini the water may evaporate leaving the dissolved nutrients in the organ to which they have been transported. The xylem characteristically transports upwards the nutrients absorbed by the roots and distributes them through the plant. The second transport system in the plant, the phloem system, consists essentially of a series of living cells ranging through the plant, usually alongside and parallel to the xylem. The way in which materials move through the phloem cells is not at all clear, but it too, is a most efficient transport system. Movement of materials in the phloem is a movement from one living cell to another, not just a movement through open tubes. Characteristically the phloem transports soluble carbohydrates away from the leaves to other parts of the plant, but this system also transports inorganic nutrients, e.g., phosphate or potassium, back from the leaves. There would thus appear to be the capacity for the circulation of such nutrients from one part of the plant to another.

This rather simple view of transport of nutrients within the plant has had to be modified in recent years in several important ways:

1. The classic view of transport of mineral nutrients in the xylem is that the nutrients are absorbed by the roots, transported across the root tissues, and enter the xylem vessels, up which they are to be transported quite passively. Techniques have been devised whereby one can extract the liquid contents of the xylem from a woody shoot in the laboratory. It is then possible to examine directly the nature and amount of materials present in the xylem stream. Most detailed observations have been made on the level and forms of the element nitrogen in xylem sap. In many woody species the level of nitrate, the form in which nitrogen is generally absorbed from the soil, is very low, most of the nitrogen being present as organic compounds. In the xylem sap of apple trees, for example, all of the nitrogen appears to be present as various amino acids and amides. The actual level of nitrogen present