

of water into roots may be compared with its rising in capillary tubes; that the endosperm in the seed may be likened to the yolk in an egg; and that the prevalent conception of a vegetable soul was a gratuitous hypothesis.

A few experiments by John Ray showing the upward passage of sap in the wood and its lateral movement as well; Woodward's measurements showing how much water a mint may take up by its roots and discharge by evaporation; Christian Wolff's acute observations on the exhaustion of the soil after much has been grown on it, and on the variety of matters contained in rain-water—are all of interest, but they are "thrown into the shade by the brilliant investigations of Stephen Hales (1677-1761), in whom we see once more the genius of discovery and the sound original reasoning powers of the great explorers of nature in Newton's age" (Sachs). His *Vegetable Statics* (1727) may be called the foundation-stone of plant physiology.

Hales deserves a most honourable place in the history of physiological botany, not merely because he was a pioneer at an early date, but because he indicated the only sure path of progress. He brought rigorous physical methods to bear upon a biological problem. By ingenious experiments and careful measurements he "made his plants themselves speak". His investigations on the ascent of sap remain of interest, and he was the first to prove that a great part of the food of plants must be derived from the air. It must be remembered, of course, that physics and chemistry had made some progress, else Hales could not have secured his foothold.

In spite of the admirable beginnings made by Malpighi, Mariotte, and Hales, vegetable physiology degenerated for nearly half a century into profitless theorizing about circulation and the like. A new impulse was needed, and that came from chemistry, which Lavoisier had begun to reorganize. In 1774 Priestley (1733-1804) had discovered oxygen, and five years later he showed that this gas was, in certain conditions, exhaled by plants. In the same year Ingen-Houss (1730-1799) took an even bigger stride, showing that it is only in the light