

acquainted with Maxwell's work, will be astonished at its variety and importance. Would that another ten years' teaching had been allowed us! The premature death of our great physicist was a loss to science that can never be repaired.

RAYLEIGH.

SAP.

Sap: Does it rise from the Roots? By J. A. Reeves. (London: G. Kenning, 1890.)

THE object of this book is clearly stated in the following words from the introduction (p. 4):—

"Facts will be advanced to show there is no evidence to support any of the following theories, viz.:—That the sap in trees rises at any time; that inorganic matter rises from the soil; that the soil is exhausted by the growth of vegetation; that sap is elaborated in the leaves," &c.;

and the style is exemplified in the following quotations from the conclusion (p. 82):—

"Instead of water ascending and gases descending; the facts (which are open to the observation of any person disposed to give unbiassed attention to the subject) go to prove that the water *descends* to the roots, and the gases *ascend* to the leaves, both actions being in strict conformity with the Laws of Gravitation."

"Let the reader witness a monster forest tree during a Summer shower, after a long drought, and then calmly consider—Whether the CREATOR IN HIS INFINITE WISDOM ordained that the thirsty leaves should be refreshed and invigorated by drinking in the genial rain falling upon them. Or,—Whether each leaf was designed to *resist such moisture*, but, at the same time, to draw the water it needs from the soil, which is often hundreds of feet below, and as DRY AS DUST."

The italics and large and small capitals are the author's, and we have now to examine how he proceeds to justify the extraordinary statements quoted.

Starting with a number of extracts from Sachs's "Text-book of Botany," which refer to several different things, and are in part misquoted or mutilated, and of which the most remarkable is as follows,¹ "It is not known how water reaches the tops of trees, but probably by the *formation of dew*," the author concludes that much difference of opinion exists. This conclusion is not without warrant, but the nature of the diverging opinions is by no means illustrated by his statements, and is not to be understood without an acquaintance with much more modern literature than he seems to have any knowledge of. At any rate, he might have obtained even more conflicting statements by judicious culling from the writings of Böhm, Elfving, Westermaier, Vesque, and other modern authorities. Granted, however, that much difference of opinion has been expressed on the subject, let us see how the author proceeds to clear up the matter. He suggests as an alternative theory that the leaves of plants obtain their water and mineral substances from the air.

"It is suggested that the foliage of plants by absorbing the moisture in the air also absorbs the impalpable dust which it contains."

¹ At p. 684 of Sachs's "Text-book," second edition (English translation), this statement runs: "It is not known how this water has reached the higher parts of the trees, though it is possibly by the formation of dew," &c., and it bears a very different signification from that given.

"It seems quite possible that, in dry weather, a portion of the dust alluded to, which comes in contact with the leaves of plants, may, with the dews of night, pass through the leaf-cells into the downward flow of sap. If so, such inorganic matter becomes a constituent of the sap, to be chemically acted upon in the formation of new cells effecting the mysterious operations called growth."

This kind of thing is sufficiently startling, and what its effect may be on the minds of those insufficiently acquainted with the elements of botany need not be discussed. For the information of those who expect to find such views supported by new and adequate evidence, however, the following illustrations may suffice:—

"The oil which rises through the cotton wick of a lamp to support the flame is constantly referred to as an apt illustration of the transpiration theory."

"The leaves of the weed *anacharis* contain a large proportion of silica, although the plant has no root, and it grows whilst flowing with the stream."

"Seeds sown in flannel, moistened with distilled water, will grow (although not to maturity) and produce as rich green foliage as if grown in alluvial soil. [N.B.—Iron cannot be supplied from flannel.]"

If it were not that the book contains internal evidence of the deadly earnestness of the writer, we should have regarded these (and other paragraphs, adduced to show that the roots do not absorb the water and minerals of the transpiration current) as quaint jokes of the Max O'Rell or Mark Twain type. Moreover, the work teems with such funny statements. Speaking of trees (p. 40),

"If the pendent ends of the branches be embedded in the soil, the descending sap will be *drawn out* and and [*sic*] roots will be formed of the discharged sap."

Although the superfluous "and" might suggest that even the pen of the author gasped and stammered, as it were, at this monstrous statement, we fear it must be regarded as an innocent misprint, for the idea that tissues and roots can be formed by the mere hardening of sap is gravely expressed in several places, *e.g.* pp. 37, 48, and 54.

Other notions of sixteenth century value are to be found serving as the foundation stones for the curious superstructure which the author dignifies as a theory. Thus, on p. 32:—

"The germination and growth of a seed seem to be controlled by the same law of gravitation as the growth of a mature plant. Water *descending*, gas *ascending*. . . . When, however, the seed is placed in moist warm soil, water is absorbed, and a kind of fermentation or decomposition commences, the contents are expanded, the gas is necessarily evolved. This expansive operation continues until the skin of the seed is broken. The heavy watery parts exude first, and cell to cell of atomic matter becomes united with the embryonic radicle, and gravitates downwards, forming the root; while the gases or vapours, which result from the fermentation in the seeds, press upwards and cause the plumule to form."

We could not resist quoting this rather lengthy joke, for the sake of the climax: it may be doubted whether the days of a belief in levitation could have produced a statement to equal the last sentence.

This must suffice to show the tenor of the production before us, and we can only conclude by expressing our wonder that any writer could be found to invent the text and any publisher to produce it.