

ON THE STRUCTURE OF ROOTS.

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It is a general belief that plant-roots exhibit but very few modifications in regard to function and structure, and almost as a rule the histology of this organ is silently passed by in works on plant-anatomy. Furthermore, it is a very common feature of herbarium specimens that the parts underground, for instance the roots, are either totally absent or poorly preserved. It is, therefore, often very difficult to study roots in herbaria, and the student is mostly obliged to secure the material himself and to make alcohol preparations. When roots are dried and pressed they may in some cases be made useful to histological research by being placed in boiling water and then preserved in strong alcohol, but many roots, especially the fleshy ones, lose their delicate structure to such an extent when they are dried and pressed, that they are not suitable for this purpose. If the herbalists would preserve parts of the various organs of plants in alcohol as an appendix to their herbaria, the plants might be studied more carefully and from other points of view than merely systematically.

To give some illustration of the various functions performed by roots, we might refer to a modern and very suggestive paper by our excellent friend Dr. August Rimbach,* in which the following four types are proposed: "nutritive," "attachment," "contractile," and "storage-roots."

Roots of the first type possess no pronounced power of resistance, since they have no mechanical tissues, nor are they contractile nor especially adapted "to store" nutritive matters. They are generally very slender and certain plants possess only this type, for instance: *Dentaria*, *Tulipa*, the *Gramineæ* and many others.

The second type, the attachment-roots, needs no further explanation, and these we know from the epiphytic *Bromeliaceæ*.

The contractile roots have the power of contracting, thus drawing the shoot deeper and deeper into the ground, as for instance: *Scilla*, *Crocus*, *Gladiolus*, some species of *Oxalis*, etc.

Storage-roots are, on the other hand, such roots as possess

* Berichte Deutsch. Bot. Gesellsch. Vol. 17. Berlin 1899.