

to notice the very early growth of one of these plants, you would see a primary root which, however, soon disappears and is replaced by secondary roots springing partly from the base of the stem and partly from the lower joints of the stem. These roots are sometimes called adventitious roots.

But not only will you notice differences in the length of roots in different plants, but you will notice differences in the same plants in different soils. Sow some beet seed in a soil that is not deeply loosened up, and notice how much shorter the roots are than those grown from the same kind of seed sown in a deeply-loosened up soil. This shows you why farmers in growing such crops as beets, turnips, and carrots always cultivate and loosen up the soil as deeply as possible.

Again, trace out the roots of a plant, such as grass, grown in a soil that remains wet for a long time in the spring, and then do the same with a similar grass plant grown in a soil that dries out earlier in the spring. You will find that the roots of the grass grown in the drier soil, have extended down much more deeply into the earth. The reason for this is, that roots are no fonder of cold water to live in than you are, and therefore in a cold wet soil have to spread out very near the surface. In the drier soil they strike down deeply. Now watch the effect when the dry summer days come. The plant on the soil that was so wet wilts away, because its roots are all near the surface and cannot reach down to the water below, whereas the plant in the drier soil, unless the weather becomes very hot and dry, can grow easily, because its roots are down deep in the soil near the water that lies there. Do you not see from this one reason for underdraining fields?

Once more, trace out for a little way the roots of a grass grown in what farmers call a rich, mellow soil, and then do the same in a soil that is poor in plant food. You will find that the roots in the rich soil have branched very much more than in the poor soil. This is because of the large amount of plant food in the rich soil. Have you ever seen people trying to make a lawn? If you have, you will have noticed that, in some soils, the grasses remain in separate tufts and do not mat into a good sod. These are the poor soils. But in a rich soil you will have noticed that in a very short time, not more than a year or two a good close sod has formed, on which you can easily play croquet, tennis or other games. This is because the roots have developed so much more thickly in the good soil, and thus have produced a better growth of grass, and have become more closely matted together, making a firmer sod.

Now, we have observed a lot of different things about roots. Let us look a little closer at them and see what we can learn about the way in which they push through the soil, how they hold so firmly to it, and how they absorb water and plant food. You have already discovered how very difficult it is to pull up all the roots of a plant without breaking them. When I tell you that the roots of some clovers have been traced



Fig. 12. Showing adventitious roots of corn.