

part of "Brothers," by the same author, is also good. So are the early chapters of "Pip," by Ian Hay, and the excellent account of Pip's first cricket match might well be read aloud to a class reading "Tom Brown." Kipling's "Stalky & Co.," should be read together with the criticism of it by A. C. Benson, in the "Upton Letters." Mr. Benson, who was for years a master at Eton, has an interesting chapter on the difficulties of writing a school story that shall be true to life. "A Scout's Son," a story of a Canadian boy's school life in England, is very much praised, but I have not read it. "Emmy Lou," is an admirable story of a girl's life at an American public school, and "What Katy Did at School," a good picture of a rather old-fashioned type of boarding school.]

### Botany for Public Schools.—III.

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At the season when fruits mature, a study of this phase of plant life should be profitable. And since fruits grow from flowers, it will be convenient to speak of the two interchangeably. One can take no better exercise on a clear October day than to walk through the fields and groves, and observe Nature's preparation for the next year's growth.

Merely to notice the presence of fruit or seed is not sufficient. Far more interesting is it to observe the modifications of certain vegetable organs which brought about the formation of fruit. Doubtless, everyone knows that a plant does not fruit freely while it is growing rapidly. In early summer, its buds expand into leaf-bearing branches. Later, growth becomes slower; and flower-bearing branches appear. Can it be possible that flower branches (that is, flower-clusters or single flowers) are simply stunted and modified leaf-branches?

Let us observe. If we look on willow shrubs we may find "cones" that look somewhat like cultivated hops, or like the pistillate flower-clusters of the hop-hornbeam. These are not natural to the shrub. They show a diseased condition. On examination they prove to be enlarged buds. A gall-fly lays eggs in the bud of the willow. These eggs hatch to small maggots, whose activities modify the growing bud—even make it a house fit for them to live in. Thus, the twig that should have grown a foot long, with lanceolate leaves arranged in five ranks, grows only about an inch long, and with broad scale-like leaves. The dwarfing effect of the maggot therefore produced the "cone," the central axis of which is the dwarfed twig, and the scales of which are dwarfed and modified willow leaves.

If a maggot, sapping the strength of the twig,

produces a "cone," why could not growing fruit or seed produce a similar effect? We know that seeds do grow at the expense of the stem.

There is practically no difference in structure between this growth on the willow and the real cone on the pine, spruce, fir or hemlock. [This willow growth is known as pine-cone willow gall, because it resembles a pine-cone, grows on the willow, and is caused by a gall-fly.] Since the willow gall is plainly a dwarfed branch, doubtless the pine cone is the same. The scales on the pine cone are arranged on the central axis just as the green leaves (bundles of "needles") are arranged on the branch. Having a different work to perform, they are of a different shape and colour. As their work is not the production of food, they are not green. Since they are to cover the seed, they are broad instead of needle-shaped.

But, though we may believe a cone is a modified branch, that does not prove that all flower clusters or fruit clusters are such. It is not, however, a very great step in complexity from the cone to the catkin. Birch, alder and willow seeds are enclosed in an ovary, and spruce seeds are not. But the willow catkin is as plainly a modified branch as is the spruce cone. Below each flower on the central axis of the catkin is a small bract. The flower grows in the axil of this bract. By the spiral arrangement, we know the bracts are stunted leaves.

From catkins to spikes, and from spikes to racemes are very short and very natural steps.

With any of our familiar plants, a glance is sufficient to tell us a flower or flower cluster is a branch. Where do branches grow? They are either at the apex of the plant or in axils of the leaves. (Are they also in the axils of leaflets?) Flowers grow in the same locations. They come from buds. Therefore, they, also, must be branches. Examine a golden-rod or aster. Its leaves are in five ranks. In the axils of the lower leaves we find leafy branches. In the axils of the upper leaves, or near the end of the lateral branches, you find flowering branches. That is, early in the season, the plant produced green leaves with which to feed itself. Later, when its life is nearing an end, it produces small coloured leaves—flower leaves—which are to serve a purpose in reproduction. The individual dies; but the race is well provided for.

I have spoken of certain plants bearing leaves in five ranks. This is not the only arrangement, but