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NOTES ON THE SELF-PRUNING OF TREES.

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In a dense forest of growing trees the smaller, side branches of the main stem, as well as those of the larger branches, are continually dying off. But the tree rids itself of these dead branches by forming a collar of tissue from the cambium layer around the base of the branch, which presses more tightly as layer after layer of living wood is added, until the branch finally falls off and the hole which is left is grown over in a short time. This process is known as natural pruning. But the process which we wish to consider is very different from this, and we desire to distinguish it by the term, self-pruning. In this case the living branches are cut off or else the cutting-off process is the cause of the death of the branch. A special adaptation is provided to accomplish the result and the process is one whose purpose is the shedding of the branches rather than the attempt to accommodate the plant to conditions of injury brought about by other causes. In a number of species perfectly formed winter buds were developed on the branches which were shed, and so far as our observations go, the twigs are cast in the fall and winter.

Although the shedding of branches is well known, especially in the conifers, not as much notice has been taken of it as we think it deserves. We have been taking observations for several years and have been partly anticipated by Dr. Bessey in a note in *Science* 12. 650, 1900, — Botanical Notes — The Annual Shedding of Cottonwood Twigs. Bessey describes the shedding of the twigs of Populus deltoides as occurring about the middle of October, and after giving the details of the process, concludes as follows: "It is an interesting fact that the Tamarisks (Tamarix sp.) which are held by some botanists to be closely related to the Poplars, shed their twigs by exactly the same device as that described above. In the Tamarisks the shedding of the twigs is a part of the annual process of defoliation, their leaves being so small that it appears to be less trouble

and expense to drop twig and all than to separate every individual leaf. Possibly in the Cottonwoods, with their large leaves, we have a survival of the Tamarisk twig-shedding habit long after its original significance has disappeared." Dr. Bessey, however, we believe, will not insist on this supposition when he considers that the same thing occurs in species of Prunus, Quercus, and other widely separated genera.

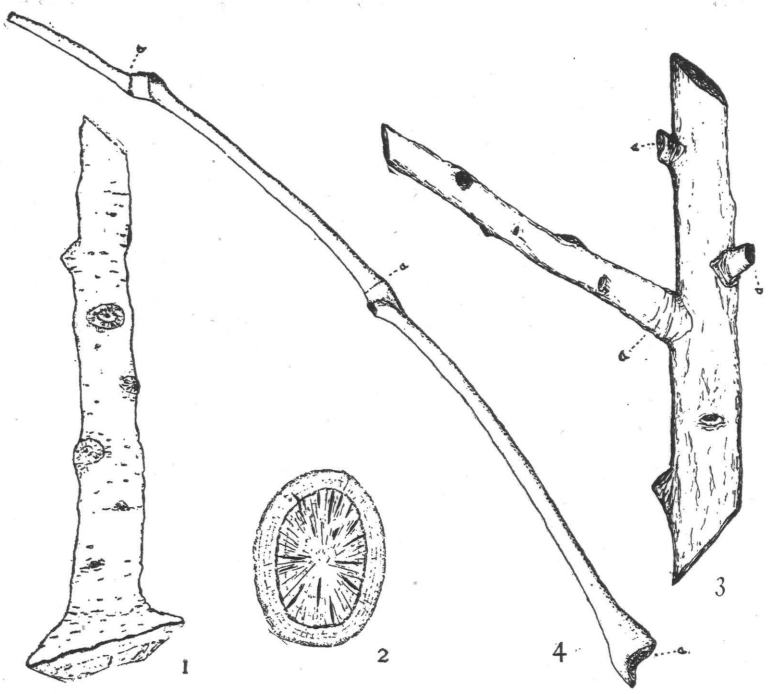

FIG. 1—Twig of Populus alba, showing large basal joint and scars where smaller twigs have been detached.

FIG. 2—View of basal joint of same twig as Fig. 1.

FIG. 3—Twig of Salix nigra, showing position of the brittle zone (*a*).

FIG. 4—Green twig of Ampelopsis cordata, showing joints (*a*) at the leaf nodes.

The self-pruning of twigs from woody stems, so far as our observations go at present, is accomplished in three general ways: 1st, by the formation of a single joint close to the parent branch; 2nd, by the formation of a brittle zone near the base of the limbs which are to be shed; 3rd, by a series of transverse joints corresponding to the leaf nodes.

Among the plants which come in the first class, the most striking perhaps, is Populus alba, in which very large branches are frequently cut off in such a perfect manner that one might think the pruning had been done with a sharp knife. Green twigs from one to fifteen years old were found to be shed and no doubt still older ones are cut off. The twigs have well-developed winter buds and this is also the case in other species of Populus and in certain species of Quercus and Prunus. In Quercus alba shed twigs were found from one to four years old while in Q. acuminata there were some seven years of age. In Prunus serotina twigs from one to six years old were cut off. In Ulmus Americana not only are joints formed at the base of the twigs, but the twigs also break apart at the nodes, caused by annual growth.

The following species were found belonging to the first class:

Populus alba L.
" deltoides Marsh.
" grandidentata Mx.
" tremuloides Mx.
" dilatata Ait.
Quercus alba L.
" robur L.
" macrocarpa Mx.
" acuminata (Mx.) Sarg.
Ulmus americana, L.
Prunus serotina, Ehrh.
Tamarix gallica L.
Tsuga canadensis (L.) Carr.

All the plants found with brittle zones belonged to the willows. It is interesting to note that the branches shed may be one to several years of age and that certain branches do not develop a brittle zone. Salix nigra and S. amygdaloides seem to show the character most perfectly and it is remarkable to see how readily the branches drop off.

The following species show the adaptation:

Salix nigra Marsh.
" amygdaloides anders.
" fragilis L.
" alba vitellina (L.) Koch.
" babylonica L.

Among those which come in the third class, the most remarkable plant observed was Ampelopsis cordata. About the time that the leaves are shed nearly all the slender green branches literally fall to pieces and drop off. Most of the fruit is on these branches

and the berries are thus shed at the same time. In the winter the plant is remarkable for the few branches left and it looks like an artificially pruned vine.

The species observed belonging to this class are the following:

Ampelopsis cordata Mx.
" tricuspidata Seib. & Zucc.
Parthenocissus quinquefolia (L.) Planch.

The shedding of the twigs of woody plants may in many cases be entirely an adaptation to get rid of the leaves as in the case of the dwarf branches of Pines and the young twigs of Tamarisks. But even in the Tamarisks it is doubtful whether the joints formed in the older branches can be claimed to have such a purpose, since in this case the leaves have all been shed with the annual twigs. The shedding of the old woody branches may have a different purpose. In regard to the trees mentioned above, we think that the process is one primarily to rid the tree of surplus branches. This would manifestly be an advantage and would give room and opportunity for the development of many young leafy shoots every year without accumulating too great a mass of useless members. This is certainly the case with the poplars and the willows. In no case do we think it admissible to say that the adaptation is primarily for the purpose of propagation, although this may be a very important incidental result in such plants as the willows when growing in wet places. In the case of Ampelopsis cordata, the only reasonable explanation seems to be a preparation for the winter condition, since the branches which are shed do not ripen and the plant has an admirable method for shedding its leaves. The slender branches would be in great danger of being killed by the cold of winter. The shedding of the young branches of Taxodium distichum (L.) Rich. is remarkably like that in Tamarix. The slender, dwarf branches clothed with the leaves drop off in the fall or the following spring. The habit must be quite ancient, as such branches of Taxodium distichum miocenum Hr. are very abundantly preserved as fossils. In Taxodium mexicanum Carr. the dwarf branches are not shed until the second year. Glyptostrobus pendulus Endl. and G. heterophyllus Endl. also have deciduous dwarf branches. There are other conifers and no doubt many other angiospermous trees which possess these interesting adaptations and by careful observations, no doubt many interesting ecological facts will be brought to light.