THE TREE IN WINTER.

When autumn has turned the verdancy of the forest into discolored hues, and the roaring gales have shaken off the last withered leaf,

> "And woods, fields, gardens, orchards, all around
> The desolated prospect thrills the soul,"

even then nature is not dead, she sleeps only. The new life lies hidden in the bud, born early in summer from the axil of the leaf.

It is our own fault, if in the bare forest we see only a crowd of wooden trunks and limbs and twigs. There is in winter an abundance of objects to be studied by the naturalist. The book of nature lies open at every season to the attentive eye.

To recognize the different trees in winter is not only amusing to the friend of nature, but in many cases of great practical use. To expose the characters by which the species of our woody plants can be distinguished in winter, is the aim of this paper. As the space allowed is not sufficient for a synoptical description of each single species,—matter enough to fill a book,—the reader cannot expect more, in these few lines, than an introduction to the subject, and may accept this as an invitation to inform himself by autopsy and study, assisted by the most necessary drawings.

Everybody will easily recognize, even at a distance, an old oak tree by its stout stem, its strong crooked divaricate limbs; or an elm by its domelike appearance, caused by its numerous twigs dividing from a number of primary limbs of equal strength; or a *Gymnocladus* by its slender stem with but few branches and comparatively thick twigs. In some trees the bark is characteristic: that of the hackberry is very rough with narrow elevated ridges, while that of the beach and hornbeam is quite even and smooth. The bark of the shell-bark hickory separates the outer layers in long flaps, while in the mockernut and bitternut it is compact, and often nearly smooth; sometimes the bark of the stem is rough and that of the limbs smooth, as in the red oak; the bark of the twigs is often corky-ridged (*Quercus macrocarpa*), or separates in small flaps (*Quercus bicolor*), or bears two opposite corky ridges (*Ulmus alata*). In many trees the ridges anastomose obliquely, leaving lozenge-shaped spaces. The white color of the bark of the canoe birch is very characteristic. The whole division of white oaks differs from that of the black oaks by the color of the bark, which is paler in the former and darker in the latter. We have no surer guide than the characters taken from the arrangement, form and construction of the buds and, in many cases, the form of the leaf-scars.

PHYLLOTAXIS.

As the buds grow from the axils of the leaves, their arrangement is the same as that of the leaves. They are either opposite or alternate.

When the buds are opposite, one pair stands transversely to the next lower, so that, when seen from above, the four buds form a cross, as do also the leaves and the branchlets; the third pair corresponds to the first one. This position is called decussate, and we find it in the species of Euonymus, Staphylea, Aesculus, Acer, Negundo; Hydrangea, Cornus (except C. *alternifolius*), Lonicera, Sambucus, Viburnum, Bignonia, Tecoma, Fraxinus, Foresteria.

A whorl of three buds we find in Catalpa, and also usually in Cephalanthus (sometimes four or only two). Each whorl alternates with the next one, so that, seen from above, a whorl of six is formed. In all the rest of our woody plants the buds are alternate. Though seemingly irregular they are arranged in a definite order. The buds are alternate in two lines (bifarious), or in other words the third bud corresponds to the first, the second to the fourth; two buds make one circuit, and this is expressed by the fraction $\frac{1}{2}$; the numerator indicates the circuit, the denominator the number of buds. This arrangement we find in the species of Asimina, Vitis, Ampelopsis, Cercis, Hamamelis, Brunnichia, Dirca, Ulmus, Celtis, Morus and Smilax.

In Betula and Alnus three buds make one circuit in a spiral line; the fourth bud stands above the first ($\frac{1}{3}$).

In the majority of our woody plants five buds make two turns in a spiral line, and the sixth bud stands above the first (two-fifths). In the oaks the upper buds are somewhat crowded. The beech and Tilia, though properly belonging here, have the buds on the horizontal branches in two opposite lines.

There is one little tree (*Ptelea*) with eight buds in three circuits ($\frac{3}{8}$), and one shrub (*Amorpha fruticosa*), with thirteen buds in five circuits (five-thirteenths). In Rhamnus four buds make one circuit, but the merithalls* between the first and second and the third and fourth, are much shorter than between the second and third; and as we sometimes find the pairs of buds in Euonymus and Fraxinus displaced (one higher than the other), we may conclude that Rhamnus belongs to the same division as those. The position is properly decussate. The same conclusion we may make in regard to the elm, the seedling of which has opposite leaves; and perhaps we may explain the bifarious position of the buds on the branches by a (hypothetic) torsion of the merithalls.

The best way to count the buds and their circuits, is to thrust a pin into each leaf-scar at a right angle to the stem, and attaching a thread to it, pass this from the lower to the next higher until the one is reached which corresponds to the first one.

Figures 18—21 on Pl. IV show in diagram the phyllotaxis of four different woody plants. The figures represent the bark split longitudinally

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*Internodes.

and laid flat. The lines represent the vascular bundles, which enter the bud at the numbered points. In Fig. 19 we see that the fibres of two-fifths of the vascular ring enter into one leaf. If we segregate the merithalls and put the buds at the same level, we have a whorl of 5, 8 and 13, and the whole number of buds represents a whorl pulled out into a spire.

There are sometimes supernumerary buds in some species of Juglans, Carya, Gymnocladus, Amorpha, Gleditschia; two to even four buds appearing one above the other. The uppermost develops, or it forms an abortive twig, a spine (Gleditschia); then the next lower develops, the lowest remaining dormant. In Crataegus the axillary bud is often transformed into a spine, when an accessory bud appears on both sides.

The species with opposite buds have a true terminal bud. This is sometimes abortive and wanting in *Euonymus* and *Staphylea*, or the shoot had an indefinite growth and withered in fall at the upper end, as in *Sambucus*, *Tecoma*, *Catalpa*, *Cephalanthus*. Then of course there is no terminal bud.

SIZE AND FORM OF THE BUD.

The buds of our woody plants are formed in summer, and are visible during winter. Only *Gleditschia* and *Robinia* show no buds in winter; these are hidden in the bark and break forth only in spring. Others show only a little knob (*Ptelea*, *Cephalanthus*). There are a number of trees which have very large buds, at least at the upper end of the shoot (*Aesculus*, *Fraxinus*, *Juglans*, *Carya*, *Populus*), others very small ones (*Cercis*, *Celastrus*). The buds are either leaf-buds or flower-buds or mixed, containing leaves and flowers at once. The latter are quite similar to the leaf-buds; the flower-buds are mostly more roundish and swollen, and placed at the lower part of the shoot (*Fraxinus*), but some flower-buds are cylindrical and appear (in *Rhus aromatica*) at the upper end of the shoot.

The true terminal bud of the species with decussate buds and the pseudo-terminal bud of the species with alternate buds, are often much larger than the axillary buds; and, as these are often the only ones that produce new shoots, these trees show in winter a limited number of long branches. When we examine such branches, we find sometimes a row of shoots, each with a few approximated leaf-scars, and below these a ring of narrow scars of the bud scales, fixing the limit of each shoot, and then a long shoot with remote buds. (*Fagus*, Fig. 16 on Pl. II, and *Cornus alternifolius* Fig. 9 on Pl. III.) By counting these shoots we can determine the age of the branch.

The bud is fusiform, often very slender (*Amelanchier*, *Cornus*, *Virburnum lentago*); or ovate, more or less pointed (*Aesculus*), or oval and obtuse (*Diospyros*, *Ulmus fulva*), or globular (*Crataegus*), or compressed (*Asimina*, *Liriodendron*, *Hamamelis*).

DIRECTION OF THE BUDS.

The axis of the bud stands mostly at an angle of 15 to 45 degrees to the axis of the branch, sometimes at a right angle (*Fagus*, *Celastrus*); or the bud is appressed, the axis being parallel to the shoot (*Cornus*, *Virburnum*, *Salix**).

The axis of a bud which stands straight above the leaf-scar is radial, it points to the centre of the branch; but in some species, particularly in those with bifarious buds (*Morus*, *Celtis*, *Ulmus*, *Tilia*) the bud stands not right above the leaf-scar but a little aside, then the direction of the bud is oblique, and its axis is tangential, it strikes the periphery of the shoot. The axis itself is sometimes not straight, but bent (*Celtis*, *Ulmus*).

THE SCALES OF THE BUD.

The number of scales is not always definite. It is said to be ten in *Carya alba*; and yet I have counted in the upper bud a greater number, sometimes even as many as twenty, though in many species the number is constant. *Salix* has the bud covered by a single hood-like scale, *Tilia* has two, the inner one larger and enveloping the bud with overlapping margins.' In *Negundo* and *Staphylea* one pair is visible, the inner ones are herbaceous and pass into leaves. *Acer dasycarpun* has four pairs, and *Acer saccharinum* eight pairs, *Aesculus* four opposite rows of five to six scales each. *Fraxinus* and *Euonymus* have three pairs.

The arrangement of the scales follows the rule of Phyllotaxis. In the bifarious species the scales are arranged in two rows, and there are four scales in each row (in *Ulmus*, *Celtis*, *Morus*). In those with five buds in two circuits the buds have the same arrangement, they are imbricate.†

The form of the scales is often variable in the same species and the same individual. It is mostly ovate and convex, pointed (*Aesculus*, *Populus*, *Quercus coccinea*), or mucronate (*Crataegus*), or obtuse (*Corylus*, *Quercus nigra*). The scales are pinnately grooved at the upper end in many species with pinnate leaves (*Fraxinus*, *Juglans*, *Carya amara*).

The surface is smooth (*Crataegus*, *Quercus rubra*), or pubescent (*Fagus*, *Carya alba*), or tomentose (*Rhus glabra*, *Ulmus fulva*, *Quercus coccinea*), or sericeous (*Dirca*), or velvety (*Asimina*), or furfuraceous (*Carya amara*). The color is mostly brown, but sometimes green (*Euonymus*), yellow (*Carya amara*, *Dirca*, *Liriodendron*), rusty red (*Zanthoxylon*), bluish black (*Fraxinus sambucifolia*), purplish brown (*Asimina*). Some have a darker colored zone along the margin (*Morus*).

VERNATION.

When we cut a bud horizontally, we observe the inner arrangement, the position of the leaves and their parts. In the species with decussate

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*In Salix cordata Var. angusta, only the flower-buds are somewhat spreading.

†M. C. De Candolle (*Memoire sur la famille des Juglandees*) calls the buds of *Carya olivaeformis* and *amara* decussate. That may be true concerning the lateral buds; in the terminal buds, as many as I have examined, I have found the phyllotaxis invariably 2-5.

The same author differs from other botanists in his phyllotaxis, since he passes from one scale, bud or leaf to the next on the longest and not on the shortest line, and thus, of course, makes three circuits instead of two.

buds the pairs stand at right angles, the lower ones outside, those higher on the shoot inside (Pl. I, Figs. 21–25). In the bifarious species the leaves are located side by side, the lowest outside, the highest in the middle, the posterior side of the midrib looking toward the leaf-scar (*Ulmus*, Pl. IV, Fig 14); or they stand opposite, the lower inclosing the upper ones (*Celtis*, Plate IV, Fig. 15), the posterior side of the midrib looking toward the bud-scales. In those with the spiral position of the buds the leaves are arranged in the same way; the posterior side of the midrib looks toward the corresponding scale (*Populus*, Pl IV, Fig. 16). When the species has compound leaves, the leaflets lie either side by side or in a half-circle, the uppermost in the middle, the lower ones at the sides (*Carya alba*, Pl. IV, Fig. 17).

The blade of the leaf is either conduplicate (*Prunus**, *Amelanchier*, *Asimina*, *Cercis*, *Ulmus*, *Tilia*), or plicate (*Acer*, *Hamamelis*, *Ribes*), or involute (*Euonymus*, *Celastrus*, *Staphylea*, *Populus*, *Viburnum*), or revolute (*Salix*, *Ptelea*) or convolute (the leaflets of *Carya*, Pl. IV, Fig. 17), or equitant (*Cornus*, Pl. I, Fig. 24, or open and slightly concave (*Cephalanthus*, *Sassafras*).

A very singular arrangement we observe in *Liriodendron*, Pl. III, Fig. 4. The leaf is conduplicate and bent inward from the upper part of the petiole, and the cover of the bud is nothing else than the two stipules of an abortive leaf.

LEAF-SCARS.

At the base of the bud we observe the scar of the fallen leaf, an area of varying form, covered with a thin layer of corky matter which is formed in the latter part of the season and separates the leaf from the shoot; and within this area we notice the vestiges of the vascular bundles that enter the leaf-stalks.

The scars are either flat upon the stem (*Aesculus*), or on a projection, pulvinated (*Quercus*); they are sometimes concave (*Ampelopsis*, *Catalpa*), or convex (*Ulmus*).

The form of the scar depends on the form of the base of the leaf-stalk, and is very variable. It is narrow, nearly linear (*Negundo*), or crescent-shaped (*Cornus*, *Viburnum*), or triangular (*Populus*), or semi-circular (*Fraxinus*, *Quercus*), or elliptical (*Liriodendron*), or three-lobed (*Crataegus*, *Cercis*, *Amorpha*), with five sharp angles (*Lonicera flava*), or oval with the upper end truncate or emarginate (*Tecoma*, *Catalpa*, *Sassafras*), or heart-shaped (*Rhus toxicodendron*, *Gleditschia*, *Juglans*, *Carya*), or horse-shoe shaped (*Rhus glabra*, *Ptelea*), or ring-shaped around the bud (*Platanus*, *Dirca*). Here the bud was covered by the hood shaped basis of the leaf-stalk. In *Dirca* the bud is situated in a cup-like cavity the margin of which forms the leaf scar. When two scars of opposite leaves meet (*Negundo*), the twig seems to be articulated.

The marks of the vascular bundles are very characteristic, presenting sometimes one point in the center (*Celtis*), or a horizontal streak (*Sassafras*).

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*The European species of *Prunus* proper have convolute leaves.

Usually there are three points forming a triangle, or more and then forming either a curved line (*Asimina*), a horseshoe-shaped line (*Cephalanthus*), or a closed chain following the outline of the scar (*Morus*, *Sambucus*, *Fraxinus*), or separating in groups (*Juglans*, *Carya*, *Gymnocladus*). The marks are somewhat concave (*Aesculus*) or convex (*Lindera*).

THE TWIGS.

The direction of the twig commonly agrees with the direction of the bud. The *Sassafras* has a peculiar growth; the secondary shoots of the summer from the lower buds attain a greater length than the primary ones, and as the shoots are curved upward, the whole has the appearance of a chandelier (Pl. III, Fig 7). The shoots are either smooth (*Fraxinus americana and sambucifolia*, *Acer*, *Crataegus*), or pubescent (*Fagus*, *Betula*), or rough hairy (*Corylus*, *Ulmus fulva*), or tomentose-pubescent (*Fraxinus pubescens*, *Carya olivaeformis*, *Diospyros*), or prickly, and then the prickles are placed irregularly on the bark (*Rosa*, *Rubus*, *Smilax*), or there is only one on each side of the scar, representing a stipule (*Robinia*, *Zanthoxylon*). Prickles should not be confounded with spines (or thorns). *Ribes* has a spine below the persistent base of the leaf-stalk, and this represents a bract.

In many species we see ridges running downward from the leaf-scars (*Populus monilifera*, *Rhus toxicodendron*), in some species with opposite leaves these ridges are very sharp and prominent, and the twig becomes quadrangular (*Fraxinus quadrangulata*, *Euonymus atropurpureus*).

The color of the twig is mostly brown, but other colors occur, red (*Cornus sericea*), purplish (*Cornus alternifolia*, *Asimina*) yellowish (*Platanus*), green (*Sassafras*, *Euonymus*, *Staphylea*, *Negundo*), grayish (*Fraxinus sambucifolia*, *Rhamnus*), white, thickly covered with a white woolly pubescence (*Salix candida*).

THE PITH.

The pith in a horizontal section of a twig shows different forms in the different species, and in the same individual. In the middle of the merithall (space between two single leaves or pairs of leaves or whorls), it is more or less circular in the majority of our species; but sometimes it shows a hexagonal shape in species with opposite leaves; in those with five leaves in two circuits, a pentagon (*Sassafras*, *Liquidambar*), or a five-rayed star (*Quercus*, *Populus*). Near the upper end of the merithall (wrongly called "joint,") the form of the pith is modified by projections towards the leaf or pair of leaves.

The vertical section in *Juglans* and *Celtis* shows the pith in horizontal plates. I have observed this only in one other plant of our flora, the *Phytolacca*.

The color of the pith is mostly whitish, pure white in *Sassafras*, often with a rosy tinge in *Tilia* (cream color when older), yellowish in *Rhus glabra* and *Rhus toxicodendron*, reddish in *Gymnocladus*, *Cornus*, *Rhus aromatica*, greenish in *Gleditschia*, brownish in *Juglans cinerea*, *Carya amara*.

It is very large in proportion to the thickness of the wood in *Sambucus, Sassafras, Rhus.* Only *Smilax* has no pith; it belongs to the endogenous plants.

To treat of the wood here, would lead us too far, for the matter is too ample to be condensed into a small space.

The plates will aid somewhat in the identification of specimens.

SODIC PINATE AS A TEST FOR LIME.

By J. A. SEWALL.

Pinic acid or sodic pinate precipitate salts of calcium, magnesium and iron.

I have recently made some experiments with the sodic pinate, with reference to its delicacy as a test for detecting the presence of the salts of the first mentioned metal (calcium), with the following results, using a solution of calcic sulphate:

$\frac{1}{2500}$ part of calcic sulphate in one part of water, yields a very copious amorphous precipitate, which readily subsides.

$\frac{1}{5000}$ part yields an abundant bulky precipitate.

$\frac{1}{10000}$ part, an abundant precipitate.

$\frac{1}{25000}$ part, an immediate cloudiness, and in a few minutes a good precipitate.

$\frac{1}{50000}$ part, quite the same result as is given by the $\frac{1}{25000}$ solution.

$\frac{1}{125000}$ part, a very satisfactory deposit after a little time.

$\frac{1}{250000}$ part, a distinct turbidity, and after a few hours a satisfactory deposit.

I observe that on adding a few drops of the reagent to distilled water, the solution becomes, after several days, slightly opalescent.

The reagent was prepared by dissolving one part of the sodic pinate in fifteen parts of distilled water and filtering the solution.

The quantity of the solution of the calcic sulphate operated on in each trial was one fluid ounce. The quantity of the sodic pinate solution used in each trial varied from two to ten drops, the larger quantity being used in the stronger solution of the calcic salt.

Ammonic oxalate fails to precipitate lime in a $\frac{1}{65000}$ solution, (*Fresenius*).

It will be seen from the above that the sodic pinate is a much more delicate test for calcic salts than the ammonic oxalate. The deportment of other calcic salts is quite the same as that of the sulphate.

3. *Peronospora gangliformis*, Berk. Lettuce mould.
4. *Microsphæria elevata*, n. sp. On leaves of Catalpa bignonioides; magnified 75 diam.
5. Sporangia of same.
6. *Peronospora viticola*, B. & C. On grape leaves.
7. Mycelium of same, with haustoria in pith of young stem.; magnified 350 diam.
8. *Peronospora infestans*, Mont. Magnified 350 diam.

PLATE III.

1. Section of leaf of Pinus austriaca, with *Pestalozzia* ———. Magnified 20 diam. The leaves are probably dying from some other fungus.
1a. Spores of same, magnified 85 diam.
2. *Podosphæra kunzei* (?) Lev. On cultivated cherry leaves; magnified 75 diam.
2a. Sporangium of same.
2b. Macrosporium-like or capnodium-like bodies on appendages.
2c. Appendage having moniliform divisions.
2d. Similar to c. Found mostly on mycelium.
3. *Sphærotheca castagnei* (?) Lev. On Erechtites hieracifolus; magnified 75 diam.
4. Sporangia of same.
5. *Rhytisma acerinum*, Fr. On leaf of Acer dasycarpum; natural size.
6. Vertical section of same. c. Asci with young spores.
7. Plycinidia of an Erysiphe on Verbena urticifolia.
7f. Macrosporium-like forms found with latter.

PLATE IV.

1. *Erysiphe*, ———. On Aster puniceus.
2. *Microsphæria extensa*, C. & P. On Quercus rubra; magnified 75 diam.
3. Appendage, magnified 300 diam.
4. Ruptured conceptacle of same; a. sporangia.
5. Triposporium-like bodies on same mycelium.
6. *Phylactinia guttata*, Lev. On Fraxinus viridis.
7, 8, 9, 10 & 11. *Microsphæria ravenelii*, Berk. On Gleditchia triacanthos.
12. Macrosporium-like bodies, with *Microsphæria fresii*, Lev. On leaves of Syringa vulgaris.

THE TREE IN WINTER.

PLATE I.

1. Aesculus glabra, Willd. Buckeye.
2. Acer saccharinum, Wang. Sugar maple.
3. Acer dasycarpum, Ehrh. Soft maple.

4. Negundo aceroides, Moench. Box elder.
5. Staphylea trifolia, L. Bladder nut.
6. Euonymus atropurpureus, Jacq. Burning bush.
7. Sambucus canadensis, L. Elder.
8. Fraxinus americana, L. White ash.
9. Fraxinus pubescens, Lam. Red ash.
10. Fraxinus viridis, Michx., f. Green ash.
11. Fraxinus sambucifolia, Lam. Black ash.
12. Fraxinus quadrangulata, Michx. Blue ash.
13. Viburnum lentago, L. Sheep berry.
14. Viburnum dentatum, L. Arrow wood.
15. Cornus paniculata, L'Her. Panicled cornel
16. Lonicera flava, Sims. Yellow honeysuckle.
17. Tecoma radicans, Juss. Trumpet-creeper.
18. Catalpa bignonioides, Walt. Indian bean.
19. Cephalanthus occidentalis, L. Button bush.
20. Rhamnus laceolatus, Pursh. Buck-thorn.
21. Horizontal cut of the bud of Fraxinus sambucifolia.
22. Horizontal cut of the bud of Acer dasycarpum.
23. Horizontal cut of the bud of Staphylea trifolia.
24. Horizontal cut of the bud of Cornus paniculata.
25. Horizontal cut of the bud of Euonymus atropurpureus.

PLATE II.

1. Quercus alba, L. White oak.
2. Quercus macrocarpa, Michx. Burr oak.
3. Quercus bicolor, Willd. Swamp white oak.
4. Quercus prinus, L. (Var. acuminata, Michx.) Chestnut oak.
5. Quercus imbricaria, Michx. Shingle oak.
6. Quercus coccinea, Wang. Scarlet oak.
7. Quercus rubra, L. Red oak.
8. Quercus nigra, L. Black-jack oak.
9. Populus monilifera, Ait. Cottonwood.
10. Populus heterophylla, L. Downy poplar.
11. Populus grandidentata, Michx. Large-toothed aspen.
12. Populus tremuloides, Michx. Aspen.
13. Corylus americana, Walt. Hazlenut.
14. Fagus ferruginea, Ait. Beech.
15. Ostrya virginica, Willd. Hop hornbeam.
16. Carpinus americana, Michx. Hornbeam.
17. Juglans cinerea, L. Butternut.
18. Juglans nigra, L. Black walnut.
19. Carya alba, Nutt. Hickory.
20. Carya tomentosa, Nutt. Mockernut.
21. Carya olivaeformis, Nutt. Pecan.
22. Carya amara, Nutt. Bitternut.
23. Liquidambar styraciflua, L. Sweet gum

PLATE III.

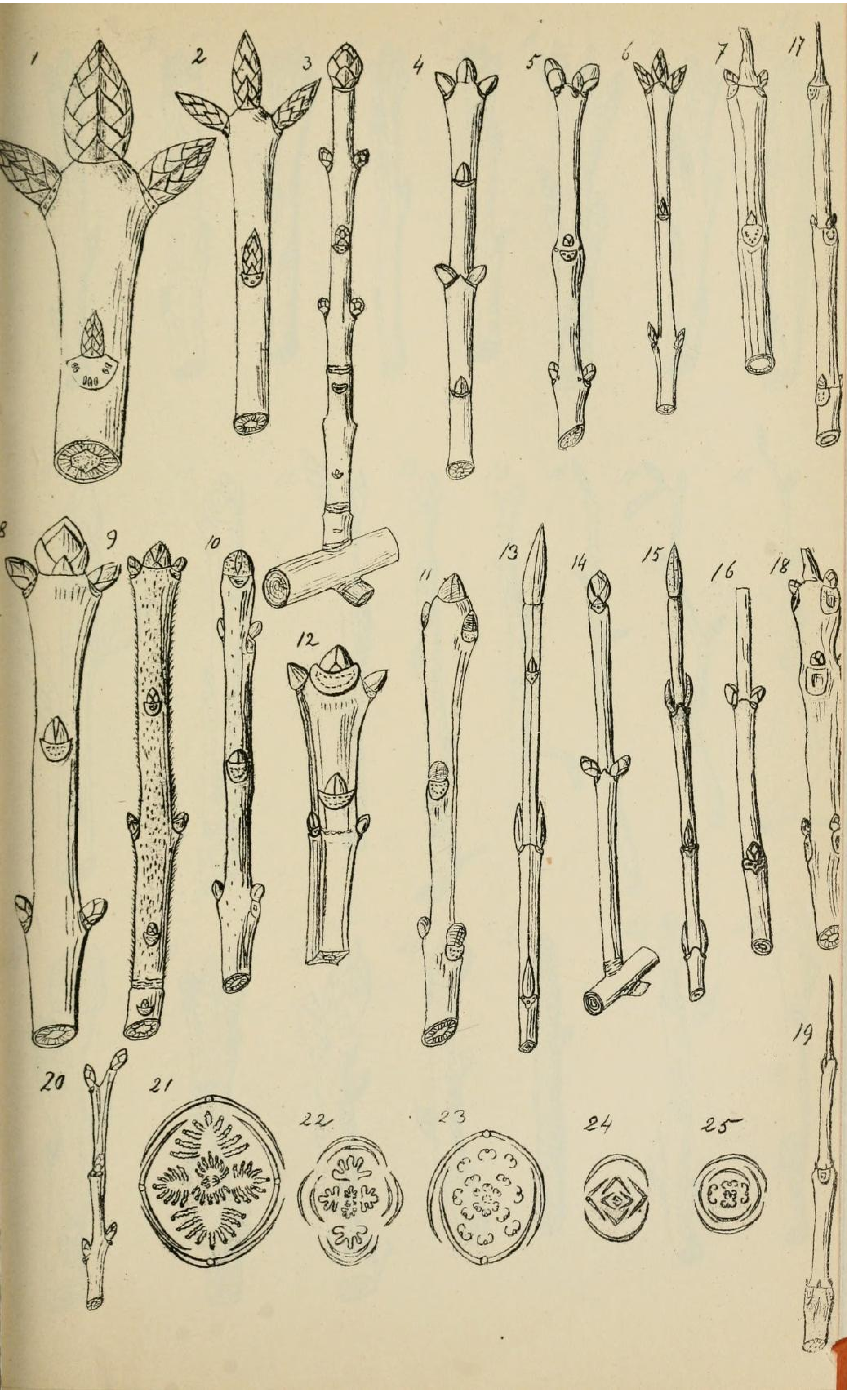
1. Gymnocladus canadensis, Lam. Coffee-bean tree.
2 Amorpha fruticosa, L. False indigo.
3. Platanus occidentalis, L. Sycamore.
4. Liriodendron tulipifera, L. Tulip tree, (or wrongly, yellow poplar.)
5. Dirca palustris, L. Leatherwood.
6. Nyssa multiflora, Wang. Sour gum.
7. Sassafras officinalis, Nees. Sassafras.
8. Lindera benzoin, Meisn. Spice bush.
9. Cornus alternifolia, L. Alternate-leaved cornel.
10. Rhus glabra, L. Smooth sumach.
11. Rhus toxicodendron, L. Poison ivy.
12. Rhus aromatica, Ait. Fragrant sumach.
13. Zanthoxylon americanum, Mill. Prickly ash.
14. Ptelea trifoliata, L. Hop tree.
15. Robinia pseudacacia, L. Locust
16. Gleditschia triacanthos, L. Honey locust.
17. Ribes rotundifolium, Michx. Wild gooseberry.
18. Ribes floridum, L. Black currant.
19. Crataegus tomentosa, L. Black thorn.
20 Prunus americana, Marsh. Plum.
21. Prunus serotina, Ehrh. Black cherry.
22. Pyrus coronaria, L. Crab apple
23. Amelanchier canadensis, Torr. & Gr. June berry.
24. Salix discolor, Muhl. Glaucous willow.
25. Betula nigra, L. Red birch.
26. Diospyros virginiana, L. Persimmon.
27. Ilex verticillata, Gr. Black alder.

PLATE IV.

1. Asimina triloba, Dun. Paw-paw.
2. Tilia americana, L. Linden.
3. Morus rubra, L. Mulberry.
4. Ulmus fulva, Michx. Slippery elm.
5. Ulmus americana, L. White elm.
6. Ulmus alata, Michx. Winged elm.
7. Celtis occidentalis, L. Hackberry.
8. Cercis canadensis, L. Red bud.
9. Hamamelis virginica, L. Witch hazel.
10. Celastrus scandens, L. Wax-work.
11. Ampelopsis quinquefolia, Michx. Virginia creeper.
12. Vitis riparia, Michx. Grape vine.
13. Smilax hispida, Muhl. Greenbrier.
14. Horizontal cut of the bud of Ulmus.

15. Horizontal cut of the bud of Celtis.
16. Horizontal cut of the bud of Populus.
17. Horizontal cut of the bud of Crataegus.
18. Horizontal cut of the leaf of Carya alba.
19. Diagram of the phyllotaxis of Quercus.
20. Diagram of the phyllotaxis of Juglans.
21. Diagram of the phyllotaxis of Ptelea.
22. Diagram of the phyllotaxis of Amorpha.

NOTE.—In these drawings the chief characteristics of these species are exposed, but it must not be expected that every specimen compared with the figure must exactly agree; there is much variation in the form of the leaf-scars within certain limits in the form of the buds, in the pubescence, etc. Not every twig of the hazel is so glandular hairy as the figure shows, not in every twig of the blue ash or burning bush, do we find the wings as in our figures, these are often only faint lines.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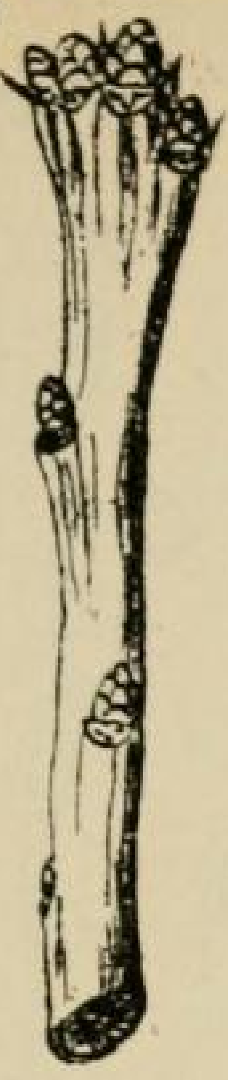

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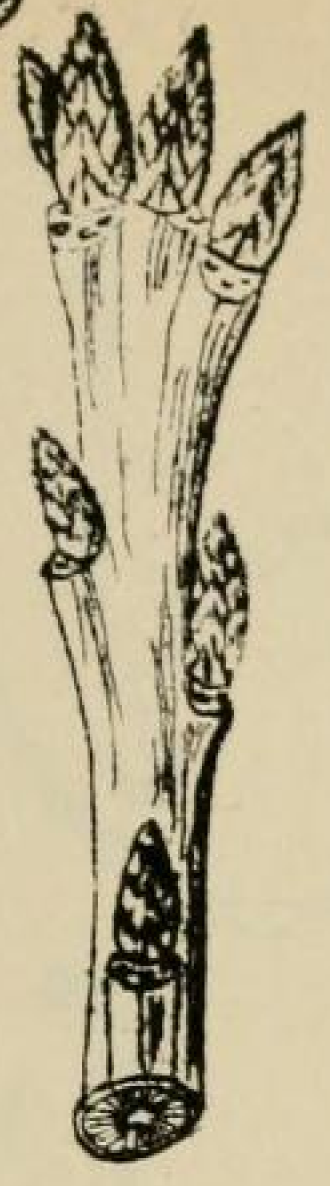

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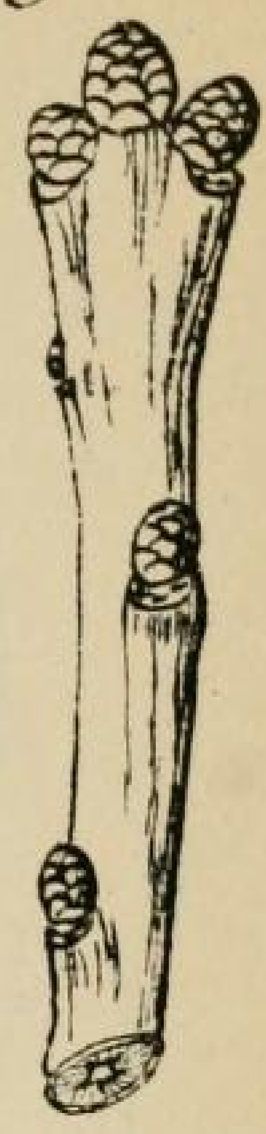

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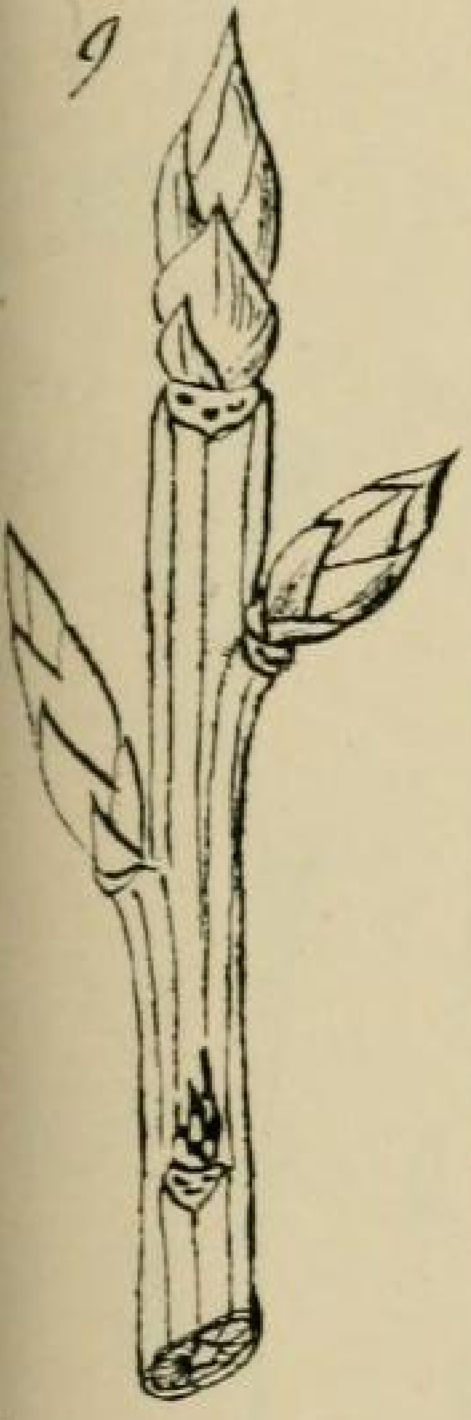

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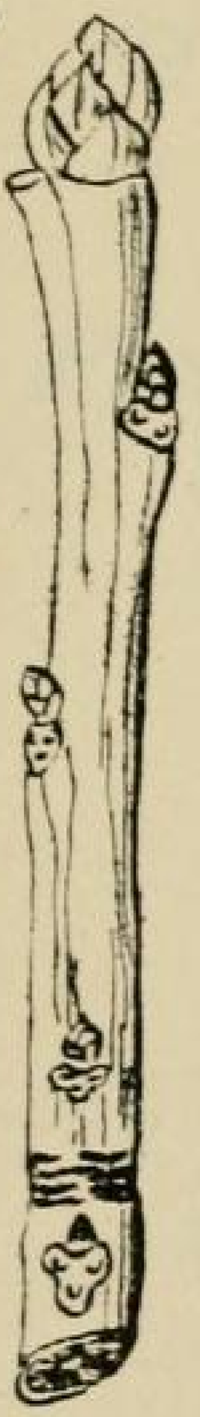

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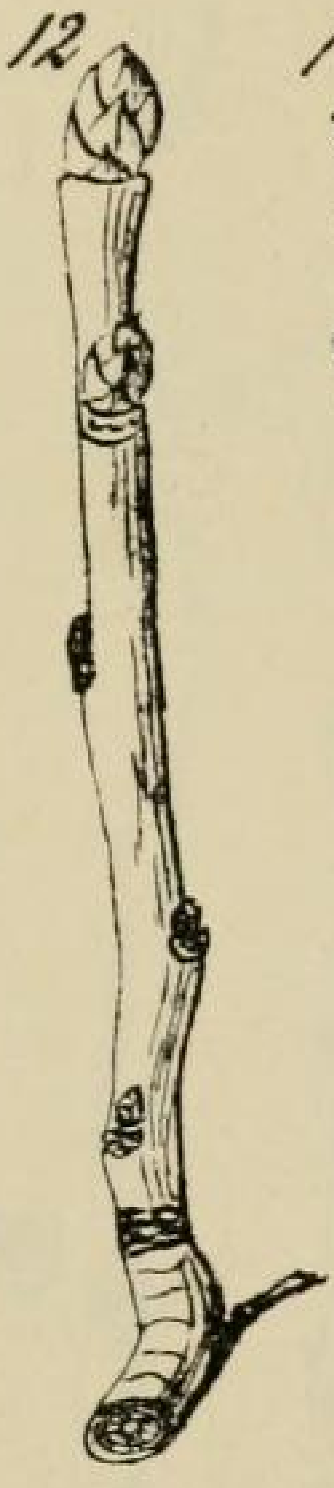

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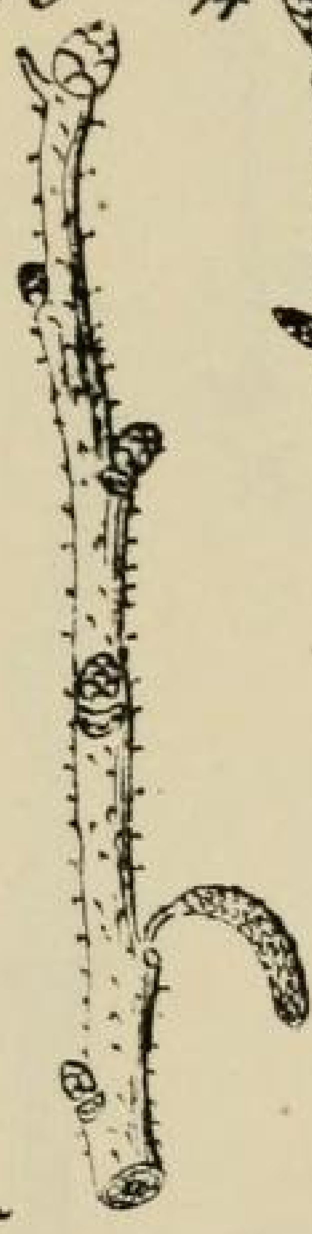

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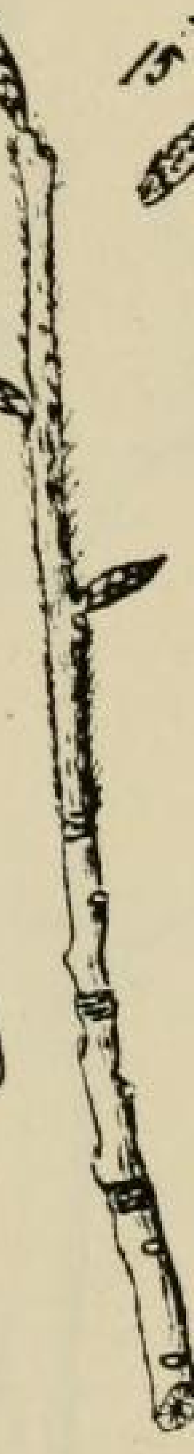

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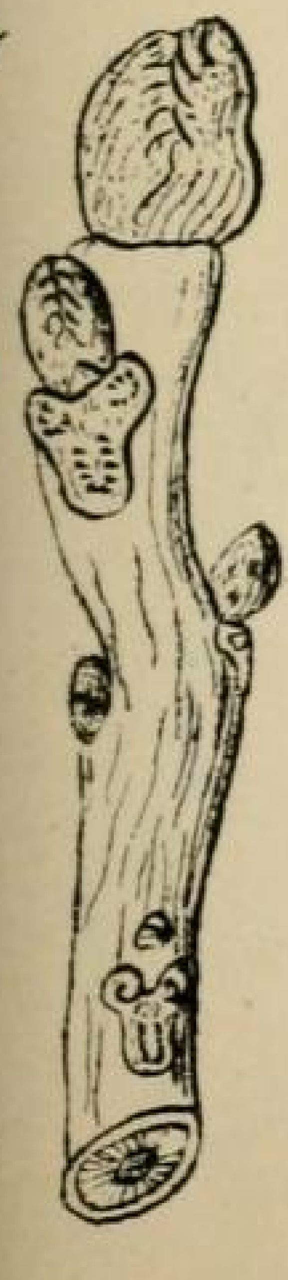

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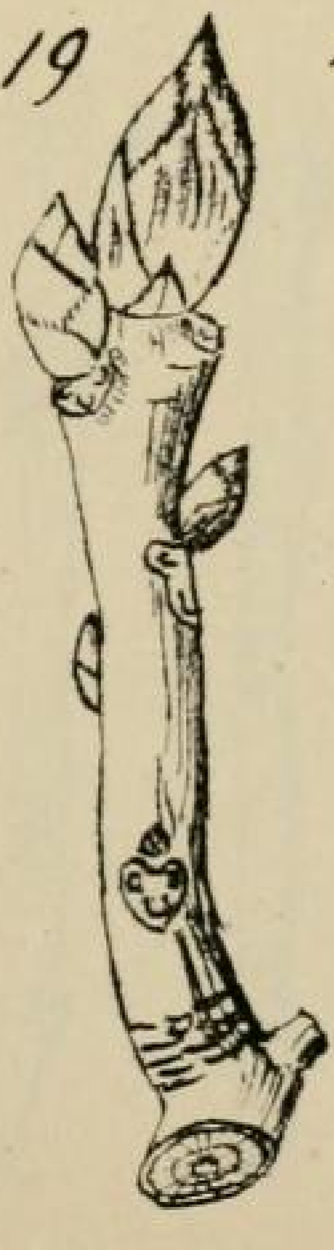

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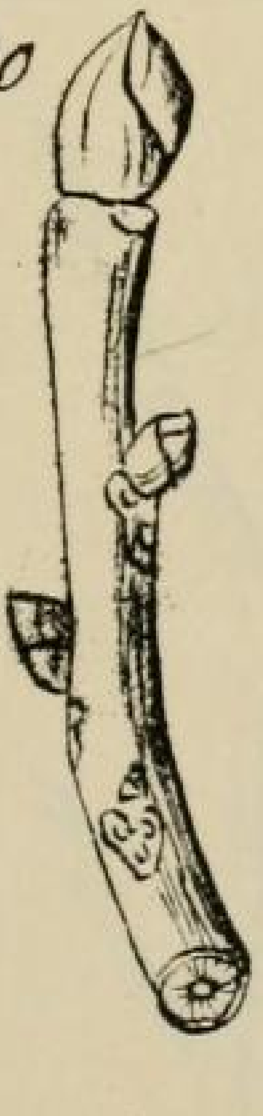

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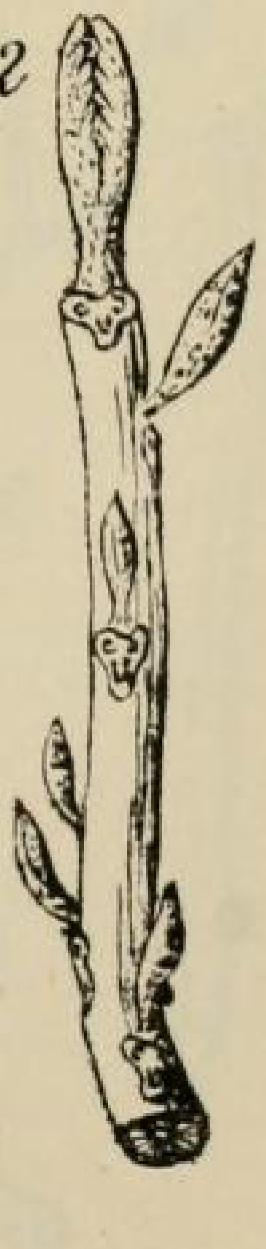

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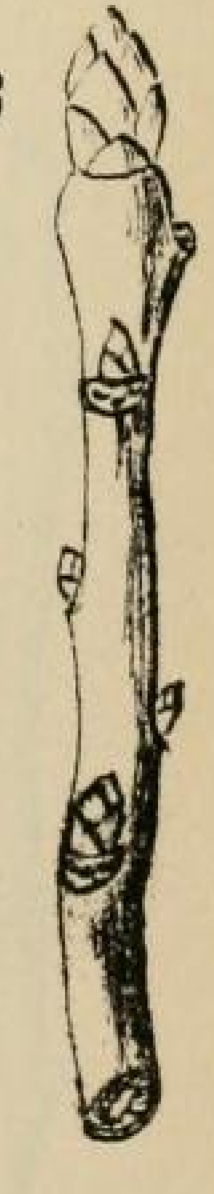

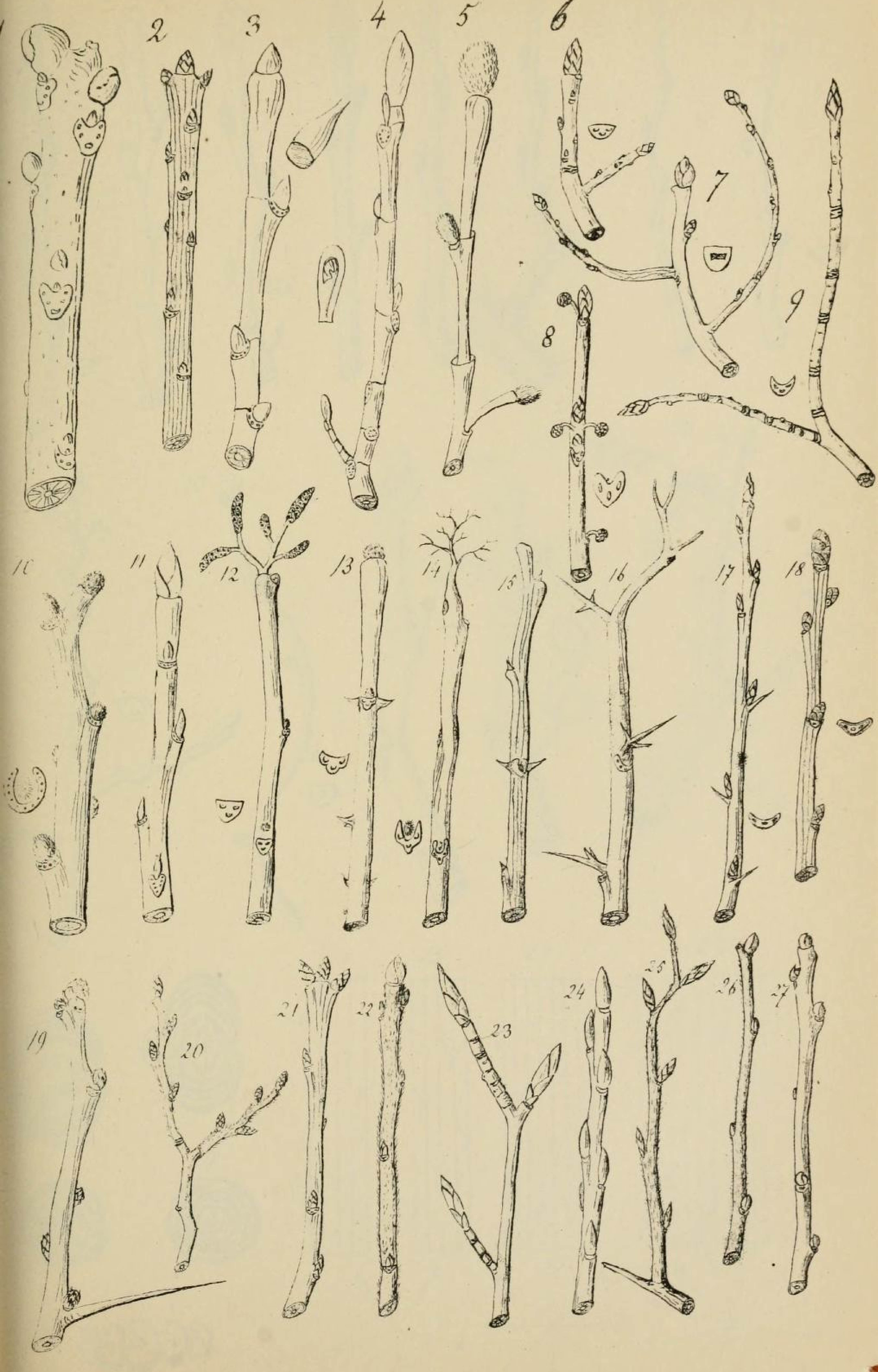
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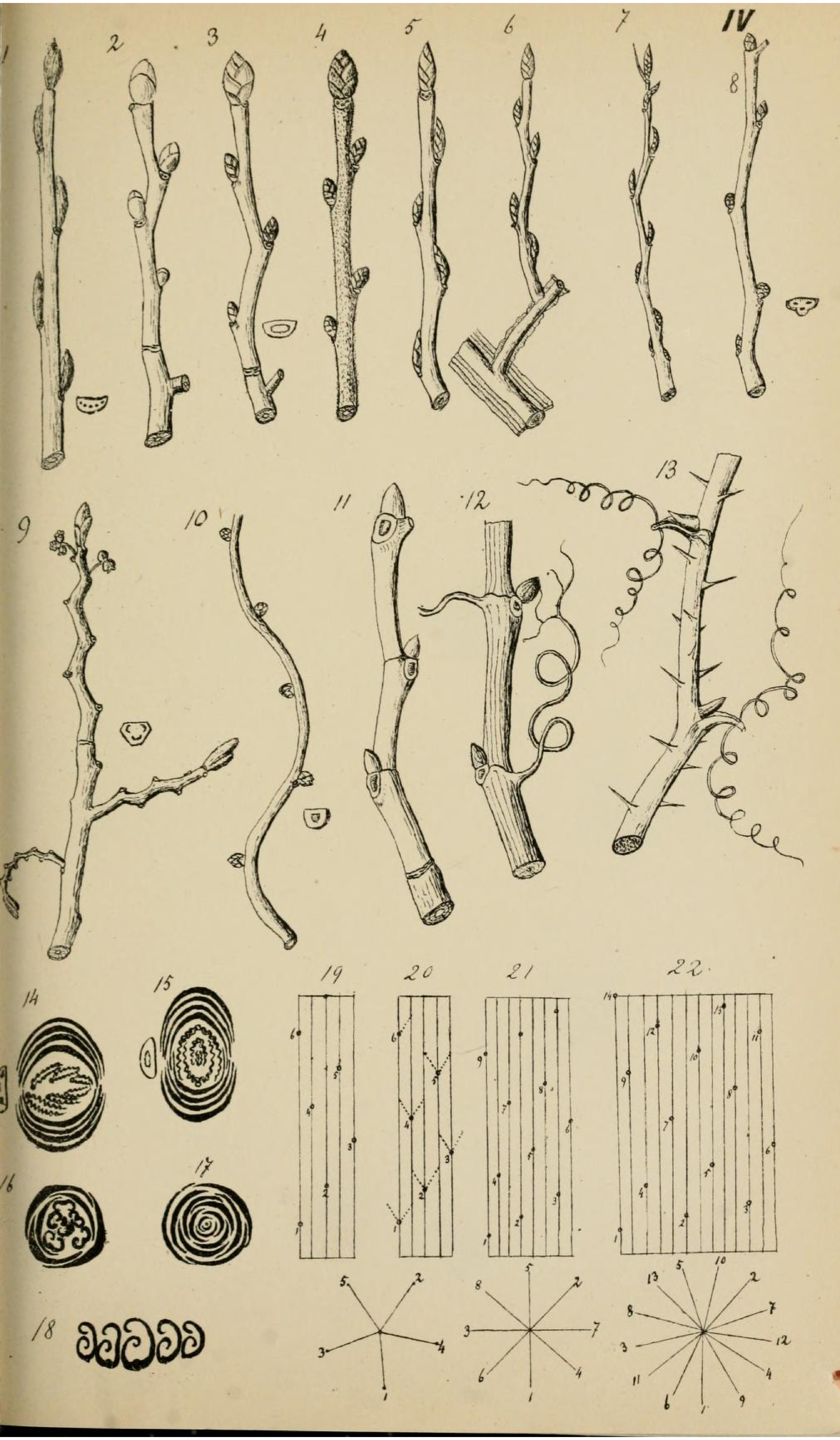
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ERRATA.

BULLETIN No. 1.

Page 33, line 5, after Report, read 1853 and '4.

Page 34, insert *Genus Poecilichthys, Ag.* between numbers 1 and 2.

Page 38, second line, for 2 1-6 read $2\frac{1}{6}$. Wherever, in this paper, two figures are separated by a hyphen, they should be written in the form of a common fraction.

Page 40, line 11, for *Aphredodereus* read *Aphredoderus*; under No. 40, for *gruuniens* read *grunniens*.

Page 44, No. 71, for *chrysochrous* read *chrysochloris;* for J. N. read J. W.

Page 45, No. 74, for E. L. read F. L.

Page 47, after 103 insert the following:—$103\frac{1}{2}$. *C. analostona, Grd.*, Silver-fin. Everywhere abundant through Central Illinois. Occurs less commonly further north.

Page 52, Note 2, for der read den; for Archiev. read Archiv.
Note 3, for des read der; for Wein read Wien.

Page 53, 8th line, for M. Bary read DeBary.
Note 7, for der (Brandpilze) read die.

Page 54, for *Peronosporiæ* read *Peronosporeæ.*

Page 55, 8th line, for *hauptoria* read *haustoria.*
14th line, insert (12) after six, and add one to each of the three reference numerals following.
5th line from bottom, omit (15).
2d line from bottom, insert (16) after Common.

Page 56, 10th line, 2d paragraph, instead of '75–6 read '74–5.
15th line from bottom, for pappillate read papillate.
11th line from bottom, for *Poltactis* read *Polyactis.*

Page 57, 7th line, for *Peronosporiæ* read *Peronosporeæ.*
21st line from bottom, insert European before vine.

Page 58, 8th line, for *Peronosporiæ Peronosporeæ.*
2d line, 2d paragraph, for 3 read 5.
7th and 8th lines, 2d paragraph, for one to three read twelve to fifteen.
4th line from bottom, for *bignouioides* read *bignonioides.*

Page 68, No. 40, reduce Acridium differentiale, etc., to a synonym, and insert above it C. differentialis, Thos.

Page 72, Plate II, fig. 1, for *Melanispora* read *Melampsora.*

Page 73, Plate III, fig. 3, for 3 read 5.
Plate III, fig. 5, for 5 read 3.
Plate III, fig. 7, for Plycinidia read Pycnidia.
Plate IV, fig. 12, for *fresii* read *friesii.*