EXPERIMENT STATION

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BOTANICAL DEPARTMENT.

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FIFTH REPORT ON KANSAS WEEDS - - - VEGETATIVE PROPAGATION OF PERENNIAL WEEDS.

Plants propagate by means of seed or by means of vegetative sprouts. In the present bulletin are given the results of some investigations upon the underground parts of our perennial weeds and their methods of vegetative propagation. Our perennial weeds may be divided into two classes, those which propagate vegetatively and those which do not. The first class may propagate by two distinct methods, roots and stems.

PROPAGATION BY CREEPING ROOTS.

Plants which propagate by means of creeping roots have the power to produce buds upon the roots at indefinite points. The buds called adventitious buds, develope into stems and these stems may become independent plants by the decay of the connecting root. The following weeds propagate by running roots.

Sumac (*Rhus glabra.*)
Perennial Rag weed (*Ambrosia psilostachya)*
Pasture Thistle (*Cnicus undulatus)*
Indian Hemp *(Apocynum cannabinum.)*
Milk weed *(Asclepias Cornuti.)*
Climbing Milkweed *(Enslenia albida.)*
Bindweed *(Convolvulus arvensis)*
Sheep Sorrel *(Rumex Acetosella.)*

The following form deep vertical roots and produce new stems from adventitious buds at the top, but do not propagate extensively, often only one stem appearing from the deep root:

Horse Nettle *(Solanum Carolinense.)*

Ground Cherries *(Physalis species.)*

Propagation by Creeping Stems.

The creeping stem may be above ground when it is called a stolon or it may be below the surface when it is called a rootstock or more technically a rhizome. The only plant among our weeds which propagates by stolons is Buck Bush *(Symphoricarpos vulgaris.)*

More commonly the propagation is by means of rootstocks. A rootstock can be distinguished from a root by the presence upon its surface of leaf scales at definite intervals, the nodes. The new stems spring from buds at the nodes and the roots usually occur at the nodes though in some cases they are scattered all along the rootstock. Our weeds which propagate by rootstocks are:

Poison Ivy (*Rhus Toxicodendron.*)
Wild Rose (*Rosa Arkansana.*)
Elderberry (*Sambucus Canadensis.*)
Golden Rod (*Solidago serotina.*)
Golden Rod (*Solidago Canadensis.*)
Ironweed-Sunflower (*Helianthus grosse-serratus.*)
Maximilian's Sunflower (*Helianthus Maximiliani.*)
Wild Artichoke (*Helianthus tuberosus.*)
White Morning Glory (*Convolvulus sepium.*)
Smart Weed (*Polygonum Muhlenbergii.*)
Nettle (*Urtica gracilis.*)
Nut Grass (*Cyperus esculentus.*)

Two in the above list form tubers at the end of the rootstocks which preserve the species over winter and produce new shoots the following season.

Wild Artichoke (*Helianthus tuberosus.*)
Nut Grass (*Cyperus esculentus.*)

Weeds which Form a Crown.

Many of our weeds form a thick crown near the surface of the ground, but do not send out creeping propagating stems or roots. The crown lives from year to year each season sending out new stems near the base of the old ones. The crown gradu-

ally enlarges and by the decay of connecting parts may sooner or later form separate plants. In some cases the buds are adventitious upon the top of a thick root, sometimes the buds are lateral on the old stems near the base. The crown-forming weeds are as follows:

Yellow Wood Sorrel *(Oxalis corniculata.)*
Red Root *(Ceanothus ovatus.)*
Wild Senna *(Cassia Marilandica.)*
IRON WEED *(Vernonia Baldwinii.)*
GOLDEN ROD *(Solidago rigida.)*
OX EYE DAISY *(Chrysanthemum Leucanthemum.)*
DANDELION *(Taraxacum officinale.)*
WHITE VERVAIN *(Verbena urticaefolia.)*
BLUE VERVAIN *(Verbena stricta.)*
CATNIP *(Nepeta Cataria.)*
MOTHER WORT *(Leonurus Cardiaca.)*
PLANTAIN *(Plantago Rugellii.)*
RIB GRASS *(Plantago lanceolata.)*
WILD FOUR-O'CLOCK (*Oxybaphus nyctagineus.*)
POKEWEED *(Phytolacca decandra.)*
PATIENCE DOCK *(Rumex Patientia.)*
PALE DOCK *(Rumex altissimus.)*
CURLED DOCK *(Rumex crispus.)*
PASPALUM *(Paspalum Setaceum.)*
DROP-SEED GRASS *(Sporobolus cryptandrus.)*
ERAGROSTICS *(Eragrostis pectinacea spectabilis.)*

The dandelion ordinarily produces buds from the roots, but if the top is cut off adventitious buds readily form at the upper end and thus renew the stems. Rib Grass or English Plantain also forms buds in this way. Some of the others in this list may do the same but they have not been observed to produce buds from cut roots as the experiment was not tried

METHODS FOR KILLING PERENNIAL WEEDS

Perennial weeds are much more difficult to eradicate than annuals or biennials. In the case of annuals and usually of biennials death results if the plant is pulled up either by hand or by tools, but perennial plants are broken off leaving a portion in the soil which soon sends up new shoots.

Weeds Forming a Crown. The perennial weeds which form a crown but do not produce rootstocks or creeping roots can be killed by cutting off below the crown provided they do not pro-

duce buds from the cut portion as does the Dandelion. This cutting must be deep enough to reach below the knotty portion any part of which is likely to send out new buds.

It will be observed that most of the weeds of this kind (compare the preceding list) are pasture weeds, that is they are native prairie species which persist in wild pasture land, and not being eaten by stock, tend to increase at the expense of the grass. Of this kind, we have Red Root, Iron weed, Golden-rod, White Vervain, Blue Vervain. A few others are found in neglected spots, such as fence corners. These are not troublesome. Among these are Catnip, Motherwort and the Docks.

The three grasses of the list are troublesome only in sandy soil and can be easily dug out as they do not form a strong crown.

Pokeweed and Wild Four-o'clock are usually not troublesome but in some localities are quite abundant In eradicating these it should be remembered that the root is large and deep seated (See Plate X. Figs. 52 and 55.) The other weeds of this category are troublesome in lawns and tame pastures in the eastern part of Kansas. One of them, the Yellow Wood Sorrel, rarely becomes particularly troublesome, but the other four are often among our worst weeds. These are Ox-eye Daisy, Dandelion, Plantain, Rib Grass. They are not difficult to kill individually but from their occurence in grass land they are difficult to kill in the aggregate. In lawns they must be cut out by hand. In tame pastures they can be exterminated by plowing up the land and putting in a crop requiring hoeing or cultivating. All four propagate abundantly from the seed but only the Daisy and Rib Grass become troublesome in pastures.

Weeds with Creeping Under Ground Parts. As already stated these creeping portions may be roots or stems but the method of eradication would be the same in both cases.

These include our worst weeds when considered from the standpoint of difficulty of eradication. Some in the list, though hard to kill, do not become very troublesome, such as Milkweed and Indian Hemp. Even these in certain localities or under particularly favorable conditions may become noxious. The following are worthy of special mention: Perennial Ragweed, Pasture Thistle, Bindweed, Sheep Sorrel and Smartweed. The first two are found only in pastures of wild grass. It does not pay to dig them out. The grass will usually hold its own against these unless grazed too closely Close grazing is what gives all pasture

weeds a chance. Pasture Thistle cannot be killed by cutting off below the crown. (See special description, No. 19.)

Sheep sorrel, though a vile weed in some parts of the United States, does not become as troublesome here in Kansas. The other two species, however, namely, Bindweed and Smartweed have established themselves in several localities through eastern Kansas. Smartweed is rarely troublesome except in moist or undrained soil. Here it often "takes the land." In many cases the crop which this weed is supposed to have driven out would not grow if the Smartweed was not there. It is recommended to drain the land and sow some close crop such as alfalfa. The Smartweed probably does much less damage to crops than its abundance would lead one to suppose.

The Bindweed is one of the worst weeds we have. Fortunately it is established in comparatively few places. It should be eradicated as soon as discovered and before it has had time to spread. Probably the best way is to cover the patch with straw or some other covering which will exclude the light, to a depth sufficient to smother it. Just how long the roots would retain their vitality under these conditions has not been determined but probably not more than one full season.

It must be borne in mind that the cultivation of soil containing weeds with creeping under ground parts tends to spread the weed rather than to kill it. The roots or rootstocks are broken into pieces and carried away to fresh soil and then may strike root.

The principle upon which one must act in eradicating such weeds is this: *It is necessary to the life of the plant that some green leaves be formed in order to produce food for the under ground parts.* If this production of foliage can be prevented for long enough period the plant must die. Covering the plant or patch of plants with a deep mulch will accomplish this purpose. Or continually cutting off the green foliage as fast as it appears above the ground will do equally as well. But it is difficult to do this thoroughly. Before one is aware a few leaves have unfolded to the sun and the plant has obtained a new lease of life. Plants may be destroyed by chemical means such as strong solutions of salt, lye, acids, etc., but none of these have any advantage over a careful mulch and have the disadvantage of injury to the soil.

Feeding Weeds to Stock.

Many weeds are liked by certain kinds of stock for food. Of all

kinds of stock, sheep are probably the most valuable as weed eaters. If the weed to be eradicated is liked by sheep the easiest way to exterminate it is to keep a few head of sheep confined on the patch. They eat off the green foliage as fast as it appears and so starve the plant to death. Hogs are, said to eat the Bindweed.

SPROUTS PRODUCED FROM PIECES OF ROOTS.

In order to test the ability of root cuttings to produce adventitious buds, pieces of roots of several species of weeds were planted in sand during the summer and fall of 1897 and the results noted. Some rootstocks (rhizomes) were also tried.

GROUND CHERRY *(Physalis longifolia.)* Four inch pieces sprouted in thirteen days each sending out four to five buds. Three inch pieces, two out of three sprouted sending out two to six buds-one decayed. All the two inch pieces sprouted sending out four to six buds. All the one inch pieces sprouted sending out one to, four buds. A seven inch piece taken five feet from surface of ground sprouted six buds. The last two feet of a root except the last six inches cut into four pieces from three to eight inches long all sprouted three to six buds. A side root eighteen inches long sprouted two buds. Pieces cut one-eighth inch long failed to sprout. All pieces cut one-half inch long sprouted. Pieces one-fourth inch long, three out of four failed to sprout. The limit of size of piece seems to be between one-fourth and one-eighth inch.

GROUND CHERRY *(Physalis lanceolata.) Rootstocks.* Three inches of rhizome having two bud scales sent out one sprout. Two inches of rhizome having but one bud scale out of the axils of which the growing plant had been broken, sent out two sprouts. One-half inch of rhizome having bud scale sent out plant from axil of bud scale. Five inches of rhizome having three bud scales sent up one. plant from near upper end. Four inches of rhizome having five bud scales sent forth two plants. Three inches of rhizome having one bud scale sent up one plant. Piece of rhizome one-half inch long and without bud scale calloused but refused to sprout. Piece of rhizome one inch long having no bud scale did not sprout. The tip of a rhizome one-half inch long sent up a plant. Four pieces of rhizome one-fourth inch long, all decayed. Three one inch pieces of rhizome without bud scales, all refused to sprout.

Roots: A piece of root two inches long with two side branches each two inches long sent up three sprouts, one from main root and one from each of the branches. Three-inch pieces of root

sprouted one to two plants each. Two-inch pieces each sent out one plant, Of three one-inch pieces two sprouted sending up three plants and one refused to sprout. A piece of root five inches long with side branch four inches long sent out one plant while branch sent up three plants. Two pieces each two inches long sent up one plant, one of the pieces becoming decayed.

GROUND CHERRY *(Physalis Virginiana.)* Tips of roots growing five feet below surface of ground decayed. Two seven inch pieces of roots taken from lower part of root decayed. A piece of root twelve inches long taken from upper part of root decayed. A four inch piece taken from top of root decayed. A five inch piece, not far from top, sprouted sending out two plants. A six inch piece taken next below the last sprouted sending up two plants. A two inch piece adjoining the last sprouted one plant. A thirteen inch section next to tip of root did not sprout.

A three inch piece decayed. Of two one inch pieces, one sprouted the other decayed. Two pieces one-half inch each decayed. Four one-fourth inch sections all decayed, Two pieces of side roots decayed.

From this experiment this species would seem to be less able to produce buds upon the roots but the roots in all probability were not as vigorous as the average.

MILK WEED *(Asclepias Cornuti.)* Two-inch pieces taken six inches below surface of ground all sprouted four to six buds' each. A piece of root twelve inches long with side root fourteen inches long sprouted-main root five buds, side root three buds. Tmo-inch pieces taken promiscuously from any part of root all sprouted sending four to five buds. Two out of three one-inch pieces sprouted. Two out of three one-half inch pieces decayed. Four one-fourth inch pieces taken further down the root all decayed. Three one-fourth inch pieces taken with buds already developed when put into the sand, all started. Three one-inch pieces having no visible buds, sprouted two out of three.

PASTURE THISTLE *(Cnicus undulatus)* A one inch piece of tuber (tuberous root) sent out two plants. Two half-inch pieces of tubers sprouted two plants each. Two two inch pieces of tubers each sprouted, one sending out three plants, the other four plants. Three one inch pieces each sprouted one plant. A two inch piece partly decayed sent out three plants. A whole root of plant was cut into seven pieces and all but one sprouted one piece sending out two plants. Of three half-inch pieces two sprouted and one

decayed. (These above were grown in the summer and fall.) During November and December another experiment was started to see how many sprouts a tuber would produce when the same are broken off from time to time. Put into sand Nov. 15th. Seven tubers produced forty-three sprouts and were in a perfectly preserved condition on Jan. 1st when the experiment was discontinued. Seven connecting roots three or four slightly enlarged near where broken off produced seventy-seven sprouts. These were also in good condition when thrown out.

BINDWEED *(Convolvulus arvensis.)* *Roots:* A piece two and a half inches long taken three feet from plant sent up six sprouts. Two three inch pieces less than three feet from plant each sprouted, one sending up three plants and the other five. Three four inch pieces containing no buds sent up respectively ten, five and four plants each. Three five inch pieces, two containing buds, taken from near the plant sprouted, two sending up nine and the other eight plants each. Three two inch pieces containing buds sprouted respectively, one, two and three plants. Four half inch pieces two having buds, each sent up one sprout. Three one-fourth inch pieces having buds each sent up a plant. Later in the season, ten pieces each one inch long were put into sand and each had sprouted in twenty-one days. Eight pieces two inches long sprouted. Three pieces six inches long sprouted.

Rootstocks: Three pieces each one inch long with buds sprouted three, three, and two plants. Three pieces one-half inch long each sent up one plant (had buds). Three two inch pieces, two sprouted two plants each and one decayed. Four one-fourth inch pieces with buds, two sprouted and two decayed. Later planted ten rhizomes each five inches long and each had sprouted in twenty-one days.

CLIMBING MILK WEED *(Enslenia albida.)* A perpendicular root over six feet long was cut into pieces of various lengths and put into the sand to sprout, Oct. 15, 1897. The sprouts were broken off at various times and the following is the total number of sprouts taken from each piece. Three three inch pieces taken from upper part of root beginning three inches from the surface of the ground sprouted respectively six, eight and ten plants. One six inch piece produced eleven sprouts. A piece four and one-half inches long produced seven sprouts, seven inches long, seven sprouts, four inches long taken thirty inches below surface of ground, eleven sprouts. A piece four inches long sent up seven

sprouts; five and one-half inches, eight sprouts; seven and one-half inches, seven sprouts; eight inches, four sprouts; two and three-fourths inches, two sprouts; three inches, four sprouts; five inches, three sprouts; five inches long and last part of root sent four sprouts. This whole root, about seventy-five inches long, sent up a total of ninety-nine sprouts and the roots were plump and well preserved when the experiment was discontinued, Jan. 1, 1898. This vertical root was much more responsive to conditions of growth than a horizontal root p1aced in the same bed.

To test for size of pieces a horizontal propagating root was used which grew in the ground at an average depth of ten inches from the surface. Ten pieces one-half inch long were used and these rotted. Ten three inch pieces all ro tted. Nine six inch pieces all rotted.

Believing that the above root was injured in some way before planting, a second trial of the same kind of a root was begun, Nov. 15th. Ten half-inch pieces were used, eight had sprouted, Jan. 1st. Ten one inch pieces, seven sprouted. Ten two inch pieces, each sprouted. Six pieces, each six inches long, all sprouted, three of them having two sprouts each.

These roots when taken out of sand, Jan 1st, were all vigorous and plump. This experiment proves that both horizontal and vertical roots of *Enslenia albida* produce sprouts, the vertical being the more vigorous and responsive.

DANDELION *(Taraxacum officinale.)* Whole root cut off one inch below surface of ground from Nov. 15th to Jan. 1st, produced twelve sprouts. Cut off two inches below surface, produced fourteen sprouts. Cut off three inches below surface, produced ten sprouts. Cut off four inches below surface, produced sprouts, Dec. 6th, that were not counted. Cut off five inches below surface, produced sprouts, Dec. 6th, not counted. Cut off eight inches below ground calloused and started buds but was destroyed by insects.

BIB GRASS *(Plantago lanceolata.)* Cut off one-half inch below surface of ground, Nov. 27, 1897. On Jan. 1, 1898, there were two good sprouts. Cut off one inch below surface, produced five sprouts and most of them on the small side-roots that had been cut. Cut off one and a half inch below surface, commenced to sprout in three places but died.

JERRUSELUM ARTICHOKE *(Helianthus tuberosus.)* Tubers put in Nov. 13th were developing nicely, Jan. 1st.

DESCRIPTIONS OF THE UNDERGROUND PARTS OF SEVERAL WEEDS.

1. OXALIS CORNICULAT A, L. (Yellow Wood Sorrel.)

The root is perennial, sending out new shoots each year from buds at the top. The stems often become prostrate and root at the nodes. Not a troublesome weed.

Plate I. Fig. 1. Root and a few prostrate branches, 1/4 natural size. Some of the branches have taken rootat the nodes. The top of the root shows a fem dead stems of the previous year.

2. CEANOTHUS OVATUS, Desf. (RedRoot.)

A thick woody root,, often branching at the top, stem woody. The roots are particularly adapted to growth on stony his, insinuating themselves into the cracks and crevices, hence it becomes particularly troublesome on upland stony pasture land.

Plate I. Fig.2. A root 1-12 natural size. The protuberances are the scars of older stems.

3. RHUS GLABRA, L. (Smooth Sumac.)

Propagation by extensively creeping rather slender roots which produce adventitious buds abundantly.

Plate I. Fig. 3. Several plants connected by a creeping root, 1-48 natural size (from sketch by Mr. Clothier.)

4. RHUS TOXICODENDRON , L. (Poison Ivy.)

Propagation by creeping underground stems. These rootstocks are usually close to the surface.

Plate I. Fig. 5. The base of n plant of the climbing varieq with its numerous root stocks as seen from above, that is the rootstocks shown were in a horizontal plane, 1-12 natural size. Fig. 4. several stems of the shrubby variety (Poison Oak) connected by rootstocks [from photograph by Mr. J. B. S. Norton.]

5. MELILOTUS ALBA , Lam. (White Sweet Clover.)

Plant biennial not propagating vegetatively. Drawing shows buds at end of first season's growth.

Plate I. Fig. 6. Upper portion of root of one season's growth showing buds. Taken in the autumn, natural size.

6. CASSIA MARILANDICA , L. (Wild Senna.)

No vegetative propagation. Root perennial, the new shoots coming from buds near the base of the old one. Only locally troublesome.

Plate III. Fig 15. Root ½ natural size. The longer stem is growth of the present season. The shorter one is the stem of the previous year.

7. ROSA ARKANSANA , Porter. (WildRose.)

Propagates extensively by creeping rootstocks, or underground stems. Here and there new shoots arise from buds in the axils of scales on the rootstock, forming thus a new plant.

Plate II. Fig. 7. Diagram showing the system of rootstocks 1-24 natural size. The side branches are mostly roots. Fig. 8, a portion of a small rootstock is shown natural size. Fig. 9. a portion of a large one is shown in which a lateral rootstock has started, ½ natural size. These two latter mere horizontal.

8. SAMBUCUS CANADENSIS , L. (Elderberry.)

Propagation by creeping root-stocks or underground stems, much as in the preceeding but the rootstocks not so slender nor so extensively creeping.

Plate II. Fig. 10. An upright rootstock, with two horizontal branches, each producing a plant at the apex, ½ natural size.

9. SYMPHORICARPOS VULGARIS, Michx. (Buck Bush.)

Propagates extensively by stolons. The stolons are prostrate leafy branches which creep along the surface of the ground for a few feet and then strike root forming a new plant.

Plate III. Fig. 13. Lower part of plant with two stolons, each with a young plant at the apex 1-6 natural size.

10. VERNONIA BALDWNII , Torr. (IronWeed.)

The root stocks are large, knotty and tangled from intertwining branches. Consequently the plants occur in bunches, and all those in a bunch are usually connected.

Plate II. Fig. 12. A portion of a mass of rootstocks ½ natural size. The smaller fibres are roots. The knots are the scars of old stems. Fig. 11. A root stock taken in autumn showing buds natural size.

11. SOLIDAGO SEROTINA , Ait. (Golden-rod.)

Rootstocks slender, usually quite numerous, forming plants at their extremities.

Plate III. Fig. 14. A plant with five rootstocks, ¼ natural size. Two of th new plants are shown. The others also bore plants but are not shown. These were all taken in the summer,

and the rootstocks were formed the previous year. The second drtiting represents a rootstock taken in autumn. The rootstocks are formed in autumn and produce plants at the extremities the following spring; ½ natural size.

12. SOLIDAGO CANDENSIS, L (Golden-rod.)

The rootstocks are similar to the preceding but are stouter.

Plate IV. Fig. 22. Lower portions of plants connected by rootstocks, ½ natural size.

13. SOLDAGO RIGIDA, L. (Golden-rod.)

This plant does not produce rootstocks but forms a stout caudex or upright root, with each season's stems formed from buds produced at the base of the old ones. Thus the plant grows in compact bunches.

Plate III. Fig. 16. Lower portion of plant showing three new stems and several old ones, ½ natural size.

14. AMBROSIA PSILOSTACFIYA, DC. (Perennial Ragweed.)

Propagates from slender creeping roots, which send up plants at short intervals from adventitious buds. The new propagating roots are sent out in the fall from the old plants above the propagating root of the previous season.

Plate IV. Fig. 18. A root with two plants, 1/2 natural size. Fig. 19. A plant which has produced a propagating root with three young stems sprouting; 4 natural size. Fig. 20. Showing plants connected by roots. (Last from photograph by Mr. J. B. S. Norton.)

15. HELJANTHUS GROSSE-SERRATUS, Mart. (Sunflower.)

Root-stocks slender and often very numerous.

Plate IV. Fig. 21. A plant with rootstocks taken in autumn 1/4 natural size, at the left is the rootstock of the previous year which connected this plant with the others. The plant was taken from the periphery of a patch. It is noticeable that the new rootstocks all turn away from the center.

16. HELIANTHUS MAXIMILIANI, Schrad. (Sunflower.)

Rootstocks short and usually thickened at the base of the new plant.

Plate III. Fig. 17. A plant with three rootstocks, ½ natural size.

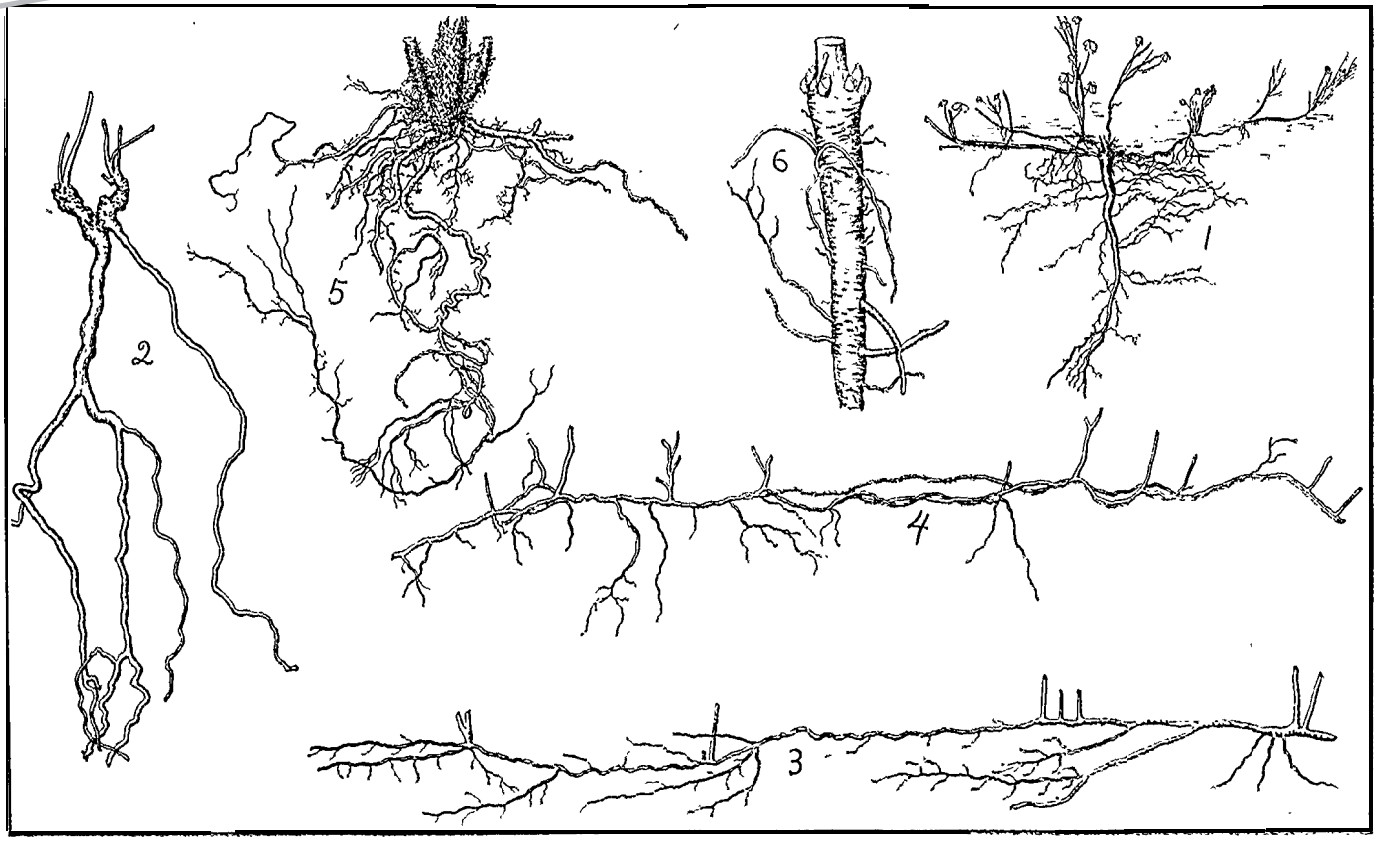

PLATE I. ROOTS AND ROOTSTOCKS.

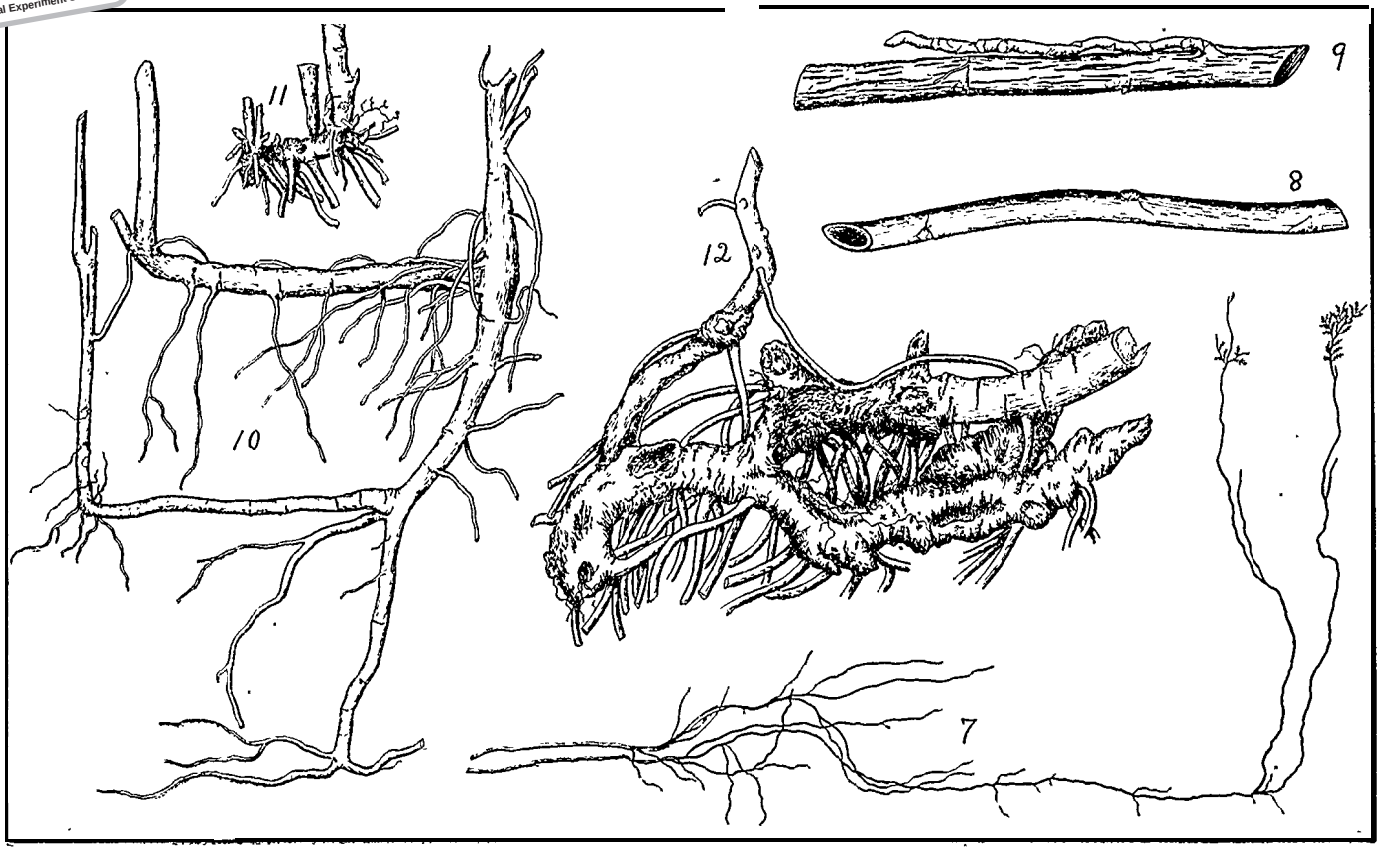

PLATE II. ROOTSTOCKS.

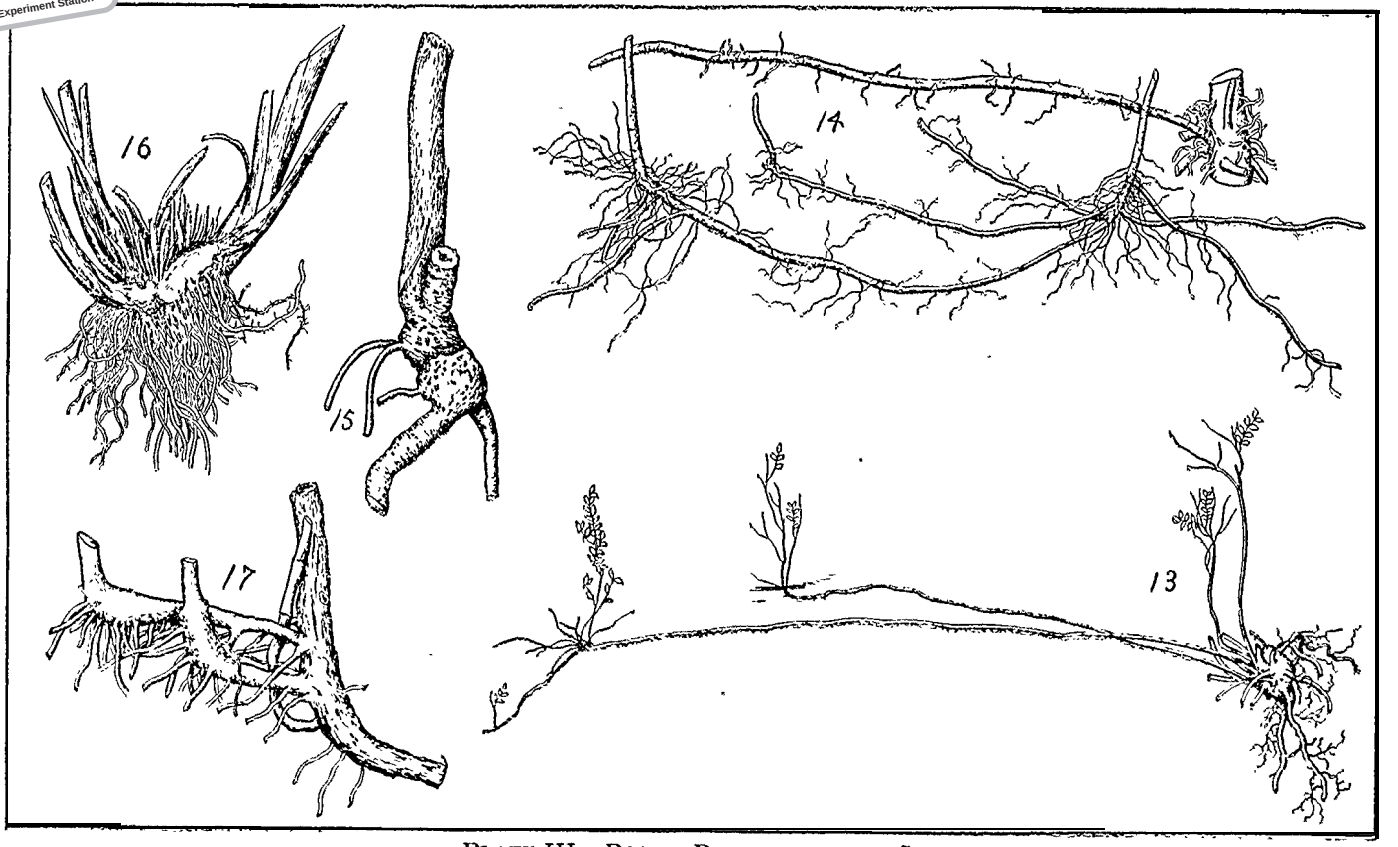

PLATE III. ROOTS, ROOTSTOCKS AND STOLONS.

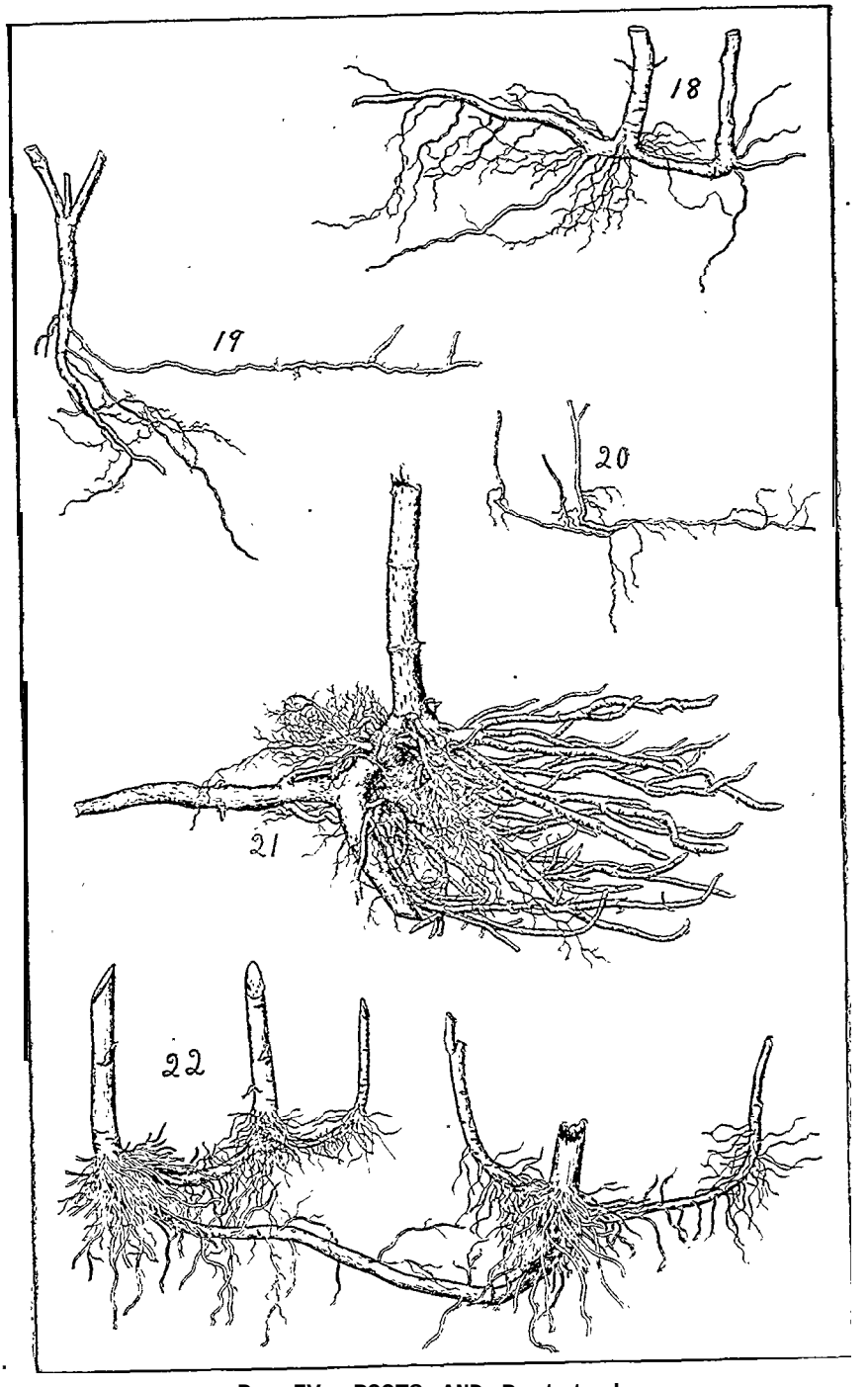

PLATE IV- ROOTS AND Rootstocks-c

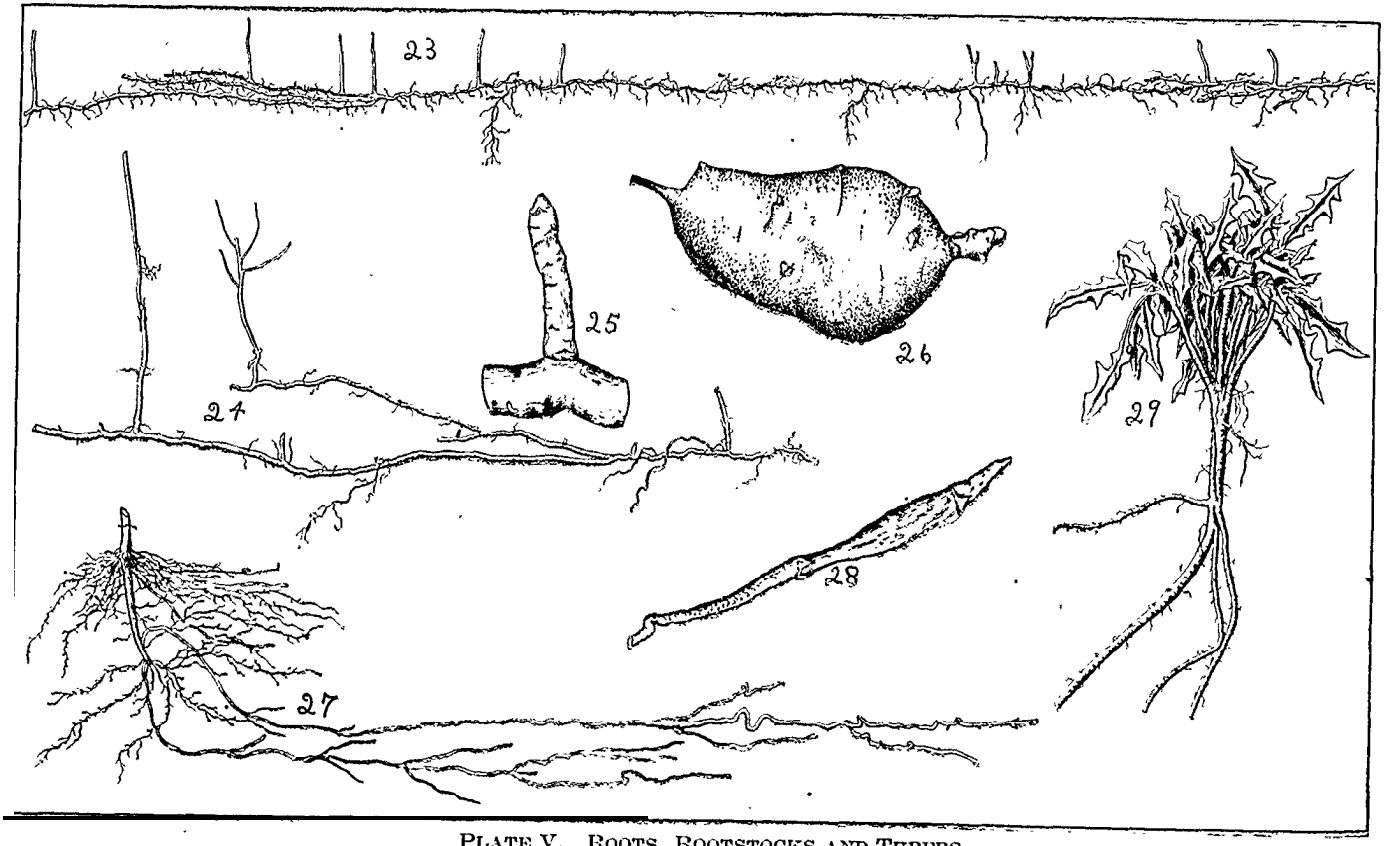

PLATE V. ROOTS, ROOTSTOCKS AND TUBERS.

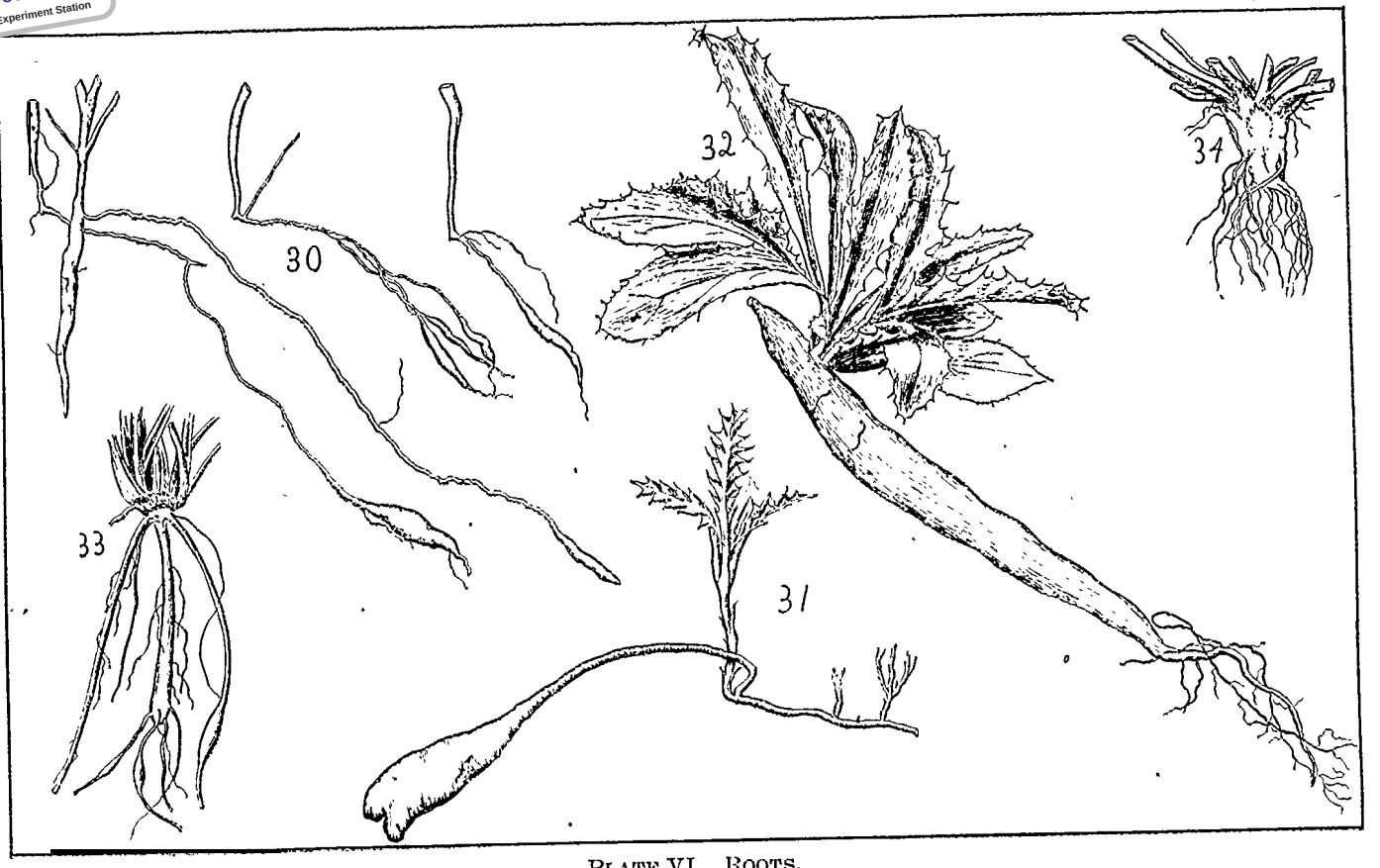

PLATE VI. ROOTS.

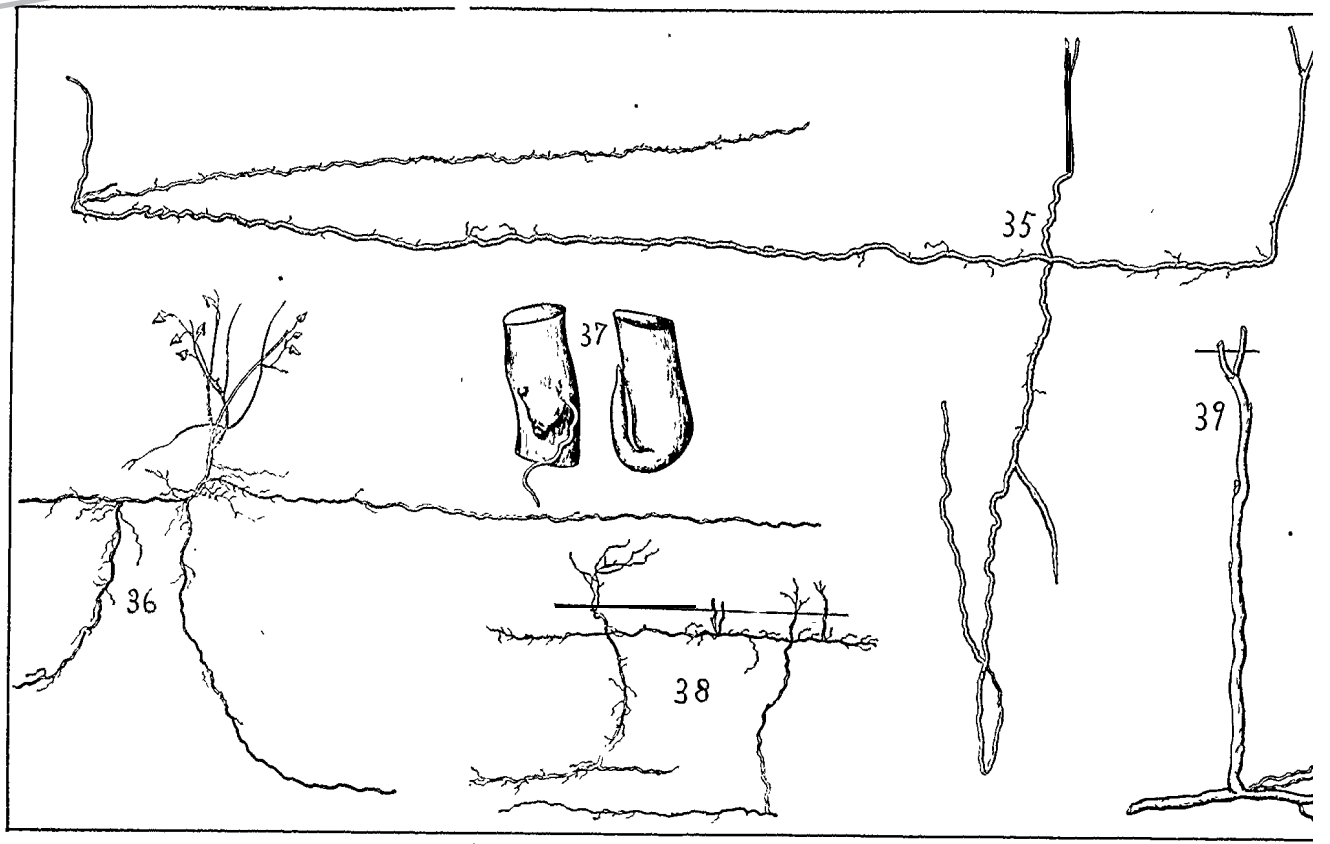

PLATE VII. ROOTS AND ROOTSTOCKS.

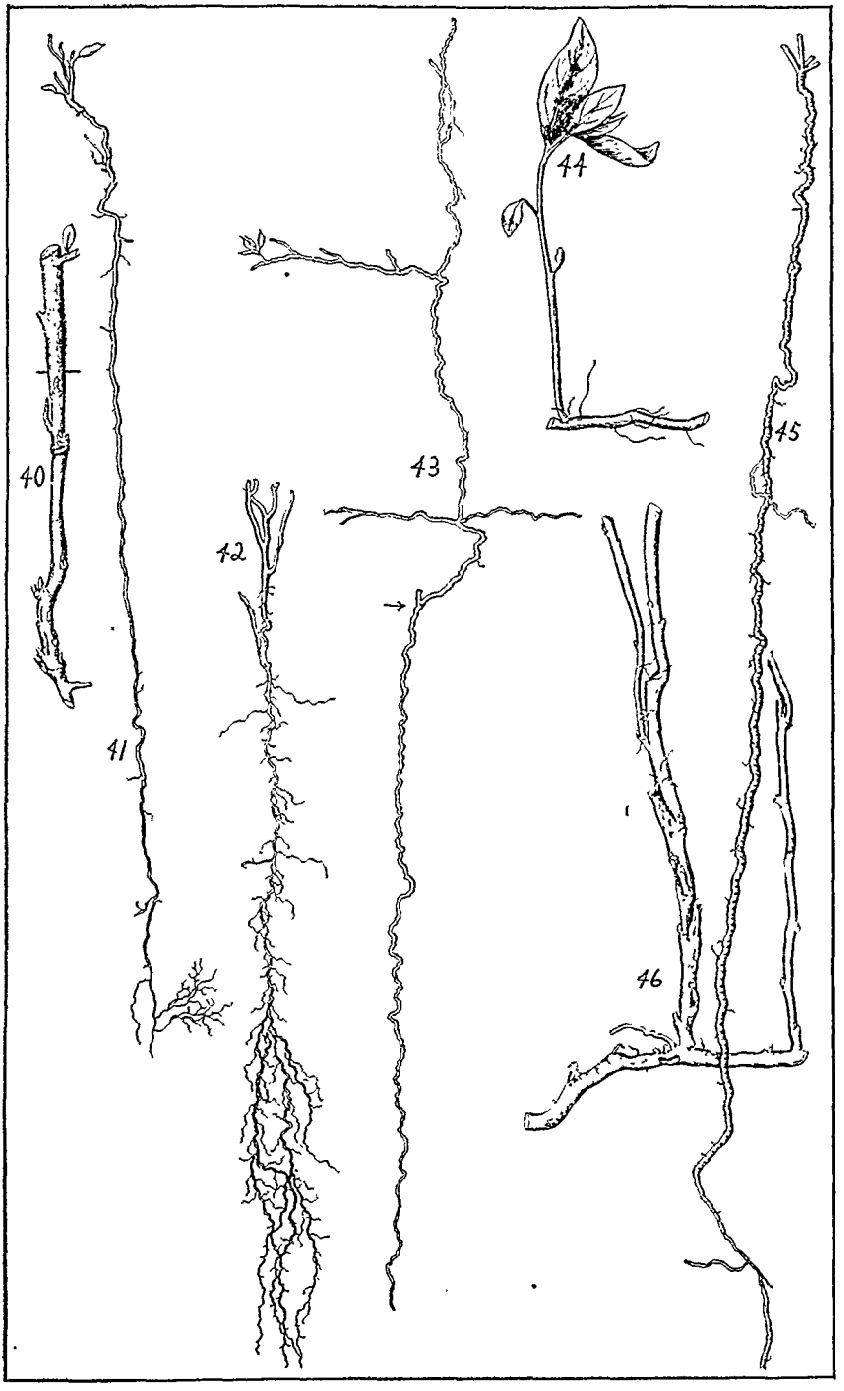

PLATE VIII. ROOTS.

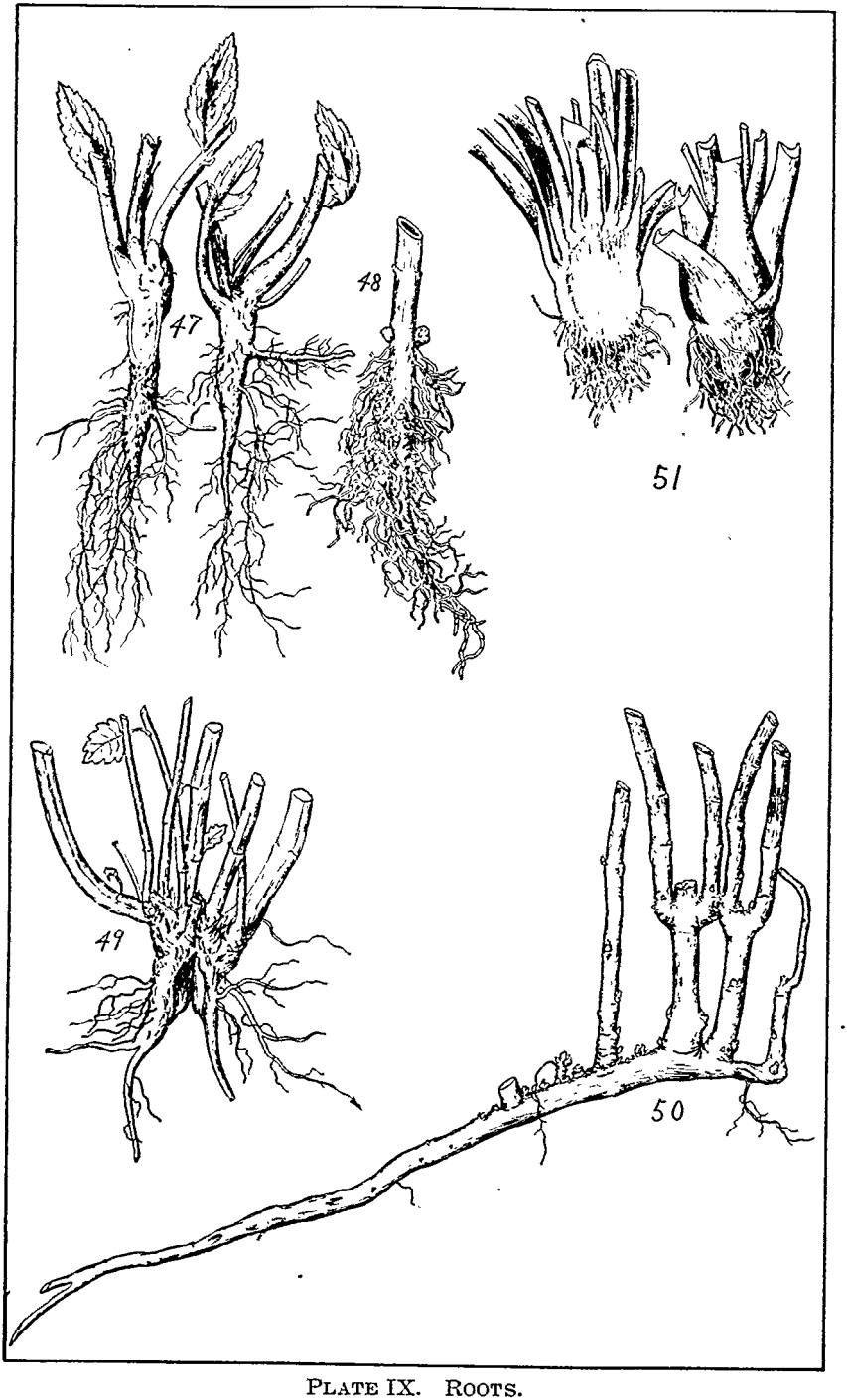

PLATE IX. ROOTS.

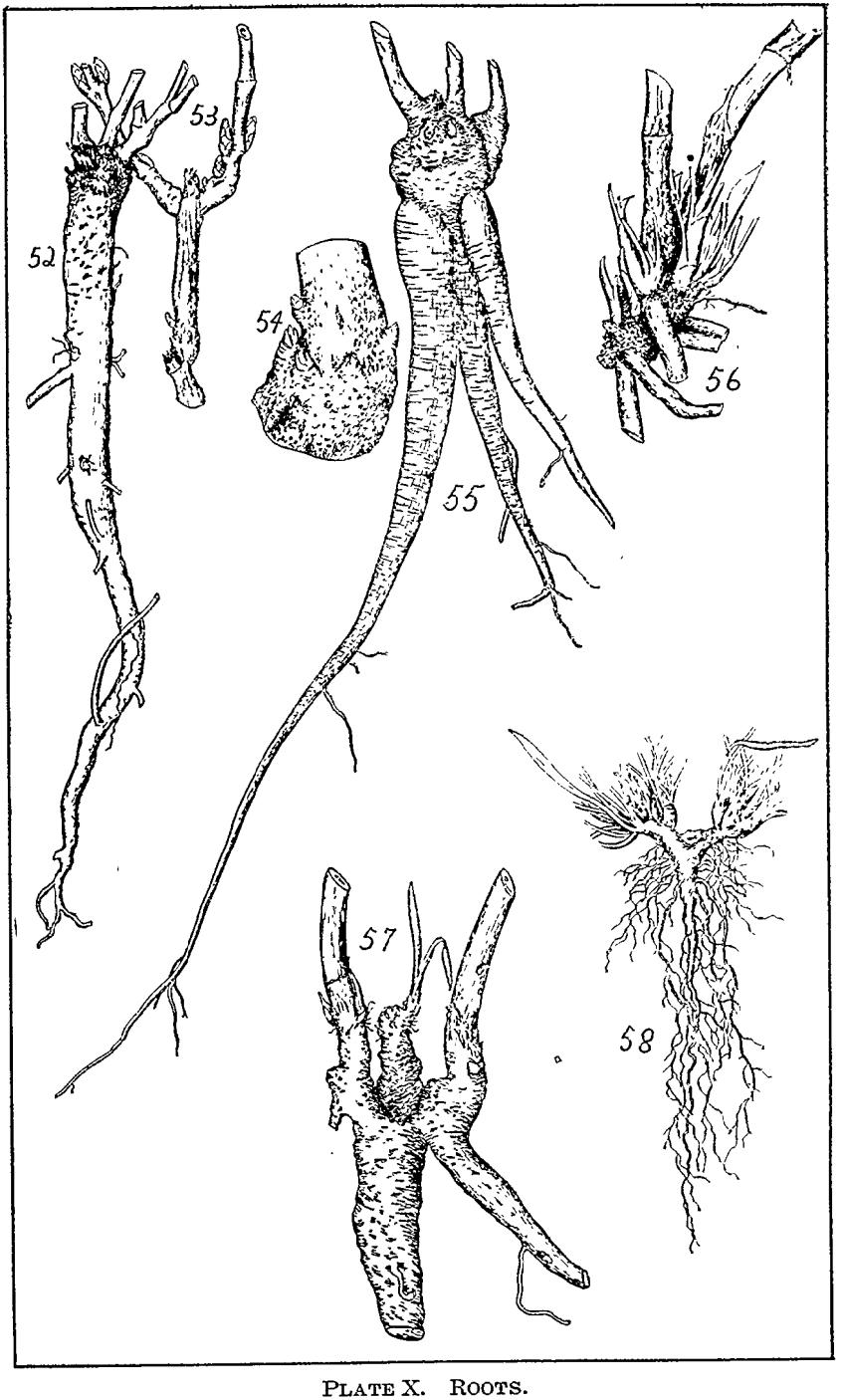

PLATE X. ROOTS.

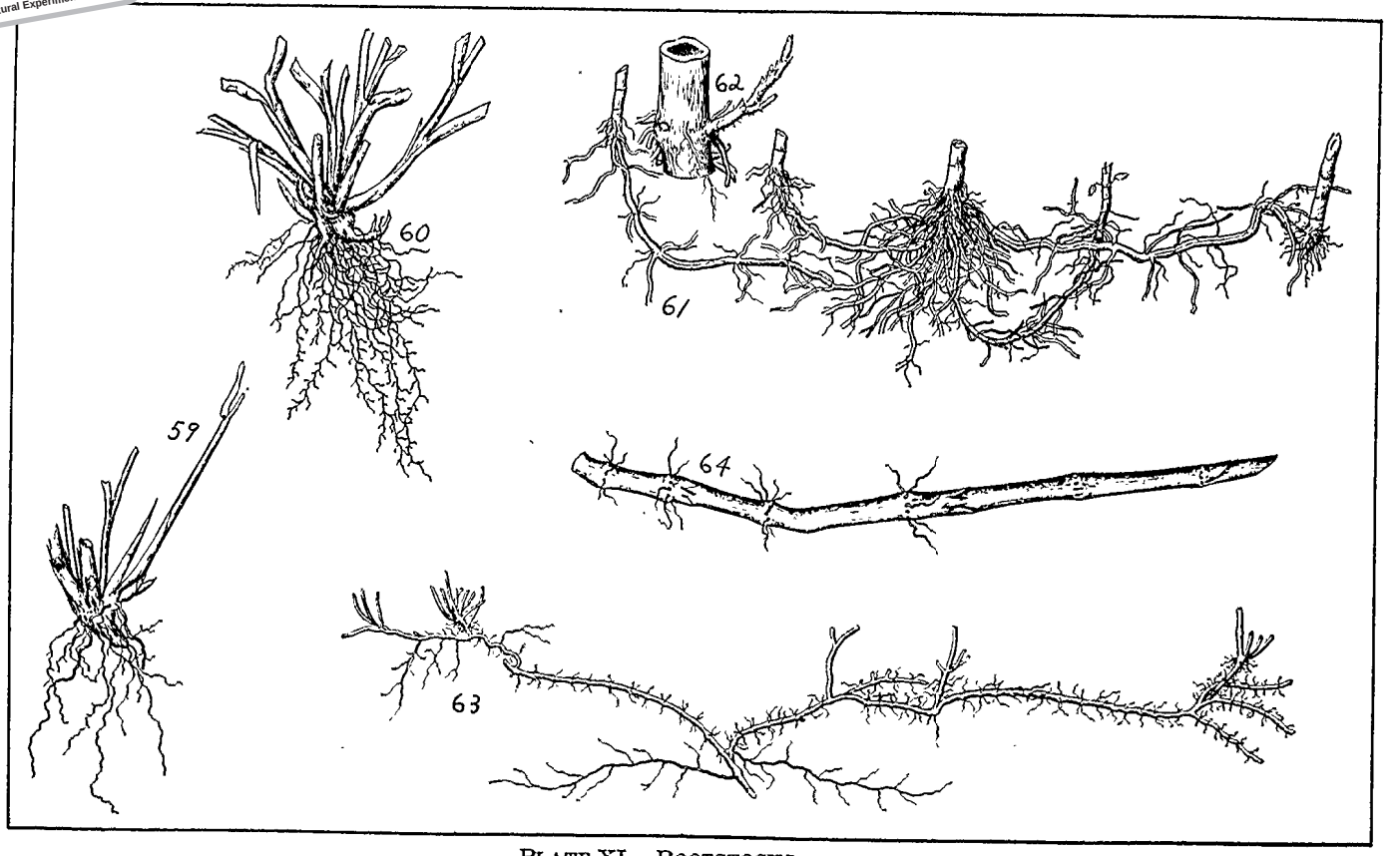

PLATE XI. ROOTSTOCKS.

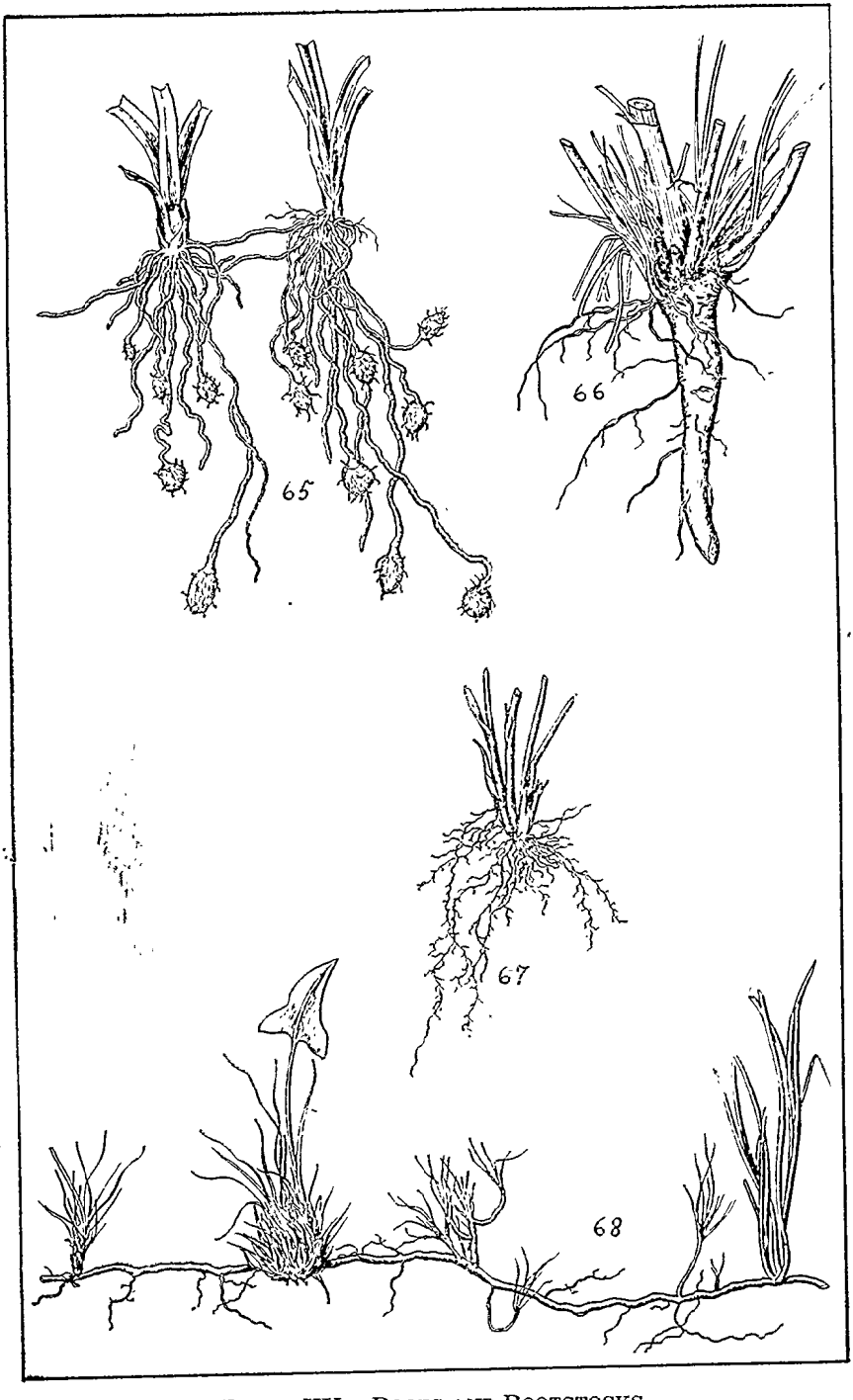

PLATE XII. ROOTS AND ROOTSTOCKS.

17. HELIANTHUS TUBEROSUS , L. (Wild Artichoke.)

Rootstocks extensively creeping and often at some distance below the surface of the soil. At the extremity they form tubers, known as artichokes. These store nourishment and produce plants the following spring. The rootstocks die in the autumn leaving the tubers isolated.

Plate 5. Fig. 27. A plant with two long rootsto1ks l-12 natural size. Fig. 28. A tuber about half grown is also shown ½ natural size, and Fig. 26 a full grown tuber with new stems just starting, natural size.

18. CHRYSANTHEMUM LEUCANTHEMUM, L. (Ox-eye Daisy.)

Plant forming a thick crown, at the top of which new stems appear yearly.

Plate VI. Fig. 34 A crown with some new stems and several old ones, ½ natural size.

19. CNICUS UNDULATUS, Gray, (Pasture Thistle.)

Roots slender and creeping, enlarging at the extremity into a spindle shaped tuber (tuberous root). These tubers serve as store houses over winter. New plants are formed by the production of adventitious buds upon a slender root or upon a tuber.

Most of our thistles are biennial, a rosette of leaves being formed one season and a flowering stem the next This species however is perennial and extensively spreading by means of these creeping roots and its tubers. For this reason the plant cannot be destroyed by cutting it off at the crown for this only excites the roots to the production of numerous adventitious buds which soon grow up into new plants. If cutting the plant is attempted it must be perseveringly continued as fast as new stems appear until the roots are exhausted.

Plate VI. Fig. 31. A tuber and portion of a creeping root with three young plants taken in autumn, ¼ natural size. Fig. 32. A tuber which had been planted in damp sand in summer, showing the formation of a plant, 1/2 natural size. Fig 30. Four plants with tubers attached, reduced, (from photograph by Mr. J. B. S. Norton.)

20. CNICUS ALTISSIMUS, Willd. (Tall Thistle)

Plate VI. Fig. 33. A sketch of a plant taken the first season showing the tendency to form tuberous roots for the storage of nourishment, ¼ natural size.

21. TARAXACUM OFFICINALE, Weber, (Dandelion.)

Root upright often branching at the upper part, each branch ending in a rosette of leaves. In old plants there is a second or third series of branching. Certainly the upper part of the system of branches and probably all, is stem formation, while the remainder is root. It is difficult to distinguish the older part of the stem from root. The root when cut has the power to form buds. (See under the head of "Sprouts produced from pieces of roots.")

Plate V. Fig. 29. Whole plant, showing several branches to root, ¼ natural size.

22. APOCYNUM CANNABINUM, L. (Indian Hemp.)

Propagating by extensively creeping horizontal roots, which produce at irregular intervals adventitious buds.

Plate V. Fig. 23. A diagram of a root 29 feet in length with several stems attached. At the left hand it was old and rotten, at the right hand side it was broken off before the end was reached, (from sketch by Mr. Clothier 1-48 natural size). Fig. 24. Another drawing illustrates a portion of a creeping root, 1-12 natural size. And a third drawing Fig. 25, shows a small piece of root from which a stem has started, natural size.

23. ASCLEPIAS CORNUTI, DC. (Milkweed.)

Propagates from a thick more or less creeping root, which sends out stems at short intervals. One plant showed adventitious buds two feet below surface. Another showed a bud four feet from plant and on root only 1/8 inch in diameter.

Plate IX. Fig 50. A root with several stems and adventitious buds, three of the stems are two years old. The first year's growth died off a short distance below the ground and the second year's growth came from lateral buds just below this; l-6 natural size.

24. ENSLENLA ALBIDA, Nutt. (Climbing Milkweed.)

Propagates by adventitious buds from slender extensively creeping roots. These roots may run in a horizontal or a vertical direction.

Plate VII. Fig. 35. Two plants connected by a horizontal root, six feet long. Another plant with a vertical root extending to a depth of seven feet, (the lower part doubled back in the drawing.) l-6 natural size.

25. CONVOLVULUS SEPIUM, L. (White Morning Glory.)

Propagates by slender underground stems. These stems are formed from a few to as much as two feet below the surface. They are white and very fragile. The roots usually spring in pairs from the base of the scales.

Plate VII. Fig. 36. A plant with a horizontal and two decending rootstocks, l-12 natural size. Fig. 37, also a portion of a rootstock showing a small leaf or scale with a root on one side, and a rootstock showing the apex turned under for protection while pushing through the soil, twice natural size.

26. CONVOLVULUS ARVENSIS, L. (Bindweed.)

Propagates by means of slender creeping roots, extending horizontally several inches below the surface. Stems are sent up at intervals from this. The buds on these stems often produce new stems and give the impression that the plant propagates by rootstocks.

Plate VII. Fig. 38. Three specimens showing horizontal creeping roots with the vertical stems. In one the creeping root is over a foot below the surface, l-12 natural size. Fig. 39. A portion of a creeping root with a vertical shoot, natural size.

27. SOLANUM CAROLINENSE, L. (Horse Nettle.)

Root slender and usually extending vertically to a depth of four or five feet Stems are produced above from adventitious buds.

Plate VIII. Fig. 42. A root with plant near top, l-12 natural size. Fig. 44 A sprout from a section of root planted in sand, ½ natural size.

PHYSALIS (Ground Cherries.)

In the three species studied there is a deep seated slender root similar to Horse Nettle. In old plants the stem portion extends to considerable depth and is variously branched. The new stems may come from the rootstocks or from the roots.

28. PHYSALIS VIRGINIANA, Mill.

Plate VIII. Fig. 41. A plant from a vertical root, l-12 natural size. Fig. 40, the upper or stem portion of another specimen natural size to show the leaf scales and buds.

29. PHYSALIS LANCEOLATA, Michx.

Plate VIII. Fig. 43. An old plant. The portion below the

arrow is root, while that above is stem as shown by the leaf scales. The leafy stem grew out from a bank; l-12 natural size.

30. PHYSALIS LONGIFOLIA, Nutt.

Plate VIII. Fig. 45. A vertical root l-12 natural size. This specimen extended down nine feet. Fig. 46, the upper portion from another specimen showing two stems growing out of the root, 1/2 natural size.

31. VERBENA URTICAEFOLLA, L. (White Vervain.)

Apparently the root is short-lived for most specimens showed no indication of a previous season's growth. Others showed buds forming to continue the growth the following season.

Plate IX. Fig. 48. A root with buds, taken in autumn, ½ natural size.

32. VERBENA STRICTA, Vent. (Blue Vervain.)

No vegetative propagation. Tap root forming a crown throwing out new stems, from near the base of the old.

Plate IX. Fig. 47. Two roots showing new stems (with leaves) coming from outside of the dead stems. One is cut to show the relation, ¼ natural size.

33. NEPETA CATARIA, L. (Catnip.)

No vegetative propagation: a strong crown is formed, producing new stems from near the base of the old.

Plate IX. Fig. 49. A plant with several fresh stems and the remains of others formed in previous years, ½ natural size.

34. LEONURUS CARDIACA, L. (Motherwort.)

Root similar to Catnip.

35. PLANTAGO RUGELLII, Decaisne. (Plantain.)

Plant forms a thick cylindrical crown, the lower portion of which bears numerous fibrous roots. From the upper portion leaves are produced. Each year the crown grows a little higher and dies off somewhat at the lower end. No vegetative propagation.

Plate IX. Fig: 51. A crown cut lengthwise showing two views, ½ natural size.

36. PLANTAGO LANCEOLATA, L. (Rib Grass.)

Plant forms a short-lived perennial root, more or less branching at crown. The new rosettes of leaves form near the base of

the old. No vegetative propagation. (See "Sprouts produced from pieces of routs.")

Plate X. Fig. 58. A root showing a two year old scar of an old rosette at the fork of the two branches. The two branches had scars of the previous season, while the small rosettes were formed during the present season, ¼ natural size.

37. OXYBAPHUS NYCTAGINEUS , Sweet. (Wild Four O'clock.)

This plant forms a strong fleshy tap root which may extend three or four feet below the surface. The new shoots form near the base of the old ones or at various places along the side of the root near the top. No vegetative propagation.

Plate X. Fig. 52. A tap root with scars of old stems at crown, ¼ natural size. Fig. 53, a root taken in autumn with buds upon the root and also upon the base of two stems, ½ natural size.

38. PHYTOLACCA DECANDRA, L. (Pokeweed.)

Forms a large fleshy tap root which frequently branches. New stems form at the crown which is a short distance below the surface of the ground. No vegetative propagation.

Plate X. Fig. 55. A root l-12 natural size. Fig 54, a crown with buds at base of old stem, ½ natural size.

39. RUMEX PATIENTIA, L. (Patience Dock.)

Forms a fleshy somewhat branched tap root with new stems formed from the crown. No vegetative propagation.

Plate X. Fig. 57. A root ¼ natural size.

40. RUMEX ALTISSIMUS, Wood. (PaleDock.)

Forms a tap root similar to Patience Dock.

Plate X. Fig. 56. A root ¼ natural size.

41. RUMEX CRISPUS, L. (Curled Dock.)

Forms a tap root similar to Patience Dock.

Plate XII. Fig. 66. a root ¼ naturalsize.

42. RUMEX ACETOSELLA, L. (Sheep Sorrel.)

Propagates by slender creeping roots which send up plants at intervals

Plate XII. Fig. 68. A creeping root with several plants, ½ natural size.

43. POLYGONUM MUHLENBERGII, Wats. (Water Smart Weed.)

Propagates by extensively creeping rootstocks. A pernicious weed difficult to eradicate.

Plate XI. Fig. 63. A system of rootstocks 1-24 natural size. [from sketch by Mr. Clothier.] Fig. 64. A portion of rootstock showing joints (nodes) ½ natural size.

44. URTICA GRACILIS, Ait. (Nettle.)

Propagates by rootstocks.

Plate XI. Fig. 61. Several plants connected by rootstocks, 1/8 natural size. Fig. 62. A young rootstock springing from the base of a stem, ½ natural size.

45. CYPERUS ESCULENTUS, L. (Nut Grass.)

Forms numerous rootstocks some of which form hard tubers at the extremity.

Plate XII. Fig. 65. Two plants connected by rootstock and showing numerous tubers, ½ natural size.

46. PASPALUM SETACEUM, Michx.

Plant forms a small crown, the new plants rather sparingly produced at the base of the old stems. No vegetative propagation.

Plate XI. Fig. 60. A plant with a new stem appearing at the left, ½ natural size.

47. SPOROBOLUS CRYPTANDRUS, Gray. (Drop-seed Grass.)

Similar to the preceding. The new stems form near the base of the old ones.

Plate XII. Fig. 67. A plant with a new stem starting at the left, ½ natural size.

48. Eragrostis PECTINACEA SPECTABILIS, Gray.
(Perennial Tickle-grsas)

Similar to the preceding.

Plate XI. Fig. 59. A plant with new stem starting at the right, ½ natural size.

The subject of the production of adventitious buds has been investigated by others, as shown by the following, in which our species are mentioned:

CASPARY ROB. Eine Wruke *(Brassica Naprus L.)* mit Laubsprossen auf Knolligen Wurzelausschlag. Schriften d. phys-oekonom. Gesellsch. zu Koenigsberg, Jahrg. XIV, 1873, S. 108-112.

[Ex Just. 1876 p. 437.] The author enumerates a number of plants which have the power to produce sprouts from roots, among which are the Dandelion *(Taraxacum officinale.)*

WARMING EUG. Smaa biologiske og morfologiske Bidrag. Bot, Tidsskrift 7-17, 1877. [Ex Just. 1877, p. 374.] Gives a list of plants which produce buds upon the roots. The list includes Milkweed *(Asclepias Syriaca=A. Cornuti)* Canada Thistle (*Cirsium arvense=Cnicus arvensis)* Rib Grass *(Plantago lanceolata)* Sheep Sorrel (*Rumex Acetosella)* Dandelion *(Taraxacum officinale.)*

Wittrock, V. B. *(Botanisches Centralblatt,* XVII, 227, 1884.) The author gives a resume of our knowledge concerning the production of buds upon roots. He states that there are 138 species of hebaceous plants which are known to produce adventitious buds upon the roots. Among these are, Dandelion *(Taraxacum officiale)* which will produce a number of buds upon the upper end of the cut portion of a root, when the top has been removed. This fact makes the plant a bad weed. The buds, however, are produced only when the root is cut. English Plantain *(Plantago lanceolata)* Milkweed *(Asclepias Syriaca)* Sheep Sorrel *(Rumex Acetosella)* produce buds upon the roots under normal conditions, but these shoots are considered additional, since the existence of the plant does not depend upon them. The main root continues to grow from year to year.

In certain plants the primary shoot dies at the end of the first year without having produced any flowers. The second year's growth comes from adventitious buds on the root. In such cases these buds are necessary to the life of the plant. Among these are Canada Thistle (which we have in the state but is not discussed in the present bulletin) and Bindweed *(Convolvulus arvensis.)*

EXPLANATION OF PLATES.

The number after the name refers to the number which each weed bears in the descriptive list. The drawings were made by Miss Bertha Kimball.

PLATE I.

1. Yellow Sheep Sorrel No 1.
2. Red Root No. 2.
3. Smooth Sumac No. 3.
4, 5. Poison Ivy No. 4.
6 White Sweet Clover No. 5.

PLATE II.

7, 8, 9. Wild Rose No. 7.
10. Elderberry No. 8.
11. 12. Iron-weed No. 10

PLATE III.

13. Buck Bush No. 9.
14. Golden Rod No. 11.
15. Wild Senna No. 6
16. Golden Rod No. 13.
17. Maximilian's Sunflower No. 16.

PLATE IV.

18,19, 20. Perennial Ragweed No. 14.
21. Ironweed Sunflower No. 15.
22. Golden Rod No. 12.

PLATE V.

23, 24, 25. Indian Hemp No. 22.
26, 27,28. Wild Artichoke No. 17.
29. Dandelion No. 21.

PLATE VI.

30,31,32. Pasture Thistle No. 19.
33. Tall Thistle No. 20.
34. Ox-eye Daisy No. 18.

PLATE VII.

35. Climbing Milkwead No. 24.
36, 37. White Morning Glory No. 25.
38, 39. Bindweed No. 26.

PLATE VIII.

40, 41. Ground Cherry No. 28.
42. Horse Nettle No. 27.
43. Ground Cherry No. 29.
44. Horse Nettle No. 27
45, 46. Ground Cherry No. 30.

PLATE IX.

47. Blue Vervain No. 32.
48. White Vervain No. 31.
49. Catnip No. 33.
50. Milkweed No. 23.
51. Plantain No. 35.

PLATE X.

52, 53. Wild Four-O'clock No. 37.
54, 55. Pokeweed No. 38.
36. Pale Dock No 40.
57. Patience Dock No. 39.
58. Rib Grass No. 36.

PLATE XI.

59. Perennial Tickle-grass No. 48.
60. Paspalum Grass No. 46.
61, 62. Nettle No. 44
63,64 Water Smart-weed No. 43.

PLATE XII.

65. Nut Grass No. 45.
66. Curled Dock No. 41.
67. Drop-seed Grass No. 47.
68. Sheep Sorrel No. 42.