ness; wind southwesterly, freshening during night and bringing short-duration rain-squall from west at 4 A. M., August 30. Very smoky dull-red sunset; as sun was about five sixths set, it turned yellow and then merged into green for about two seconds before tip sank under horizon. It did not look to me like a flash but a definite change from yellow to green lasting about two to three seconds."

JNO. A. FLEMING

WINTER ACTIVITY OF THE ROOTS OF PERENNIAL WEEDS

IN a recent number of SCIENCE, F. J. Crider[1] recorded that roots of certain plants commonly thought of as having a dormant period in southern Arizona continued to grow throughout the cooler season. During the winter of 1924–25 at Iowa State College while the writer[2] was excavating roots of the Canada thistle (*Cirsium arvense*) for chemical analysis, he noted the behavior of the roots of this plant with reference to the activity of the buds upon the horizontal regenerative roots.

Buds which grew into shoots as long as the ground was warm continued to develop upon the horizontal roots of the Canada thistle from the middle of September until the middle of November. As these shoots appeared above ground they formed rosettes only, and did not send up stalks. When the rosettes were killed by frost early in November, those shoots which were still developing in the as yet unfrozen ground were unaffected. The part of the shoots between the roots and the surface of the soil in these fall shoots was, however, slender and delicate and sparsely covered with long black scales. The freezing of the soil killed these shoots quickly, and after the middle of December no uninjured shoots were found upon the roots taken from cold but incompletely frozen soil. Regions of underground stem that had been killed by temporary freezing of the surface of the soil were black and partly decomposed down to the depth of penetration of the frost, but were succulent below. In some cases they had died back to their connection with the horizontal root. No new shoots were formed in December, and the ground was frozen solid to a depth of 50 cm during the latter part of this month. On January 3, 1925, when more samples were being taken for analysis, the latent buds on the larger roots of the Canada thistle were noticeably increased in size over what they had been three weeks previously. The soil was frozen so that it had to be removed with a pick and mattock and taken to the laboratory to be thawed out. This made possible rapid and accurate observation of the root systems and conditions of the shoots upon the roots.

A break across the root at the point of attachment of the bud revealed ice crystals in the intercellular spaces, both in the root and in the bud. By the middle of January similar buds on other roots had developed into thick, vigorous, pointed shoots 15 to 20 mm long and 3 to 5 mm in diameter, with heavy, whitish scales completely covering the outside of the shoot. These were not fall shoots arrested by cold, because they were more than twice as large in cross section as the lower parts of the slender fall shoots which were still intact upon the same root and which were connected by black dead stems to the rosettes above. The new shoots had a free, sharp, growing point. The lower part of the shoots produced from September to November remained white because they were frozen during the cold period of December, 1924, and had had no chance to disintegrate.

According to Lund and Rostrup,[3] who have made an exhaustive study of the root systems of this plant, the roots of the Canada thistle radiate from a downward bend of a regenerative and storage root. They grow horizontally for one to two meters before they too turn down. This process is repeated several times in a season. The observations of Lund and Rostrup have been found to hold for the conditions of the United States as well as Denmark, but these authors seem to have made no study of the roots during the winter and hence failed to note the development of the buds upon the roots, or the new horizontal roots upon the old storage organs.

On February 3, 1926, new, light-colored, horizontal roots only 1 to 1.5 mm in diameter and 10 to 20 cm long were found upon old roots, and upon the newer downward bends of the last roots of 1924, where they had been entirely absent from similar roots in December, 1924. At this same time, February 3, the shoots were from 4 to 7 cm long and from 5 to 7 mm in diameter, greatly exceeding the size of the shoots on the roots taken in January from the frozen ground. There were also more buds on the "kinks" of the horizontal roots. The shoots and roots were succulent when not frozen, and when frozen were full of ice crystals in the intercellular spaces. The remaining parts of the fall shoots quickly blackened upon thawing and were not turgid. The horizontal roots which

[1] F. J. Crider, "Winter Root Growth of Plants," SCIENCE, 68: 403–4, 1928.

[2] Charles F. Rogers, "Carbohydrate Metabolism in the Roots of the Canada Thistle." Thesis, Iowa State College, 1925.

[3] Samsøe Lund, and E. Rostrup, "Marktidselem, *Cirsium arvense* en monografi." *K. D. Vidensk. Selsk. Skr.*, 6R, n–m. Afd. X, 3: 1–152. 1901. Résumé en française, pp. 153–165.

had sprung from the older regenerative roots were by March 3, 1925, 2 mm in diameter, 15 to 30 cm long and creamy white in color. They could easily be distinguished from the old roots by their position, their size, color and freedom from "kinks," regenerative buds and shoots. On March 15 the soil was no longer frozen solid, and development of the whole root system became more rapid. Green leaves of the thistle appeared above the surface of the soil on April 12, 1925, and by this time the fall shoots had blackened and died back to the junction with the horizontal roots. In no case had buds in the axils of the scales on the fall shoots developed into new stems. The roots of two other perennial weeds, the common wild morning-glory (*Convolvulus arvensis*) and a poverty weed, *Franseria tomentosa,* were studied throughout three winters from 1925 to 1928, at the Agricultural Experiment Station at Fort Collins, Colorado. Although the size of the roots of these latter plants is different from that of roots of the Canada thistle, their cycle of bud and root formation is similar in almost every respect to that described for *Cirsium arvense.*

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AN ARTIST LOOKS AT GORDONIA

THE writer had been much interested in many newspaper items about a rare plant which had been introduced in one or two Macon gardens, a native Georgia species discovered by the famous Bartram in his travels through eastern Georgia, a species now supposed to be almost extinct, save for a plant kept alive through the years in a northern botanical garden and the parent of the plants introduced in Macon. The name given in the press of "Gordonia Altamaha" had a romantic sound but otherwise meant nothing.

However, the artist had an opportunity to converse with a friend who is a distinguished horticulturist, and this conversation, which revealed further enchanting facts about the famous Gordonia, led to a desire to see and know better a rare plant and the still greater desire to paint that plant.

Realization is often the disappointment of imagination and the present case was no exception, a first glimpse of Gordonia conveying to the neophyte only that here was but a variety of the familiar "Cape Jasmine" plant. Gradually with the help of the horticulturist the plant's rare beauty began to reveal itself. The rich foliage was a delight, shading from a pale to a beautiful bronze green, the designs of the veined and pointed leaves, the smooth, almost blue-green stalks from which the leaves seemed to grow in clusters, the variety of greens in the leaves, the undersides sometimes a silvery tinge, and in some cases of an almost green-gold luster. The tops of the leaves were glossy but of varied shades of green, scarcely two leaves being of the same shade, the young leaves appearing a delicate pea color, while the more matured ranged from almost a blue-green through the yellow-greens to a real bronze tone. The play of sunlight and shadow on this varied foliage produced a beautiful effect.

Then the horticulturist pointed out a bud, apparently about the size of the common marble or agate. The bud appeared to grow from a main stem, nestled in leaves which grew out from beneath it in a star-like radiation, the young leaves atop the more matured. There seemed to be only the one blossom-bud on the entire plant, and when first seen it was of a delicate pale pea-green, shading to a decided light yellow in the top center. The artist preparing his materials sat down to watch the unfolding of the blossom, for it was said that the flower of the Gordonia opened, bloomed, folded and died in a single day. Forgetful of time, of the hot sun, of the prick of insects, the artist sat enthralled by the miracle unfolding before his eyes and tried desperately to catch some of its wonders on his sketch pad.

The bud split in three main divisions and seemed gradually to curl and spread back from the yellow center. The green seemed to recede into the stem, drawing the yellow with it. The yellow, as it followed, took on a deeper tinge underneath, while towards the center it grew pale and, as the blossom opened, a pure white appeared. Then, somewhat like the magnolia, the petals unfurled more, and instead of three there were five divisions, and in the heart of the white a dash of gold appeared. The main flower, except for the yellow-green and pale yellow of the under part, near the stem, was of the purest and most exquisite white imaginable. The flower had now spread to a size larger than that of the "Cape Jasmine," being almost the size of a small tea-cup. The edges of the five main petals ruffled and began to curl back, allowing the beautiful yellow gold of the heart to appear. The heart, as the petals now opened rather rapidly, was of a mushroom shape and appeared to consist of closely bunched stamens growing from the center with globular pistils producing the mushroom effect. This rounded top of the mushroom-like center was a brilliant golden yellow, while the stem section was of a golden orange tone. This center glowed like a jewel, and with the pristine white of the now unfolded petals the flower was indeed a thing of beauty. A faint, pleasing odor, hard to describe, emanated from the flower.

The flower was now at the height of its blooming and the artist completed his sketch, but even as the finishing touches were put on, the white petals began