On two new instances of Spinous Roots.

BY

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With Plates XV and XVI.

COMPARATIVELY few instances of spinous roots appear to have been recorded hitherto. Among the better known cases of the kind are certain Palms, such as the species of *Iriartea* and *Acanthorhiza*, in which the rootlets of the aërial roots are modified to form spines; and the Leguminous genus *Derris*, in which the adventitious roots themselves are said to become spinous, and to help in attaching the climbing stem to its support.

The object of the present brief communication is to place on record two remarkable, and as I believe novel, instances of spinous roots, which, curiously enough, have almost simultaneously come under observation at Kew, within the last few months.

Both the plants in question are Monocotyledons, but they belong to distinct Natural Orders, and are totally different in habit, the one being a *Dioscorea* and the other a *Moraea*.

1. DIOSCOREA PREHENSILIS, Benth.

The *Dioscorea* was raised from seed collected by Mr. Scott-Elliot in Sierra Leone, and presented to Kew in January, 1892. The plant flowered in September, 1894, and was then determined as the *Dioscorea prehensilis* of Bentham. The

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peculiarity of the roots was first noticed in February of the present year. The plant was at that time at rest, the leafy stems having withered. When dug up, it was found to have formed an irregular, lobed tuber about a foot long, which was enclosed in a sort of cage of hard, interlacing, spine-bearing roots, springing from the upper part of the tuber, the whole mass being about two feet in diameter (see Plate XV). At that time the normal nutritive roots, bearing ordinary rootlets, appeared to be produced only from the base of the stem, immediately above its attachment to the tuber.

It is important to notice that the whole system of spinous roots was produced entirely underground, so that their existence was not revealed until the soil was removed. That they form a most efficient means of protection to the parts which they enclose is evident from the photograph, and is still more vividly realized by any one who has attempted to handle the rigid and bristling mass. We may reasonably suppose that the thorny hedge of roots serves to guard the tuber—the great food-store of the plant—from the attacks of burrowing or digging animals.

The spinous roots attain a diameter of about a quarter of an inch. They have an irregular curved course, usually starting from the tuber in an upward direction, and then bending down. In the mature condition they are very hard and woody, and consist entirely of the vascular cylinder or stele, the whole cortex beyond the endodermis having withered, and only hanging on the roots in shreds. The spines, which are inserted at irregular intervals, averaging an inch or less, reach a length of about three-quarters of an inch. They are sometimes solitary, in other cases two or three are inserted together at the same level, and on the same side of the root. It occasionally happens that two adjacent spines are coherent, having a common base, which may much exceed the free points in length. The spines themselves are exceedingly hard, and usually very sharp.

The study of the anatomy shows plainly that the spine-bearing organs are actually roots, in which the vascular

tissues are reduced as compared with the lignified prosenchyma. The spines themselves are shown by their structure to be rootlets, though highly modified. In them, as in the roots which bear them, the hardy woody portion is entirely stele, limited on the outside by the endodermis. The dry and withered cortex often forms a membranous envelope around the lower part of the spine.

Histological details are reserved for a future communication, which must await the opportunity for a study of the development. The spinous roots at present on the plant are not only mature, but to all appearance dead, serving no other than a purely defensive function.

The normal roots have the structure usual among Monocotyledons ; it is of interest, however, to note that, when old, the rootlets die off, leaving behind a somewhat spiny base, so that there is here a certain approach to the peculiar character of the special protective organs.

The plant has now been transferred to a hot, moist house, where it has rapidly formed a new twining stem, already nearly thirty feet in length and half an inch thick. The stem, which for some time remained unbranched, is clothed with strong, broad-based prickles, which bear a marked superficial resemblance to the spines on the roots. Anatomical examination, however, shows that the prickles contain no vascular elements, so that they are no doubt merely outgrowths from the external tissues.

At intervals averaging about fourteen inches, the stem bears thick, green cuspidate scale-leaves, two inches long, which are alternate near the base of the stem, but elsewhere are inserted in pairs. These curious organs, which are sessile, with a broad base, bear no resemblance to the normal foliage of the plant. They probably represent the modified and enlarged leaf-bases. The stem is now (April 27) producing branches from the axils of the scale-leaves, but at present the branches, like the main stem, bear scale-leaves only, and have as yet formed no normal foliage [1].

[1] This has since appeared, on branches of the second order, May 5.

Numerous fleshy normal roots are growing vigorously from the base of the stem, and a few from the tuber itself. So far, however, there is no sign of any increase in the tuber, nor have any new spine-bearing roots as yet made their appearance.

The existence of spinous roots is not altogether unknown in the genus *Dioscorea; D. spinosa,* Roxb., is described in Hooker's Flora of British India (vol. vi, p. 291) as having 'long woody rigid fibres, bearing spines half an inch long.' Roxburgh himself, in describing the same species (under the name of *D. aculeata*), uses these words: 'tubers oblong, pendulous, the fibres of the proper roots become spinous[1].' It would appear, then, that this Indian species is similar, as regards the character in question, to the West African *D. prehensilis.* It is not improbable that other instances may be brought to light within the genus *Dioscorea,* which appears to offer considerable scope for further morphological investigation.

2. Moraea, sp.

Root-clusters of this Iridaceous plant were sent to Kew, in December, 1896, by Mr. J. W. Mathews, of the Municipal Gardens, Cape Town, who found it growing wild in the neighbourhood of Cape Town. The stem has an enlarged base, perhaps representing the original corm; above the base it becomes cylindrical, and is hard and woody throughout. The spinous roots, which are stiff and wiry, spring from the swollen base of the stem on all sides, radiating out in every direction, and curving and interlacing, so as to form a dense network, which bristles with spines, and suggests a vegetable hedgehog more than anything else.

The whole mass is from two to three inches in diameter, and is not unlike the root-cluster of the *Dioscorea* on a small scale (see Plate XVI). The ordinary roots arise chiefly from the under surface of the enlarged base of the stem.

Histological investigation shows that the spinous roots are

[1] Roxburgh, Flora Indica, iii, p. 800.

practically identical in structure with the normal absorptive roots. In both alike, the mature root consists chiefly of the vascular cylinder, on which the dead cortex hangs loosely; in both the endodermis is greatly thickened, and the conjunctive tissues of the stele much lignified. The only difference of importance is that the more internal vessels of the spinous roots are smaller than those of the normal organs.

The spines themselves, which are often branched, are manifestly rootlets, having essentially the same structure as the roots which bear them, except that in the spines the vessels are still further reduced.

Numerous small corms, varying in size from that of mustard-seed to that of a hazel-nut, bud out from the basal part of the main stem, among the spinous roots, which perhaps serve more especially for their protection. The corms easily become detached, and afford an abundant means of propagation. Young plants are now being raised at Kew from some of these corms, so it may be hoped that the whole development of the plant, especially that of its remarkable root-system, may be followed as time goes on.

The fact that earth is present among the roots, in all parts of the cluster, no doubt indicates that the whole mass was developed in the soil. It would be interesting to ascertain whether in nature it ever becomes loosened from its attachment to the ground, and carried away by wind, like a 'Rose of Jericho.' It is possible that the corms, which separate so readily from the stem, may be distributed in this way.

I am indebted to the Staff of the Royal Gardens, Kew, and especially to Mr. W. Watson, Assistant Curator, for much information concerning these plants. The present preliminary communication is only intended to record the main facts as to the curious and exceptional forms of root illustrated in the photographic plates.

When opportunity arises, I hope to enter on a full investigation of the development and histology of the organs in question.

EXPLANATION OF PLATES XV AND XVI.

Illustrating Dr. Scott's paper on Spinous Roots.

PLATE XV.

Dioscorea prehensilis, Benth. Tuber, with mass of spinous roots springing from and enclosing it. The normal roots are those arising from the base of the stem. About one-fifth of natural size.

PLATE XVI.

Moraea, sp. Base of stem, with clusters of spinous roots.
Fig. 1. Seen in section: on the left a corm is well shown.
Fig. 2. In surface view: almost natural size.

Both from photographs by Messrs. Gunn and Stuart.

Dioscorea prehensilis, Benth.

FIG. 1.

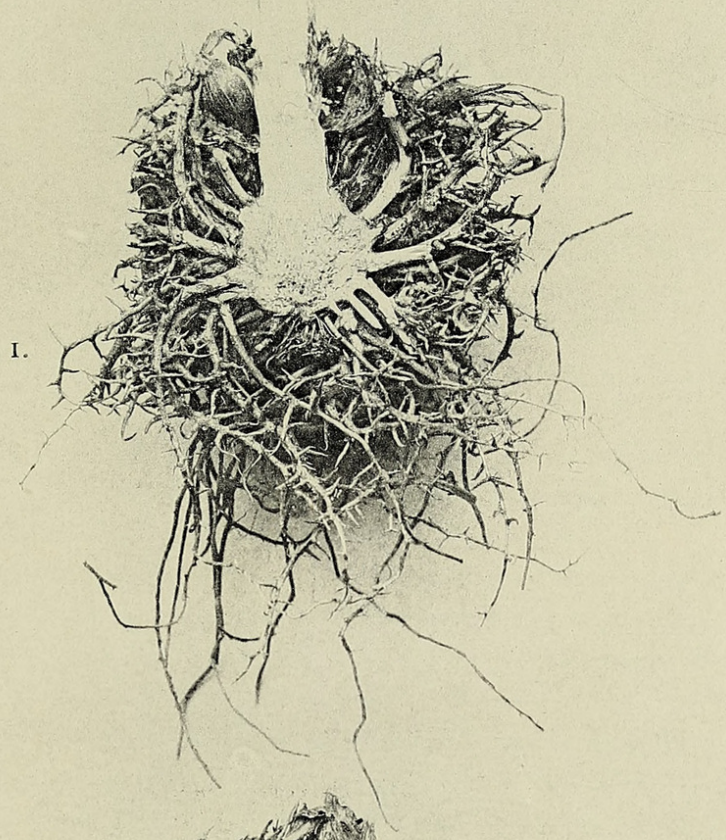
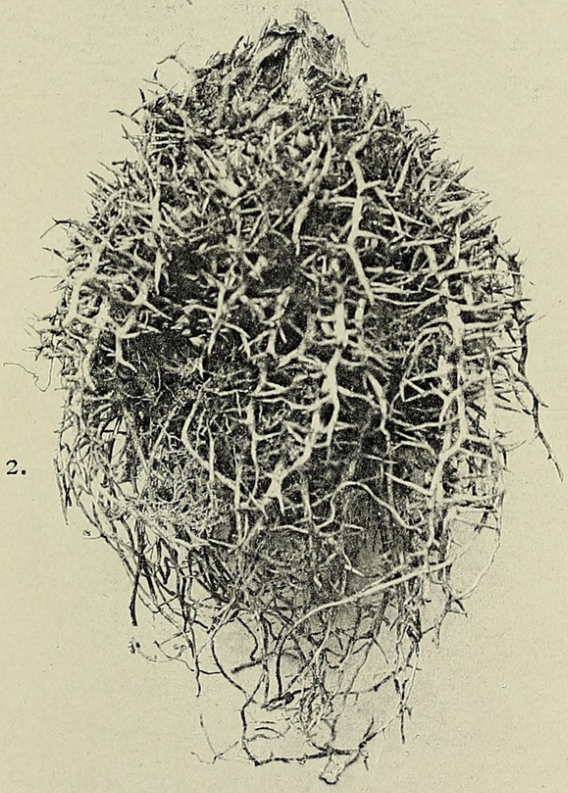


FIG. 2.



Moraea, Sp.