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## NOTES ON THE NUTATION OF PLANTS.

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In the summer of 1896, the writer studied the nutation of *Helianthus annuus* (1) and found that in this plant we have one of the most remarkable and striking diurnal phenomena to be observed in the plant kingdom. It has been believed quite generally that the disc of flowers follows the sun but Kellerman (2) showed conclusively that this is not the case. The nutation occurs in the upper part of the stem before anthesis, the terminal rosette following the sun from morning until sunset. Along with *H. annuus*, *H. scaberrimus* was studied and found to act in the same way.

In 1900, the cultivated variety of *H. annuus* was reported (3) to nutate as strongly as the wild variety, and the same was observed in regard to *H. petiolaris*.

More recently Stevens (4) has shown that a similar nutation occurs in various other genera of widely separated families. He found nutation in *Bidens frondosa* and *Ambrosia artemisiaefolia*. He also mentions the genera, *Amaranthus*, *Lespedeza*, *Melilotus* (especially *M. alba*), *Medicago*, and *Trifolium*, as containing species which show more or less nutation.

During the past summer numerous observations were made on various plants in Clay county, Kansas.

The writer had himself noticed the nutation of *Ambrosia trifida* in 1897, but it was not included in a previous report as no careful observations had been made. The giant ragweed nutates very decidedly when conditions are favorable, often bending 90° to the west in the evening. In the morning the bending of the stem is

usually not more than  $20^{\circ}$ – $30^{\circ}$  east. During dry weather the amount of nutation was increased by watering the plants. As in the sunflower, the stem is usually straight by 10 o'clock at night. *Ambrosia artemisaefolia* was studied and found to nutate well, as reported by Stevens. *Ambrosia psyllostachya* and *Xanthium speciosum* also nutate, considerable movement of the stem being readily observed during favorable conditions. *Helianthus maximiliani*, *H. grosseserratus*, *H. hirsutus*, and *H. tuberosus nutate* well before anthesis. *H. maximiliani* is especially striking on



FIG. 1.

FIG. 1. *Helianthus annuus* nutating to the west at 7 P. M.



FIG. 2.

FIG. 2. *Ambrosia trifida* at 7 P. M. Both from Clay Co., Kansas.

account of its stout stem and slender, rigid leaves. On favorable days the nutation is  $90^{\circ}$  west in the evening and  $20^{\circ}$  or more east in the morning.

Although Stevens gives *Amaranthus* as a genus which shows nutation, he does not name the species observed. During the past summer two species were studied by the writer, namely, *Amaranthus hybridus* and *A. retroflexus*. The first nutates the more prominently both in the morning and evening, probably because of its more slender stem. The process is much the same as in the sunflowers, but the curve in the stem is not nearly so abrupt. However, on favorable evenings the terminal rosette faces the setting sun to such an extent that the rays of light fall on the broad surface of the leaves at right angles.

The wild variety of *Helianthus annuus* still appears to the writer to be *the* nutating plant. For on certain cloudy days when nutation is very slight in such plants as *H. maximiliani* and *Ambrosia trifida* it is still very decided in this species.

Occasionally there are days in which all the factors favorable to nutation are at a maximum. Such days may be distinguished as special "nutation days." One of the most remarkable in the writer's experience was August 5, 1903. The ground was moist but the sky was exceedingly clear. The sunlight was very intense during the entire day. Toward evening all the nutating plants in the fields and roadsides presented an appearance not soon to be forgotten. The various sunflowers, ragweeds, and amaranths were all nodding to the west at an angle of  $90^{\circ}$ , giving to the landscape a very peculiar and even unnatural appearance.

In the account given above, fifteen species of nutating plants are named. There are probably scores of others in the United States which show a diurnal bending or nutation of the stem to a greater or less extent.

1. SCHAFFNER, JOHN H. Observations on the Nutation of *Helianthus annuus*. *Bot. Gaz.* **25** : 395-403. 1898.
  2. KELLERMAN, W. A. Observations on the Nutation of Sunflowers. *Trans. Kan. Acad. Sci.* **12** : 140-158. 1889-90.
  3. SCHAFFNER, JOHN H. The Nutation of *Helianthus*. *Bot. Gaz.* **29** : 197-200. 1900.
  4. STEVENS, F. L. Nutation in *Bidens* and Other Genera. *Bot. Gaz.* **35** : 363-366. 1903.
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