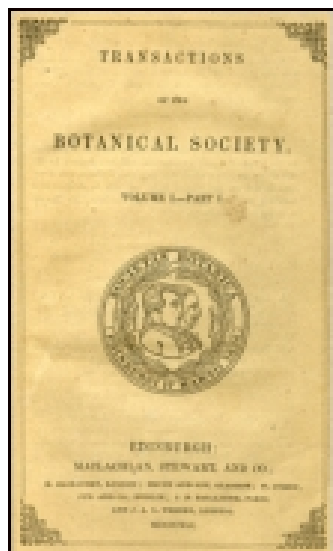


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Periodicity In Transpiration

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stricta as a Scottish species; but an examination of fifty-two specimens of *scotica*, among them a third from Orkney, from Mr. Spence, and a specimen of the variety itself, hardly sustains the idea of *stricta*.

Twice the length of the calyx is certainly very unusual, but half as long again occurs in many; and *stricta* is a taller, more gracile species, with the leaves "subtus nudiusculis," not "subtus farinosis," as in *scotica*. It seems to be better to adopt Dr. Moss's name of var. *orkniensis* for the plant.

To the bibliography should be added Low's list of Orkney plants in Barry's History:—

1. A second edition in 1808, by Rev. J. Hendrick.
2. Another in 1813, edited by W. E. Leach.
3. Syme in Bot. Soc. Edin. iv, 47-50 (1850).
4. Col. Johnston in Trans. Bot. Soc. Edin., xxvi, 207-226 (1914).

There are still about fifty species reported in various lists, etc., that have not been confirmed, and are probably mostly errors.

PERIODICITY IN TRANSPIRATION. By SOPHIE
J. WILKIE, B.Sc. (Two figures.)

(Read 14th October 1915.)

Periodicity in transpiration has been recorded by various research workers, and the evidences up to 1904 have been collected by Burgerstein in his monograph *Die Transpiration der Pflanzen* (Jena, Verlag von Gustav Fischer, 1904). A daily maximum has been obtained, and was found to occur any time between the hours of 9 a.m. and 3 p.m., varying with the different species of twigs experimented upon.

Unger (Sitzb. d. k. Akad. der Wissensch. Wien, Bd. xlv, 1862, pp. 181-327) was the first to accept this periodicity, but his experiments were not performed under constant conditions.

Sachs (Landw. Vers. Stationen, Bd. i, 1859, p. 203) believed in the rhythm of transpiration on analogy with growth periodicity.

Sorauer (Forsch. a. d. Gebiet der Agrikultur Physik von Wollny, Bd. iii, 1880, p. 351) observed a maximum of transpiration in the late forenoon and early afternoon, and a minimum before sunset.

Baranetzky (Bot. Zeitung, tom. xxx, 1872, p. 65) denies the existence of a periodicity, and is of the opinion that the plants transpire more during the night than in the daytime, mentioning that the loss of water is steady but not periodic.

Eberdt contradicts Baranetzky's views from the results of his own experimental work.

More recent research on periodicity in transpiration has been carried out by C. C. Curtis (Bull. Torrey Club, tom. xxix, 1902, p. 363). Curtis took weighings every hour for a period extending over twelve hours or less, and the temperature and humidity of the laboratory were kept as constant as possible. He obtained a maximal value for transpiration about the middle of the day, and minor fluctuations independent of the light intensity were also recorded. Experiments were performed under normal conditions in constant illumination and in the dark. He found that the curve in the dark sometimes was in keeping with that obtained under constant illumination, but it was more often very erratic. The graphs obtained by Curtis for transpiration resembled Sachs' curve for growth, Vesque's curve of absorption, and Detmer's curve for the periodicity of exudation of fluids from cut stems and fluid tensions. The transpiration graphs obtained by Curtis varied for every plant experimented upon, and for the same plant no two graphs were ever alike.

In order to have more positive proof of the phenomenon of periodicity, it was necessary to procure graphs of at least twenty-four hours' duration, and for this purpose the apparatus already described at the June meeting of the Society, 1915, was used.¹

The plants experimented upon were

1. *Pinus sylvestris*.
2. *Opuntia occidentalis*.
3. *Lilium rubrum*.

¹ See Trans. Bot. Soc. Edin., xxvi (1915), 432.

In every case records continuing over several days were obtained, and as far as possible they were uninterrupted. The temperature was kept as constant as possible, the variation being from 2° to 4° . The percentage humidity was on an average between 60 and 70.

A. *Normal Conditions of Light and Dark.*

1. *Pinus sylvestris.*

(1) 11th June to 23rd June 1914.

The natural conditions at that time were approximately sixteen hours' light to eight hours' darkness. Transpiration was found to be more active during the light than during the darkness period, the ratio being as 1:32, while the ratio of light to dark is as 1:5

An analysis of the hourly graph shows that at this season there is on an average a maximum of transpiration at 4 o'clock in the afternoon, a minimum at 3 o'clock in the morning.

(2) 25th November to 18th December 1914.

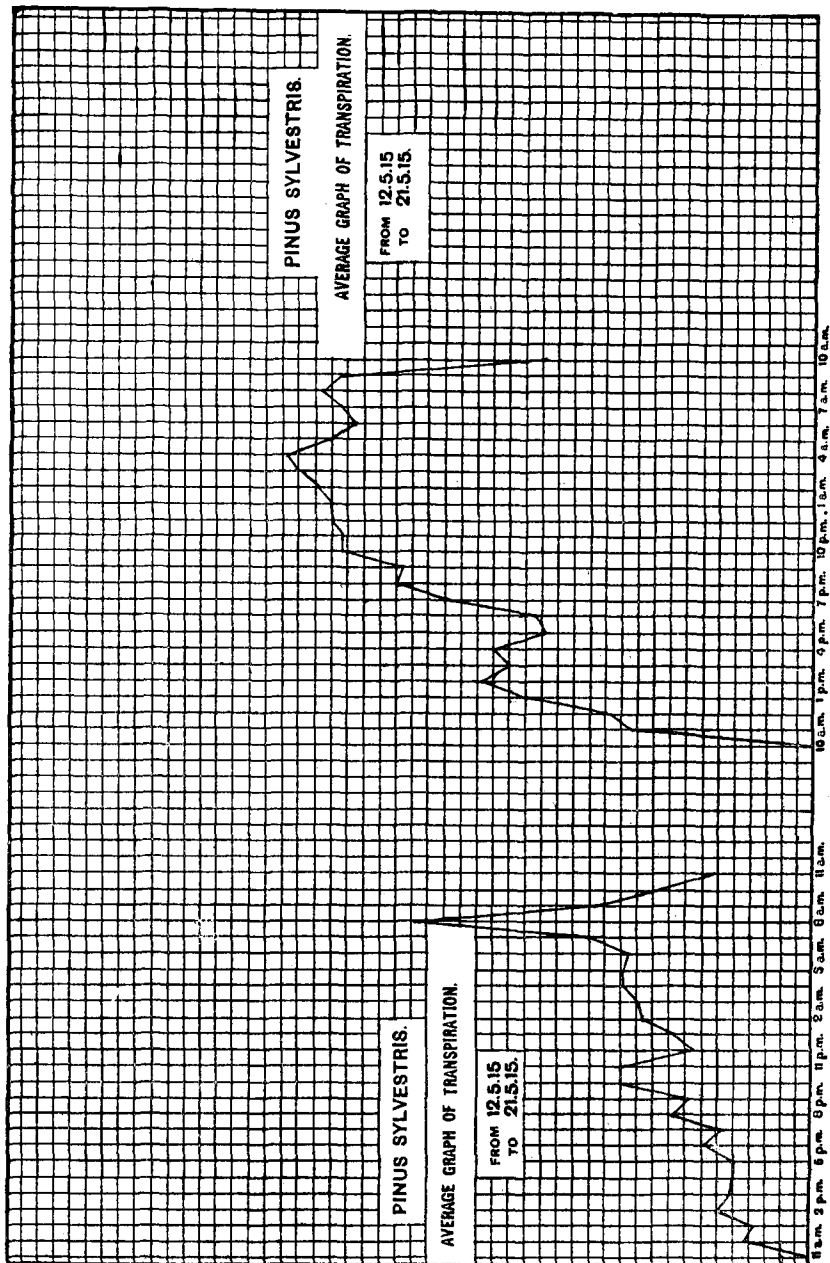
The conditions as regards the illumination of the plant at this time were eight hours' light to sixteen hours' darkness—just the exact reverse of the state of affairs in June. In this case the average mean ratio of transpiration in light to transpiration in the dark is 1:2.9, while the ratio of light to dark is as 1:2.

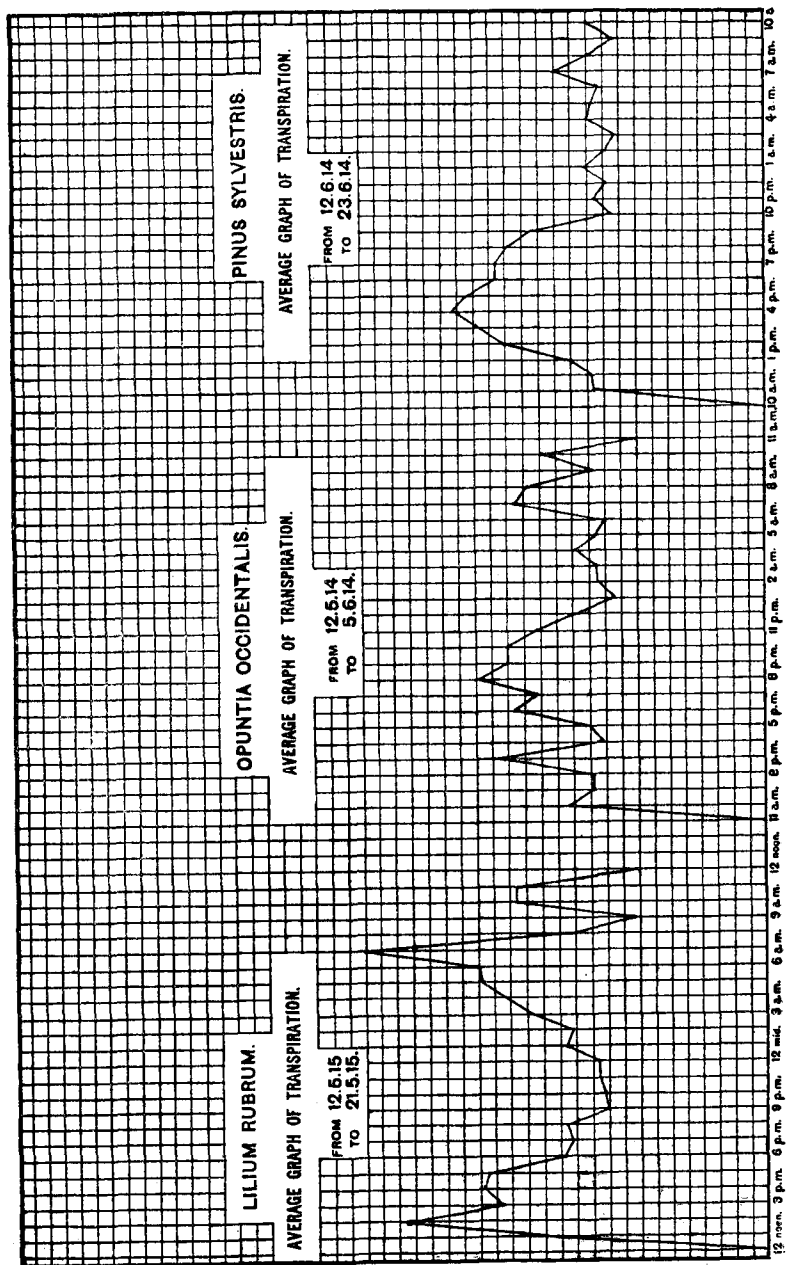
The hourly graphs show as an average a maximum at 4 o'clock in the morning, a minimum at 5 p.m.

(3) 19th January to 19th February 1915.

In this case the ratio of light to dark is for January as 1:2, and for February as 1:1.4. Here again the figures show transpiration during the period of darkness to be greater than that of light, although the difference is not so marked as in the November-December records; the ratio of transpiration in light to that in dark is as 1:1.5.

The maximal value of transpiration at this time as seen from the average graph occurs at 8 o'clock in the morning. The minimal values are very variable, but approximately there is a minimum at 1 p.m.





2. *Opuntia occidentalis*.

12th May to 4th June 1914.

The natural conditions were, at this time, sixteen hours' light to eight hours' darkness. *Opuntia occidentalis* transpires considerably during the darkness period—the ratio of transpiration in light to that in dark being as 1:37, while the ratio of light to dark is as 1:5. The hourly graphs show on an average a maximum of transpiration at 8 p.m., a minimum at 4 p.m., with subminimum at 1 a.m.

3. *Lilium rubrum*.

1st May to 21st May 1915.

The plant at this period would be subjected to sixteen hours' light and eight hours' darkness. The hourly graphs show that the maximal values of transpiration occur at 7 o'clock in the morning and 2 o'clock in the afternoon, the minimal values at 9 p.m. and 9 a.m. The ratio of transpiration in the light to transpiration in the dark is on an average as 1:22.

B. *The Effect of Darkness on Transpiration.*

The types *Pinus sylvestris* and *Lilium rubrum* were experimented upon in the dark room, and in both cases the transpiration was found to be very erratic. In spite of the absence of light, transpiration was very active, and there was evidence of a periodicity, although it was very variable.

SUMMARY.

1. Under normal conditions there is a daily periodicity in transpiration.
2. This periodicity varies in the three types experimented upon.
3. Under all dark conditions transpiration is active but erratic.

I have to thank Mr. R. A. Robertson for his kind assistance in the arranging of these results.