THE ACTION OF LIGHT ON MESOCARPUS.—Wittrock in 1878 first observed that the chlorophyll-plate of *Mesocarpus* was able to revolve in the cell. He did not attribute this action to light. In 1880, Stahl published a series of papers in the *Bot. Zeitung* in which he states—

(1) That in diffused light the chlorophyll-plate places itself at right angles to the incident light.

(2) In strong sunlight the edge of the plate is turned towards the source of the illumination.

(3) On continued insolation the plate—until now straight—becomes a curved figure.

In 1888, S. Le M. Moore in a memoir presented to the Linnean Society states that—

‘If a specimen be so arranged that, the plate having been in full face, considerable approaches are making towards the profile position, or *vice versa*, on plunging now into darkness and examining after a short interval, the movement will be found to have been almost or entirely completed¹.’

Respecting these experiments it has been found that a very short light-stimulus will suffice to turn the chlorophyll-plate either from the vertical to the horizontal position, or *vice versa*. Which of these effects will be produced depends on the intensity of the light, though to bring about the complete change of position a sufficient duration of stimulation is necessary.

A series of observations were made to determine the effect of stimuli of various duration, ranging from 10 seconds to one just sufficient to cause the plate to revolve through 90°. The experiments were carried out during successive days on which the intensity of the light was fairly constant.

I. *Experiment with diffused light (turning the chlorophyll-plate from the vertical to the horizontal position).*

In this case the *Mesocarpus* had been previously kept in the dark before being used. Cells were selected in which the chlorophyll-plates were vertical. A light-stimulus was then given for a definite period of time, and the plant (and microscope) was then darkened. In all cases a control-plant in continuous light was run side by side with the one under experiment.

¹ Journal of Linnean Soc., Bot., Vol. XXIV, p. 370.

In the case of the former (the control) it was possible to estimate the angle turned through during successive intervals of time, such as 5, 10, 15, and 20¹ minutes after exposure. It was not possible to do this in the case of short-stimulus experiments, as the cells would then have received three additional stimuli, so it was necessary to terminate an experiment on examining the result after the period of darkening. But the course of events could be reconstructed by arranging a series of *Mesocarpus* cells, each of which received the same stimulus, and then examining them one by one at successive

TABLE I.

Time of stimulation in seconds.	Angle turned through at end of				Control. Angle turned through at end of			
	5 min.	10 min.	15 min.	20 min.	5 min.	10 min.	15 min.	20 min.
10				25°	10°	50°	—	90°
45	10°	25°	30°	40°	15°	45°	85°	90°
55	10°	25°	35°	45°	20°	50°	80°	90°
60	8°	35°	61°	63°	15°	50°	80°	90°
100	5°	36°	65°	86°	10°	50°	75°	90°
120	10°	32°	65°	90°	10°	55°	80°	90°

Illustrating stimulation of vertical plate with diffused light.

intervals of time. In order to reduce any chance of error which might be due to an accidental deviation from the proper normal, each time-experiment was repeated three times, and the mean of the observations was accepted provided that there was close agreement between the results obtained.

Thus, as it was desired to ascertain what had happened at 5, 10, 15, and 20 minutes after stimulation, twelve microscopes were arranged

¹ It was found, as the result of many observations, that no further effect was produced after the lapse of twenty minutes from the time of stimulation in the experiments with diffused light. This does not hold good, however, with the observations (Series II) on the effect of strong illumination.

in four sets containing three in each, and so every observation was checked three times under the same conditions.

The results of such a series of observations are given in Table I.

The behaviour of cells receiving 10, 45, 55, 60, 100, and 120 seconds stimulus is here given, and on the right-hand side the behaviour of the corresponding controls are tabulated. It was found that the rate of turning through 90° varied somewhat at different periods. During the first five minutes the angle turned through was less than that turned through during the fifth to the tenth and the tenth to the fifteenth minute after stimulation. A decrease then generally occurred till the revolution was complete. This slow movement during the first five minutes would seem to point to a latent period.

It is also interesting to note that those cells which received a stimulus only just sufficient to turn, took *no longer* to do so than those in continuous light. There is then a maximum limit of time-stimulation, and by prolonging its duration no additional visible effect is produced. These points could perhaps be better appreciated by plotting a curve than by tabulation.

II. *Experiments with strong sunlight (turning chlorophyll-plate from the horizontal to the vertical position).*

Cells were taken in which the chlorophyll-plates were horizontal, and by the action of strong sunlight were made to turn into the vertical position. Here the times taken by the controls to turn through 90° were appreciably greater than in the first case, the

TABLE II.

Time of stimulation in seconds.	Angle turned through at end of					Control. Angle turned through at end of				
	5 min.	10 min.	15 min.	20 min.	30 min.	5 min.	10 min.	15 min.	20 min.	30 min.
30	10°	15°	15°	15°	15°	10°	20°	60°	70°	90°
45	10°	15°	20°	20°	20°	10°	15°	45°	80°	90°
90	5°	10°	60°	60°	90°	20°	40°	60°	70°	90°

Illustrating stimulation of horizontal plate with strong sunlight.

difference being about 7-10 minutes, and with very strong light the movement is slower, showing that the optimum strength of stimulus has been surpassed. But the table also shows that a *shorter initial stimulus* than that required in the case of diffuse light was competent to produce the full effect. A change in the rate of turning similar to that observed in the experiments of series 1 occurs also here, and it is shown in Table II ; the controls also bear this out.

The effect of different gases was also tried. *Mesocarpus* placed in hydrogen and exposed to continuous diffused light turned in the normal time. Some filaments were also placed in hydrogen and the dark for 50 minutes. On exposure to light, while still in hydrogen, these also turned in response to the stimulus in the normal time.

Carbon dioxide acts as a complete anaesthetic, no movement taking place after an exposure for an hour to good diffused light.

The appearance of the protoplasm in the cell when examined with a high power does not appear to alter during the process of turning. Slight staining with dahlia was tried, but this did not reveal anything further.

The protoplasm is rather granular, and the granules perform a slow streaming movement along the cell-walls, very much after the manner of the circulation in *Spirogyra*.

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