was continued for 7 weeks, during which period all the plants flowered.

No symptoms indicating abnormal growth or development could be detected among the rotated plants. The effect of anti-clockwise rotation was not re-examined.

Avena. Husked oats (*Avena sativa*, variety Burke) were soaked overnight in tap-water in darkness at 5° C, and then sown in two shallow trays on moist facial tissue with the embryo facing upwards. Each tray contained 40–50 seedlings. Using a clock-driven turntable, with a vertical axis, one tray was rotated in either a clockwise or anti-clockwise direction at one revolution a day. The non-rotated tray served as a control. The experiments were performed at 25° C and high relative humidity inside a metal incubator, which was kept in a constant-temperature darkroom so that all operations and inspections could be carried out in green light of predominantly 546 mμ. After 3 days the length of the shoot (coleoptile and mesocotyl) and the longest root of each seedling was measured to the nearest millimetre. Seven clockwise replicates, followed by eight anti-clockwise ones, were performed at weekly intervals.

Rotation of the seedlings in either direction produced no visible effects. The percentage mean difference between shoot and root lengths of stationary and rotated plants is shown in Table 1. With one exception, the extension growth of the root and shoot of the rotated plants did not differ significantly from that of the stationary plants, in any of the replicates. These results are in contrast with those of Jones, where in nine replicates the average reductions in coleoptile and root final length in clockwise rotated plants were 6·1 and 8·6 per cent respectively, while the corresponding average increases in anti-clockwise rotated plants were 5·6 and 10·2 per cent. Furthermore, the direction of rotation produced a consistent response in each replicate. Jones used a 5-day rotational period, while the results summarized in Table 1 are for a 3-day period; nevertheless, the plants were growing actively throughout the 3 days, so that an appreciable effect of rotation on the elongation rate of the shoot or root should have been apparent by the third day. Despite the absence of a significant response to rotation in the majority of replicates, examination of Table 1 shows that in each of the first seven, where the plants were rotated clockwise, the shoots grow less than those of the controls. Since the trend of this difference is in agreement with Jones's conclusions, the effect of clockwise rotation on the extension growth of the etiolated shoot of the *Avena* seedling was further examined in a second experiment, in which the experimental technique used by Jones was more closely followed.

Avena seedlings were germinated using the method already described here and kept under the same environmental conditions as in the previous experiment. On the second day, the seedlings were transferred from the shallow trays to two perforated plastic holders each holding thirty seedlings, which were then set up in two glass beakers containing tap-water, so that the roots of the seedlings just touched the surface of the water. One beaker was rotated clockwise about a vertical axis at one revolution a day, while the other was kept stationary. After 2 days, the length of each seedling shoot was measured to the nearest millimetre. The experiment was replicated fifteen times. The results, summarized in Table 2, show that shoots of rotated and stationary plants attained the same mean length. In individual replicates, the mean percentage difference between the length of rotated and stationary shoots ranged from −6·5 per cent to +10·0 per cent; but in no case was this difference statistically significant. From these results, and those for the preceding experiment, it is apparent that the extension growths of the root and shoot of the seedling of the oat variety used were not appreciably affected by daily rotation about a vertical axis in either direction.

Table 1. Effect of Rotation around a Vertical Axis at 1 Rev. a Day on Root and Shoot Extension Growth in *Avena* Seedlings

Replicate No.	Shoot			Root		
	Percentage difference of root or shoot final length from stationary control					
	Clockwise rotation					
1	−10·5 ± 4·3*			−5·8 ± 5·8		
2	−1·1 ± 3·3†			−1·4 ± 6·0		
3	−0·2 ± 9·0			−0·6 ± 6·2		
4	−3·4 ± 5·1			−5·1 ± 6·7		
5	−3·7 ± 4·0			+9·3 ± 8·4		
6	−2·9 ± 5·3			−0·8 ± 8·9		
7	−4·4 ± 7·8			−1·8 ± 5·4		
Mean length for all replicates (mm)	*S* 36·8	*R* 35·3	Difference (%) 4·1	*S* 64·0	*R* 63·4	Difference (%) 0·9
	Anti-clockwise rotation					
8	+2·5 ± 3·1			+7·5 ± 5·6		
9	−0·3 ± 3·8			+9·2 ± 6·2		
10	+1·5 ± 3·4			+3·8 ± 5·8		
11	−2·7 ± 4·4			+5·4 ± 6·6		
12	+1·5 ± 4·5			+0·6 ± 7·8		
13	+0·6 ± 3·6			+7·7 ± 5·8		
14	+1·3 ± 3·8			+0·6 ± 5·9		
15	−3·0 ± 4·1			−2·9 ± 8·1		
Mean length for all replicates	*S* 36·4	*R* 36·4	Difference (%) 0	*S* 70·6	*R* 73·3	Difference (%) 3·8

* Significant at $P < 0.01$.
† Standard error.
S, Stationary control. *R*, Rotated.

Table 2. Effect of Clockwise Rotation around a Vertical Axis at 1 Rev a Day on Shoot Extension Growth in *Avena* Seedlings
Results for 15 replicates

	Mean shoot length (mm)	Mean difference (%)	Total No. shoots per treatment
Stationary	39·7	−0·2	423
Rotated	39·6		435

While these negative results do not rule out the possibility that, under some environmental conditions, cyclamen and *Avena* plants may respond to slow rotation about a vertical axis, it can be concluded that the responses in question, if they exist, are not readily reproducible in the same way as, for example, are responses to darkness and temperature.

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It is pleasing to see a renewal of interest in plant responses to specific rotations. Unfortunately Dr. Palmer's experiments with *Avena* are not strictly comparable with mine of 1960 in at least two features, that of the variety of oat used and in his choice of a 3-day period. I understand that the variety 'Milford' is now unobtainable, but I would mention that with it I was able to experiment with rotating seedlings in a null (magnetic) field, with negative response, that is, the direction of rotation did not affect the growth of shoots; a similar result was obtained with strong magnetic fields.

I would suggest that it might be worth while to carry out experiments with rotations in weak magnetic fields and that this might lead to some explanation of the phenomenon.

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Mutants of *Puccinia graminis avenae* induced by Ethyl Methane Sulphonate

Spontaneous mutations affecting urodospore colour in cereal rusts have been observed by several investigators. The mode of inheritance of the mutant colours in the wheat stem rust fungus *Puccinia graminis tritici* E. and H. and oat stem rust fungus *P. graminis avenae* E. and H. has been shown to follow a simple Mendelian pattern[1,2] and such mutants serve as particularly useful markers in investigations of the role of asexual recombination in this group of fungi. In an attempt to produce urodospore