

THE EFFECT OF CENTRIFUGAL FORCE ON OSCILLATORIA.

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Filaments of *Oscillatoria* were centrifuged in order to ascertain if it were possible to displace the contents to any extent. First I used a force of 1,738 gravities. This force did not change the position of the contents in any respect, although the plants were centrifuged two days and four hours. The growth of the filaments also had not ceased and the movements so characteristic of the plant had not been interrupted. The filaments were not harmed in any way by such centrifugal action as a comparison with control specimens showed.

In a second experiment the filaments were subjected to 4,400 gravities for two hours and later to 5,843 gravities for three hours, but no displacement of the contents was caused.

In a third experiment 13,467 gravities were used transversely on the filaments for one hour with no change in the position of the contents; neither cessation of the growth nor of the usual movements. When *Oscillatoria* was centrifuged between the slide and cover-glass the filaments were usually broken, yet very short pieces consisting of a few cells often withstood a force of 1,738 gravities. For the use of very high centrifugal forces, as indicated above, it was necessary to place the filaments directly on the bottom of the glass cylinders and centrifuge them transversely as stated above. The filaments were then broken apart into their disk-like cells and observed from the end, but no displacement of the contents could be seen. The amount of resistance of such delicately constructed plants is rather surprising. It is also interesting to note that in all the experiments with centrifugal force on *Oscillatoria*, the characteristic movements were not stopped or apparently retarded by a force varying from 1,738 gravities to as much as 13,467 gravities. This was shown by specimens of *Oscillatoria* which were placed directly on the bottom of the glass cylinders on the outside of which was fastened a graduated scale. The machine was stopped in a few seconds and by observation it could be seen that the specimens that had been centrifuged for one hour or more and with any amount of centrifugal force had moved or radiated as far as the control specimens had in the same time. These movements

may therefore be carried out under great difficulty and against great resistance, at least of certain kinds such as centrifugal force when applied laterally. In the first experiment on the study of movements when 1,738 gravities were used for one hour, the centrifuged filaments during that time moved or radiated away from the center of the small mass of filaments equally in all directions. Actual measurements showed that the filaments had moved out in the usual way to a distance of 5 mm. The control specimens had also moved 5 mm. during the same time. There was absolutely no difference between the centrifuged specimens and the controls as to the general arrangement or appearance of the filaments which had, in each case, radiated from the very small central mass. In all cases the only requisite was the presence of a very shallow film of water about the specimens.

When the specimens were centrifuged for one hour with a force of 5,000 gravities instead of 1,738 gravities, the amount of movement in both centrifuged and control specimens was exactly the same. Both moved away in a radiating direction from the small central mass 5 mm. during the one hour of experimentation. This shows the amount of movement to be as great, as far as could be determined, in the presence of a force of 5,000 gravities as when 1,738 gravities was used. Longer periods of time than one hour, using 5,000 gravities, were not used, and it has not yet been investigated what effect, if any, this might have on the movements.

In the third experiment, where 13,467 gravities were used, both the centrifuged specimens of *Oscillatoria* and the controls moved 2 mm. during the half-hour of centrifuging. So far then as experiments have been performed, it has not been found possible to stop, or apparently retard, the amount or kind of movements of *Oscillatoria princeps* by centrifugal force. Indiana University.