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Locomotory Movement of the Nucleolus in the Bouquet Stage[1)]

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In the course of the investigation of spore mother cells in meiotic prophase *in vivo*, nucleolar movement was observed in the bouquet stage, which might contribute some knowledge to the study of physiological condition of the nucleus in this stage and to the question of the mechanism of bouquet formation. The results obtained will briefly be reported below.

Material and Method

In *Salvinia natans*, the observation of the nucleolar movement was made with intact spore mother cells lying *in situ* in the sporangium, mounted with a drop of pond water, and in *Acacia Baileyana* with intact pollen mother cells lying *in situ* in the loculus of the anther, mounted with a drop of liquid paraffin or a 0.25M saccharose solution. After the observation, the spore mother cells or the pollen mother cells were fixed with a fixative in order to determine precisely the stage of meiotic prophase in each cell.

Results

Salvinia natans: In the bouquet stage, the nucleus is found displaced from the central position in the cell and takes an eccentric position. The amyloplasts take a localized position in the broader region of the cell produced by the nuclear displacement, and form a group lying close to the nuclear membrane. The nucleus in the intact state shows no visible structure and no visible nuclear membrane except for a nucleolus or nucleoli. The nucleolus is usually ellipsoidal or lenticular in shape.

The nucleolus moves smoothly in the homogeneous-appearing

1) Preliminary note to the "Observational and experimental studies of meiosis with special reference to the bouquet stage XI".

nuclear cavity without showing any vibratory movement. In this locomotory movement, the nucleolus shows no change in shape, but maintains its ellipsoidal or lenticular shape. It is of general occurence that the nucleolus moves with its long axis parallel with the direction of the locomotory movement, though rarely with the axis perpendicular to the locomotion direction. Sometimes, the locomotory movement of the nucleolus may be suddenly interrupted, but recontinues after a short suspension. The nucleolus does not change its own shape, even on the suspension or the recovery of the locomotory movement. The maximum velocity of the locomotion observed was 8.0 micra per minute. The locomotory movement covers the whole area of nuclear cavity, but there is a general tendency of the movement to be carried out in the peripheral region or the region not so remote from the periphery of the nucleus. In some rare cases, two nucleoli are found in the nucleus, and in these cases, the two nucleoli locomote along different paths at different velocities.

The nucleolus, sometimes, makes a rotatory movement not more than one round round its axis, long or short. This movement may be observed when the locomotory movement is suspended, but usually takes place in the course of the smoothly working locomotory movement. When the ellipsoidal nucleolus locomoting in the direction of its long axis makes the rotatory movement round the short axis as wide as 90°, the direction of locomotory movement changes, and a seeming transformation of the nucleolar shape into a spherical one and a change in refractivity of the nucleolus, as a result of this transformation, are observed.

During the locomotory movement, the nucleolus which is generally of the ellipsoidal or lenticular shape, is occasionally found to be transformed into a wedge shape being drawn out into one direction, or into a spindle shape, being drawn out into two opposite directions. In some cases, the drawn out nucleolus is flat on the side parallel to the long axis.[1] The observation of these cells after fixation reveals the fact that in these cases the nucleolus which is drawn out is caught by a chromosome thread or threads and that which is flattened is adhering to the nuclear membrane.

1) In spore mother cells treated with some narcotics or respiratory inhibitors, besides these transformations of nucleolar shape, the transformations into a kidney shape, a crescent shape, a tadpole-like shape, and, in an extreme case, an amaeboid shape, are observed.

Acacia Baileyana: In the bouquet stage, one spherical nucleolus is observed in the nucleus which appears quite homogeneous. The nucleolus makes, as in *Salvinia*, a smooth locomotory movement in the nuclear cavity, maintaining its shape which is spherical in this plant. The maximum velocity of the locomotory movement observed in this case was 3.9 micra per minute.

In the meiotic prophase stages other than the bouquet stage, no movement of the nucleolus is observed in both *Salvinia* and *Acacia* so far as the present observation is concerned.

Conclusion

In *Salvinia* and *Acacia*, locomotory movement of the nucleolus is observed in the bouquet stage in spore or pollen mother cells *in vivo*, a movement by which it is shown that the karyolymph is of a low viscosity in this stage. The movement is carried out smoothly, and during the movement no recognizable change in shape of the nucleolus is observed. The movement may suddenly be suspended, but recontinues, and in these cases too, there is observable no transformation of the nucleolar shape into irregular ones. The transformation of the nucleolar shape takes place only when the nucleolus is caught by a chromosome thread or threads or when it is adhering to the nuclear membrane. On the ground that if a change in surface tension of the nucleolus is the main cause of bringing about the locomotory movement, the nucleolus must change its shape during the locomotion, these facts may be taken as suggesting that the locomotory movement is not due to a change in surface tension of the nucleolus, but to a streaming or streamings of karyolymph which may take place in this stage (cf. WEISS, 1878). These streamings of karyolymph, if they really exist, must play some important role, so we may conclude, in the presentation of a regular arrangement of chromosome threads into bouquet in the bouquet stage.

Literature cited

WEISS, G. A. (1878) Allgemeine Botanik. Bd. 1. Anatomie der Pflanzen.

ERRATA

Vol. XIX, No. 1, Art. 6. Enzyme activity in *Lilium* anthers.

P. 27, line 2: delete which.

P. 31, line 4 from bottom: for from, read form.