Nuclear Division in *Bangia fuscopurpurea* (DILLWYN) LYNGBYE

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Bangia fuscopurpurea (DILLWYN) LYNGBYE is one of the common red algae in Japan, growing on littoral rocks from early spring to summer. The chromosome number of this alga has already been reported by DANGEARD (1927) to be three in the haploid cells. As nobody in Japan has ever treated this species cytologically, I attempted the smear and paraffin methods with the materials collected in July, 1965 and 1966, at Oshoro Bay. The materials were kept alive in the laboratory of the Oshoro Marine Biological Station and fixed at mid-night on the day were collected with alcohol acetic acid (3:1) for the smear method or with Navashin's solution and preserved in 75% alcohol for the paraffin method. The staining in the former method was done with aceto-iron-haematoxylin-chloral hydrate solution recommended by W. WITTMANN (1965) and, in the latter, with Heidenhain's haematoxylin after the material had been cut 3–4 μ thick.

Results obtained by the smear method

The mitotic figures observed by the smear method are shown Plates I–IV. The nuclei in the metaphase of the vegetative division were often observed in a young thallus consisting of uniseriate cells and also occasionally in the uniseriate basal portion of a fertile thallus. In fertile portions numerous mitotic figures in various stages of division were observed (Pl. I, figs. 8–9). The nuclear division in the somatic cells follows the same process as in the spermatium- and carpospore-formation. In early prophase, the nucleolus usually disappears and the chromatin threads make their appearence within the nuclear cavity (Pl. II, fig. 10; Pl. III, fig. 23). These chromatin threads gradually become chromosomes. In late prophase and early metaphase, each chromosome takes a V-shape. In metaphase, the nuclear membrane vanishes completely, and occasionally in a side view of metaphase the spindly fibers were observed. A centrosome was not observed at the pole of the spindle (Pl. IV, figs. 34 & 39). In the metaphase nuclei of vegetative and fertile cells I could count 3 chromosomes in most of the thalli and also 4 chromosomes in some others. In anaphase, the spindle fibers are clearly observed between the groups of daughter chromosomes migrating to the pole (Pl. IV, figs. 41–43). Each chromosome group migrates further and finally reaches the polar

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position of the longitudinal axis of the cell. In telophase, the chromosomes disappear, and the nuclear membrane and nucleolus make their appearence again. About this stage, a cleavage of the cytoplasm occurs from the periphery. The cleavage sometimes begins already in the metaphase stage. The process of the nuclear division described here is very similer to that observed in *Porphyra umbilicalis* (KRISHNAMURTHY, 1959) and in *Porphyra yezoensis* and *P. onoi* (YABU & TOKIDA, 1963). The existence of the prototrichogyne in the carpogonia is shown in Pl. II, figs. 14–15 and Pl. IV, fig. 38. The number of chromosomes counted in the metaphase of the fertilized nuclei were 6 in many of the thalli, but 8 in others.

Results obtained by the paraffin method

In the paraffin method, a number of thalli are imbeded together in a paraffin block, so their sections mounted on a slide glass are quite heterogeneous in nature making the identification of sex of fertile cells uncertain except when the cells are fully mature. In early prophase and late telophase, the nucleolus in a nucleus was often found to be two in number but rarely three or more. The nucleolus is sometimes still visible in late prophase (Pl. V, fig. 48). The chromosomes observed in metaphase are always somewhat smaller than those in a smeared preparation and usually granular in shape, never taking a V-shape. Similar to the results obtained by the smear method, the number of chromosomes observed in paraffin sections was 3 or 4 in a vegetative cell (Pl. V, figs. 48–51) and 6 or 8 in a fertilized one (Pl. V, figs. 64–67).

Summary

Bangia fuscopurpurea collected in Oshoro Bay, Hokkaido, was found to be a haploid alga. The haploid chromosome number was 3 in most of the thalli, but a few thalli in which the chromosome number was 4 were also found. The diploid chromosomes in the fertilized carpogonia and their derivatives were 6 or 8 in number.

Literature

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YABU, H. & TOKIDA, J. (1963). Mitosis in Porphyra. Bull. Fac. Fish., Hokkaido Univ., **14** (3), 131–136.

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Explanation of Plates

PLATE I

Bangia fuscopurpurea (DILLWYN) LYNGBYE

Photomicrographs of various parts of one and the same male thallus treated by the smear method, showing haploid chromosomes ($n=3$)

Fig. 1. Showing a nucleus in the early metaphase of vegetative division, with a V-shaped chromosome in the center

Fig. 2. The same nucleus as in Fig. 1, focused at a different level, showing two V-shaped chromosomes

Fig. 3. A side view of a nucleus in the metaphase of the first nuclear division in spermatium formation

Fig. 4. A nucleus in late prophase in spermatium formation

Figs. 5–6. A nucleus in metaphase in spermatium formation, showing three chromosomes

Fig. 7. A nucleus in anaphase

Figs. 8–9. Many nuclei stained dark in spermatium-forming cells; the arrow points to a side view of a nucleus in the metaphase with three chromosomes

(Figs. 1–5 & 9, ×800; Figs. 6–7, ×1000; Fig. 8, ×320)

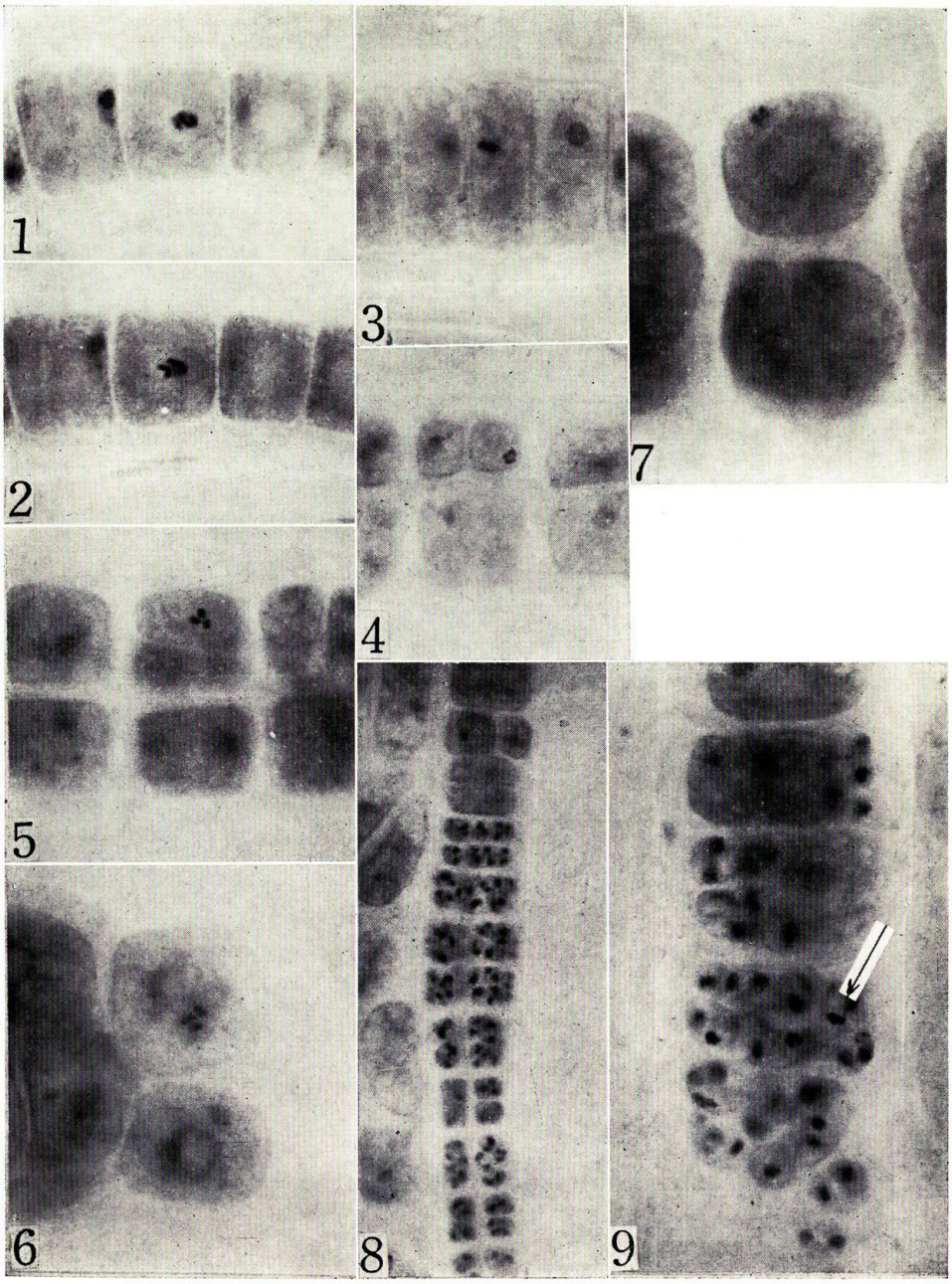

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PLATE II

Bangia fuscopurpurea (DILLWYN) LYNGBYE

Photomicrographs of various parts of one and the same female thallus (Figs. 10, 11, 12, 14, 16 and 17) and of their female thalli treated by the smear method

Fig. 10. A vegetative cell in the basal part of a thallus, showing a nucleus in early prophase

Fig. 11. A vegetative basal cell of a thallus, showing a nucleus in late prophase

Figs. 12–13. A nucleus in early metaphase in carpogonium formation

Figs. 14–15. A carpogonium with prototrichogyne on which is attached a spermatium

Fig. 16. A fertilized nucleus in metaphase, showing six chromosomes

Fig. 17. A fertilized nucleus in anaphase

(Figs. 10–13 & 16–17, ×800; Figs. 14–15, ×500)

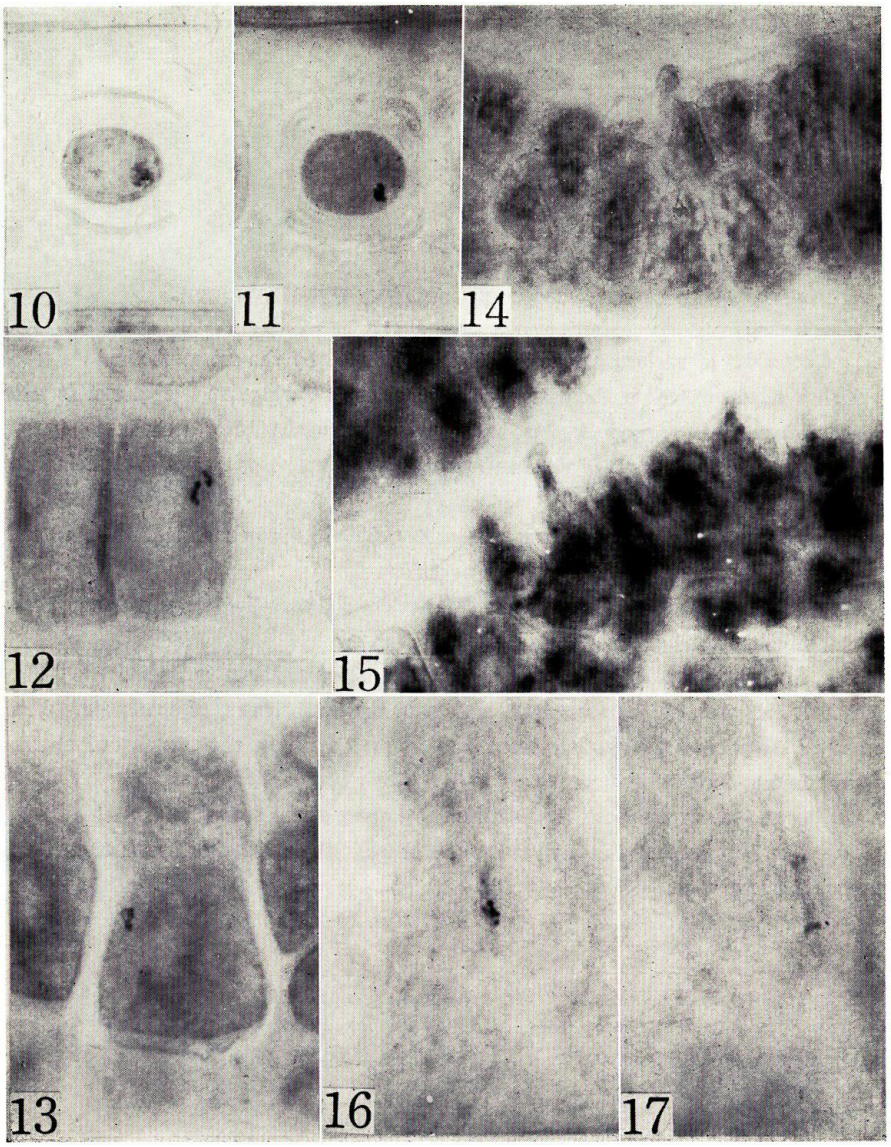

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PLATE III

Bangia fuscopurpurea (DILLWYN) LYNGBYE

Cells in various parts of male thalli treated by the smear method

Fig. 18. A vegetative cell in the basal part of a thallus, showing daughter nuclei at telophase

Fig. 19. A nucleus in early metaphase in a cell at the basal part of a thallus

Fig. 20. Two vegetative cells in the basal part of a thallus, showing nuclei in metaphase and late anaphase ($n=4$)

Fig. 21. Six vegetative cells, showing resting nuclei stained black and situated in each cell on the same side under the thallus surface

Fig. 22. Three vegetative cells, showing two nuclei in the resting stage and one nucleus in prophase

Fig. 23. A nucleus in prophase in the first division of spermatium formation

Fig. 24. A side view of the metaphase nucleus in the first division of spermatium formation

Figs. 25–27. Nuclei in the resting stage and in metaphase in the division of spermatium formation ($n=3$ and 4)

Fig. 28. A nucleus in anaphase in the division of spermatium formation

Fig. 29. Nuclei in prophase, metaphase and anaphase in the division of spermatium formation

Fig. 30. A spermatium

(Figs. 18–24 & 27–28, ×1480; Figs. 25–26 & 29–30, ×940)

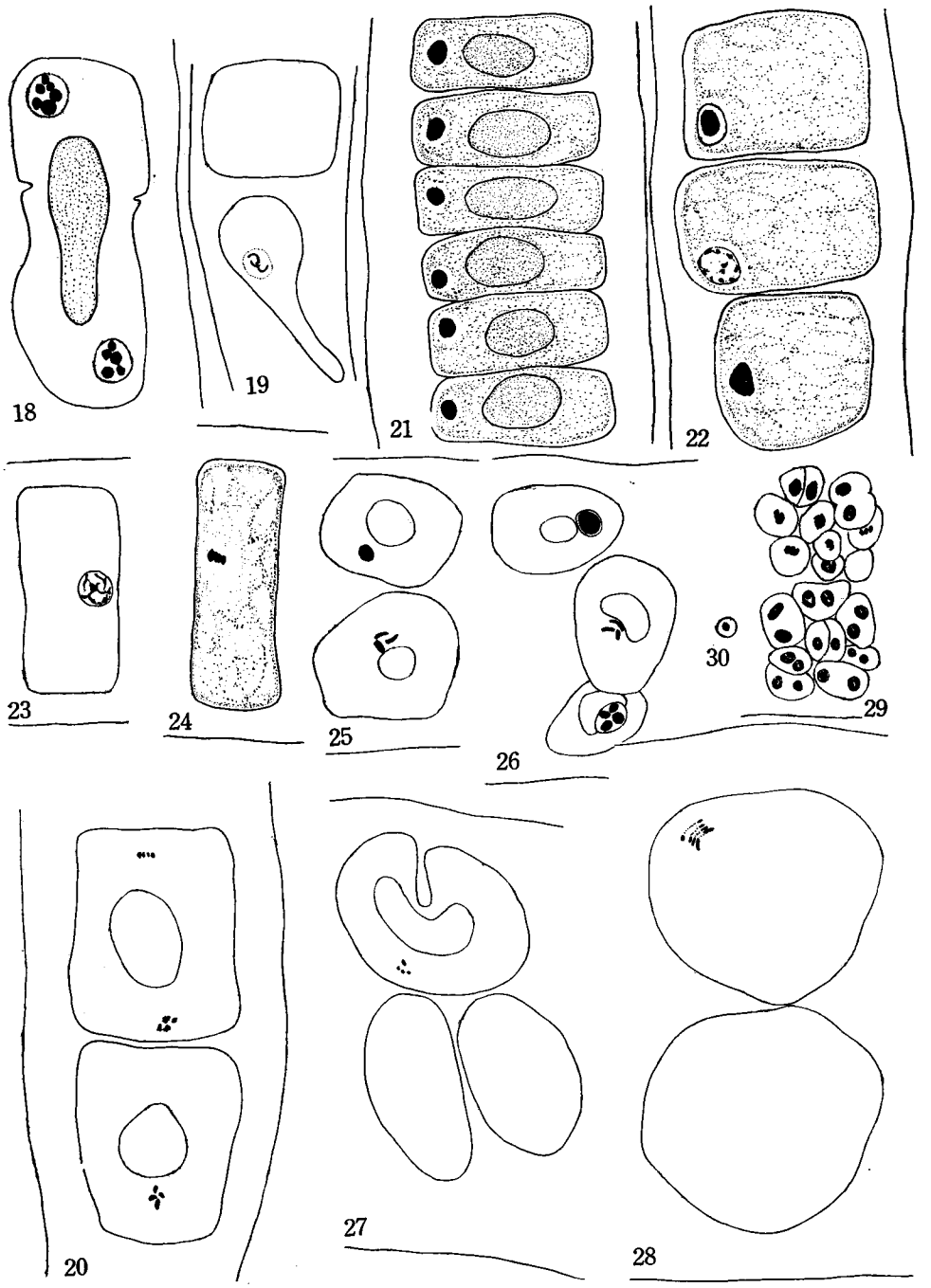

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PLATE IV

Bangia fuscopurpurea (DILLWYN) LYNGBYE

Cells in various parts of female thalli treated by the smear method

Fig. 31. A vegetative cell in the basal part of the thallus, showing nucleus in prophase

Fig. 32. A vegetative cell in the basal part of the thallus, showing a nucleus in metaphase

Fig. 33. A nucleus in metaphase

Fig. 34. A side view of a nucleus of metaphase

Figs. 35–37. A nucleus in metrphase ($n=4$)

Fig. 38. Three carpogonia with prototrichogyne on which is attached a spermatium

Figs. 39–40. A fertilized nucleus in metaphase ($2n=6$ and 8)

Figs. 41–43. A fertilized nucleus in anahapse

(Figs. 31–32 & 34–37, ×1480; Figs. 33 & 39–43, ×940; Fig. 38, ×580)

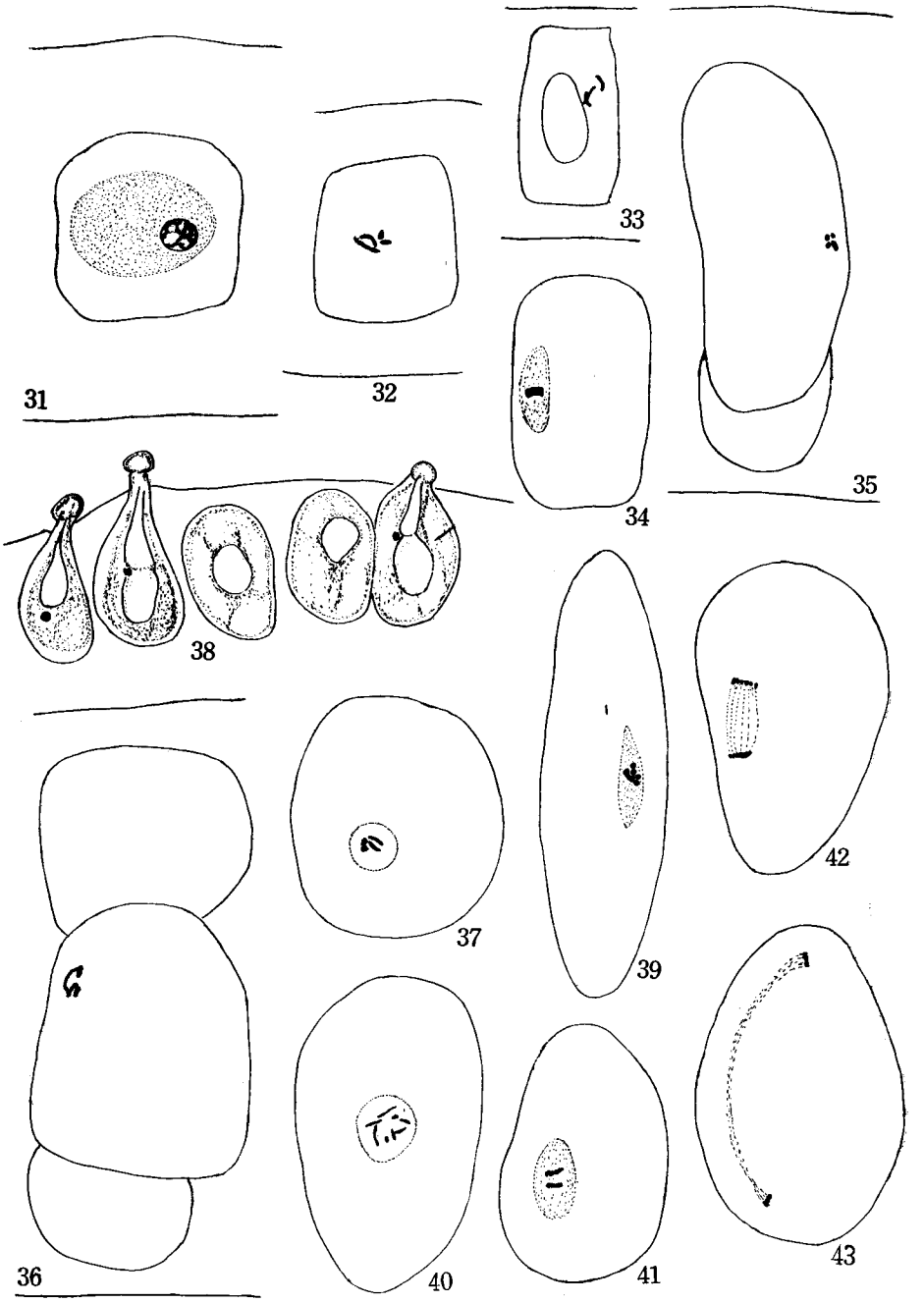

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PLATE V

Bangia fuscopurpurea (DILLWYN) LYNGBYE

Cells in sections of various thalli treated by the paraffin method

Figs. 44–47. Part of young thallus, showing nuclei in the resting stages and in telophase

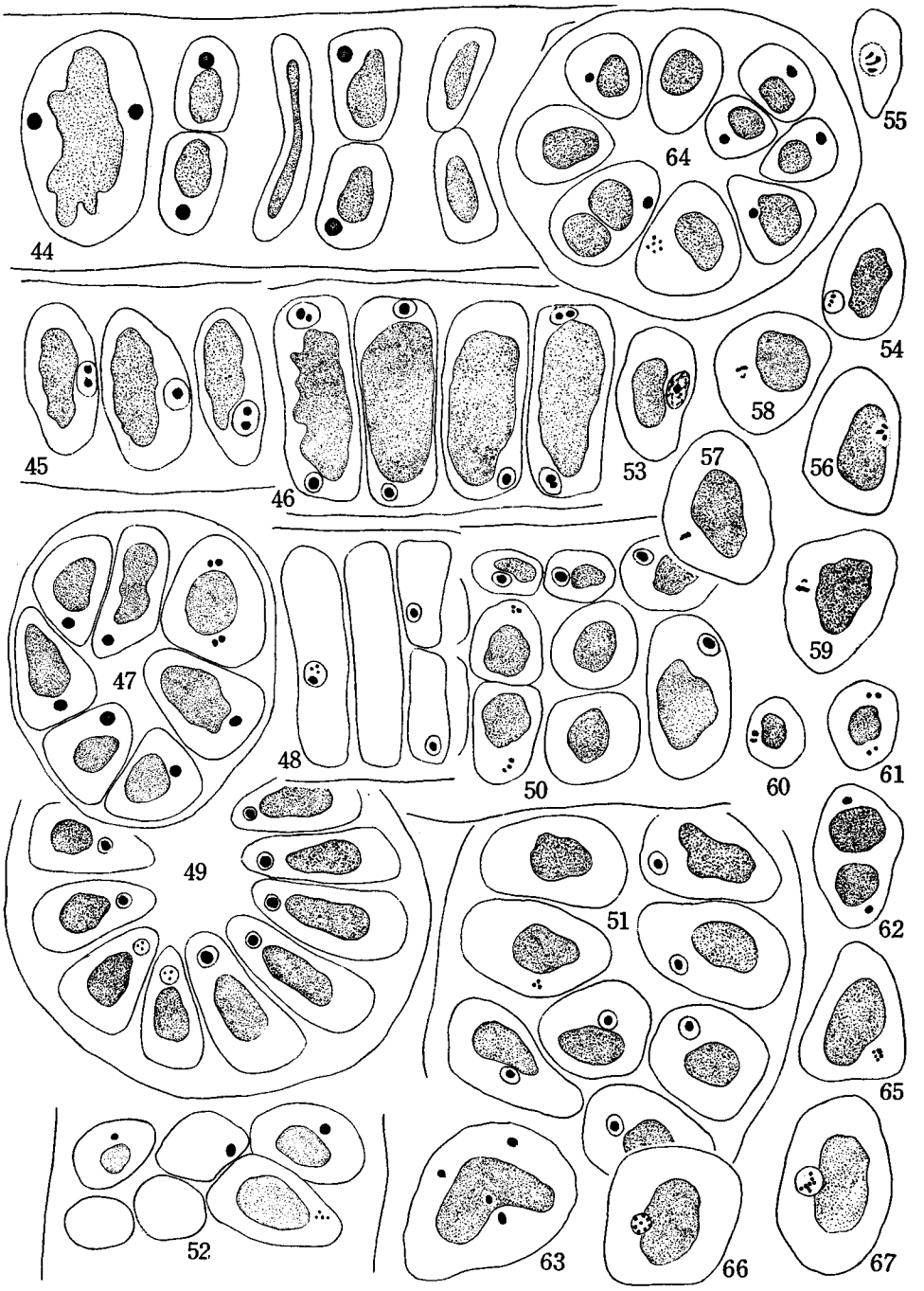
Figs. 48–49. Part of the young thallus, showing nuclei in the the resting stage and in late prophase ($n=3$)

Figs. 50–52. Showing nuclei in the resting stage and in metaphase ($n=3$ and 4)

Figs. 53–63. Various stages of nuclear division in antheridium formation ($n=3$): 53, early prophase; 54–55, later prophase; 56, a polar view of metaphase; 57–59, a side view of metaphase; 60, anahapse; 61–62, two nuclei in telophase in the second division; cell is not divided yet.

Figs. 64–67. Fertilized nucleus in metaphase (64–65) and in late prophase (66–67) ($2n=6$ and 8)

(Figs. 44–67, ×1150)



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