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## NUCLEAR DIVISION IN *ULVA PERTUSA* KJELLM.

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Nuclear division in *Ulva pertusa* Kjellm. was previously reported by Yabu and Tokida in 1960, but it was only confined to the zoospore formation. They stated that the haploid chromosome number of this alga was thirteen and in the side view of metaphase centrosome-like body was observed at the pole of the spindle. Recently Yabu and Tokida (1966) reported that iron-aceto-haematoxylin-chloral hydrate staining method recommended by Wittmann in 1965 gave satisfactory results in staining chromosomes of algae. We attempted this staining method on *Ulva pertusa* and obtained many good figures of dividing nuclei in somatic and fertile cells in both sporophyte and gametophyte. The materials used in this study were collected at Nanaehama near Hakodate City in May, 1968. After collection they were kept alive in glass vessels filled with sea-water in the laboratory. Parts of the thalli were fixed in various times between 10.30 p.m. and 0.30 a.m. with aceto-alcohol solution (1:3).

*Nuclear division in somatic cells* Nucleus in somatic cells is very small in resting stage. At the beginning of the nuclear division, nucleus rapidly increases in size and it attains up to about  $10\mu$  in diameter. For a short period limited in very early prophase, chromocenter which is oval in shape makes its appearance in a nuclear cavity (Pl. I, Figs. A & B; Pl. II, Fig. A). Number of chromocenter is usually two but rarely one in the cells of gametophyte and vice versa in those of sporophyte. This chromocenter soon takes a position closely associated with nucleolus. In the next stage some small chromatin granules become to be found within the nuclear cavity. After a short while chromosomes began to be visible. The number of chromosomes counted at late prophase and metaphase was eighteen in sporophytes and nine in gametophytes. Of these chromosomes one in gametophytes and often two in sporophytes were found to be somewhat larger in size than others. Occasionally nucleolus was seen to persist at metaphase (Pl. II, Fig. G).

*Nuclear division in swarmer formation* Chromocenter does not appear in nuclear divisions leading to swarmer formation. In *Ulva pertusa* as already reported by Yabu and Tokida (1960), meiosis occurs in the first division in zoospore formation. The stage at diakinesis in that first division was abundant in our preparations. In this stage the nucleus attains its maximum size through the

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nuclear division of swarmer formation and chromosomes widely scatter within the nuclear cavity, so the number of chromosomes could be easily counted. Each chromosome differs in shape and size. Two or three chromosomes among larger ones often take O-shape in early diakinesis stage (Pl. I, Figs. D-G). The number of chromosomes observed at diakinesis and early metaphase was mostly nine, but

Table 1. Chromosome number counted at diakinesis and early metaphase from one hundred nuclei with particularly good chromosome definition in the first nuclear division leading to zoospore formation

Chromosome number	13	12	11	10	9	8	7
Number of nuclei	4	5	12	7	62	6	4

occasionally up to thirteen as shown in Table 1. With the progress of stages from diakinesis to metaphase nucleus becomes smaller in size and each chromosome becomes granular in shape. After the first nuclear division is finished, successive divisions are repeated. In these divisions nine chromosomes were counted in many of the nuclei. Dividing figures of nuclei in gamete formation are given in Pl. I, Figs. O & P and Pl. III. At late prophase and early metaphase of the first division in gamete formation, nine chromosomes were often easily counted. In the side view of metaphase of the nuclear divisions in swarmer formation none of the centrosome or centrosome-like body was observed at the pole of the nucleus. Sometimes precocious chromosome which removed already to the pole is seen in the side view. Therefore, the body which was described in the preceding paper (Yabu & Tokida, 1960) on the present species as centrosome-like one is confirmed here to be this precocious chromosome. Judging from chromosomes found in somatic divisions and in the nuclear divisions for swarmer formation in sporophyte and gametophyte, the correct number was decided to be nine in haploid and eighteen in diploid. Besides *Ulva pertusa*, the chromosome number of *Ulva* had been reported in two species up to date, viz., in *U. lactuca*  $n=10$  by Carter (1926) and by Sarma (1958), and  $n=13$  and  $2n=26$  by Föyn (1934), and in *U. linza*  $2n=ca.$  24-25 by Levan and Levring (1942) (cf. Godwards, 1966). Thus chromosome in *U. pertusa* is smaller in number than that of the other two species mentioned above.

### Summary

Nuclear division in *Ulva pertusa* Kjellm. was observed in somatic and fertile cells of both sporophyte and gametophyte. In somatic cell division, one or two chromocenters were noticed in early prophase. Number of chromosome was established here to be  $n=9$  and  $2n=18$ . No centrosome or centrosome-like body was found in any of metaphase nuclei.

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## Explanation of Plates

### PLATE I

*Ulva pertusa* Kjellm.

Nuclear divisions in sporophyte and gametophyte

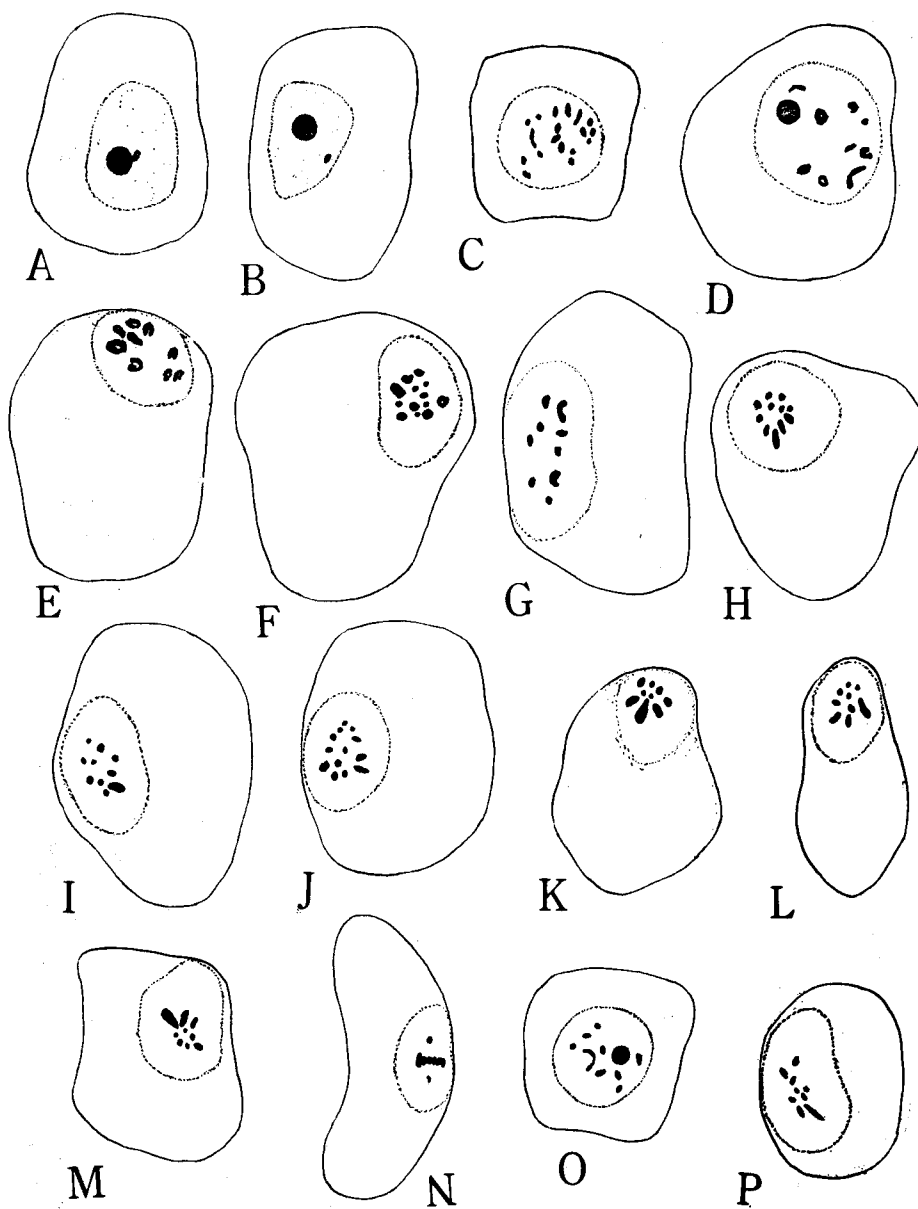
A-C. Stages in somatic cell divisions of sporophyte; A & B, early prophase, showing chromocenter in nuclear cavity; C, metaphase, showing eighteen chromosomes

D-N. Stages at the first division in fertile cells of sporophytes; D & E, diakinesis; F, diakinesis, showing chromosomes in odd number (thirteen); G, late diakinesis; H-J, metaphase, showing chromosomes in odd number (ten to thirteen) K-M, metaphase; M, metaphase in side view, showing the precocious chromosomes each of which removes to the pole of the nucleus

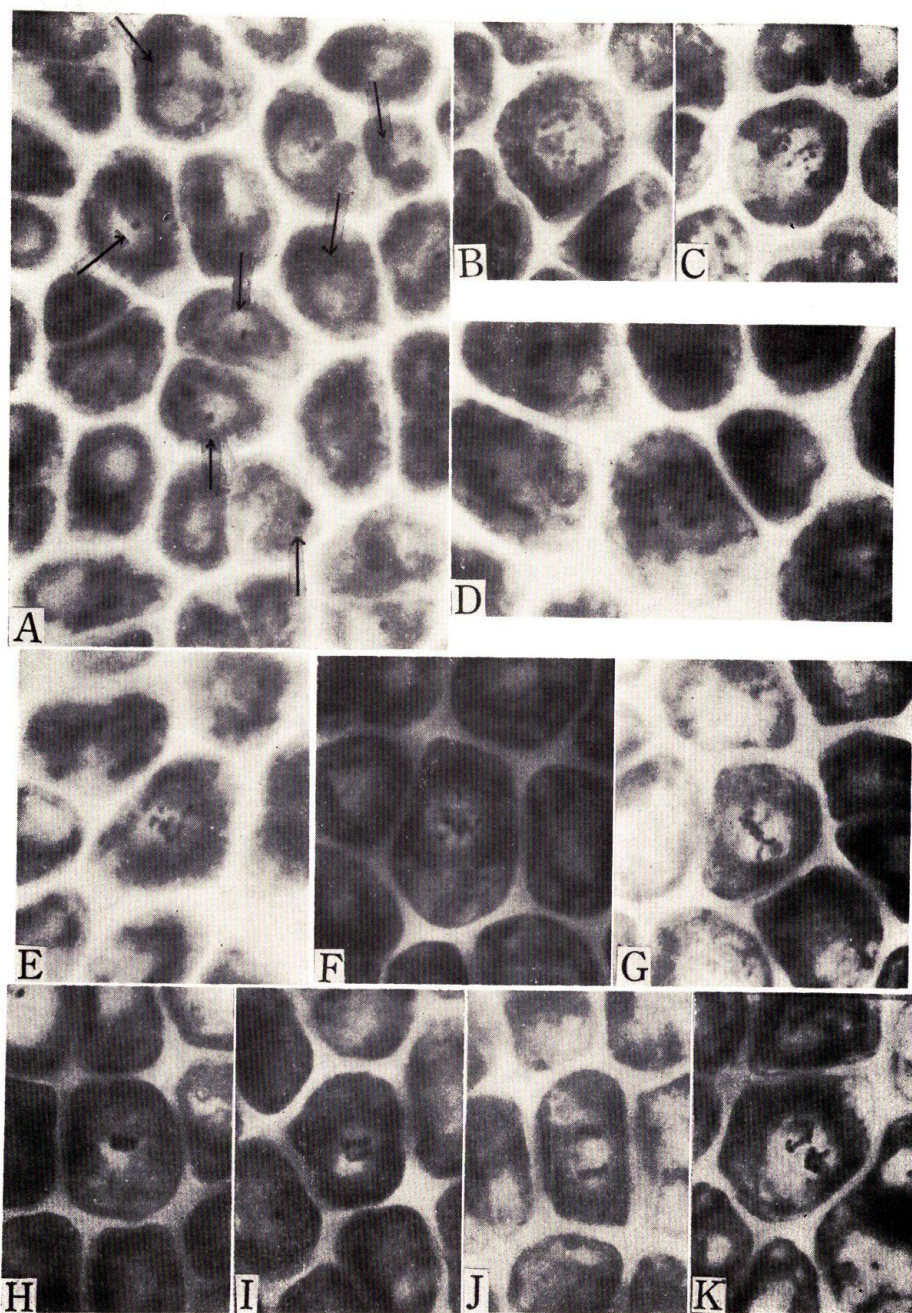
O. Stage at late prophase in somatic cell division of gametophyte

P. Stage at metaphase in the first division in fertile cell of gametophyte

(A-P  $\times$  1950)



H. YABU & C. H. PARK: Nuclear division in *Uva pertusa*



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## PLATE II

*Ulex pertusa* Kjellm.

Nuclear divisions in somatic cells of sporophytes

A. Part of thallus, showing somatic cells with nucleus in early prophase; a chromo-center (pointed by arrows) is seen in each nuclear cavity

B & C. Late prophase

D-G. Metaphase

H. Side view of metaphase

I. Early anaphase

J-K. Anaphase

(A-K,  $\times 1300$ )



## PLATE III

*Ulva pertusa* Kjellm.

Nuclear divisions in fertile cells of sporophytes

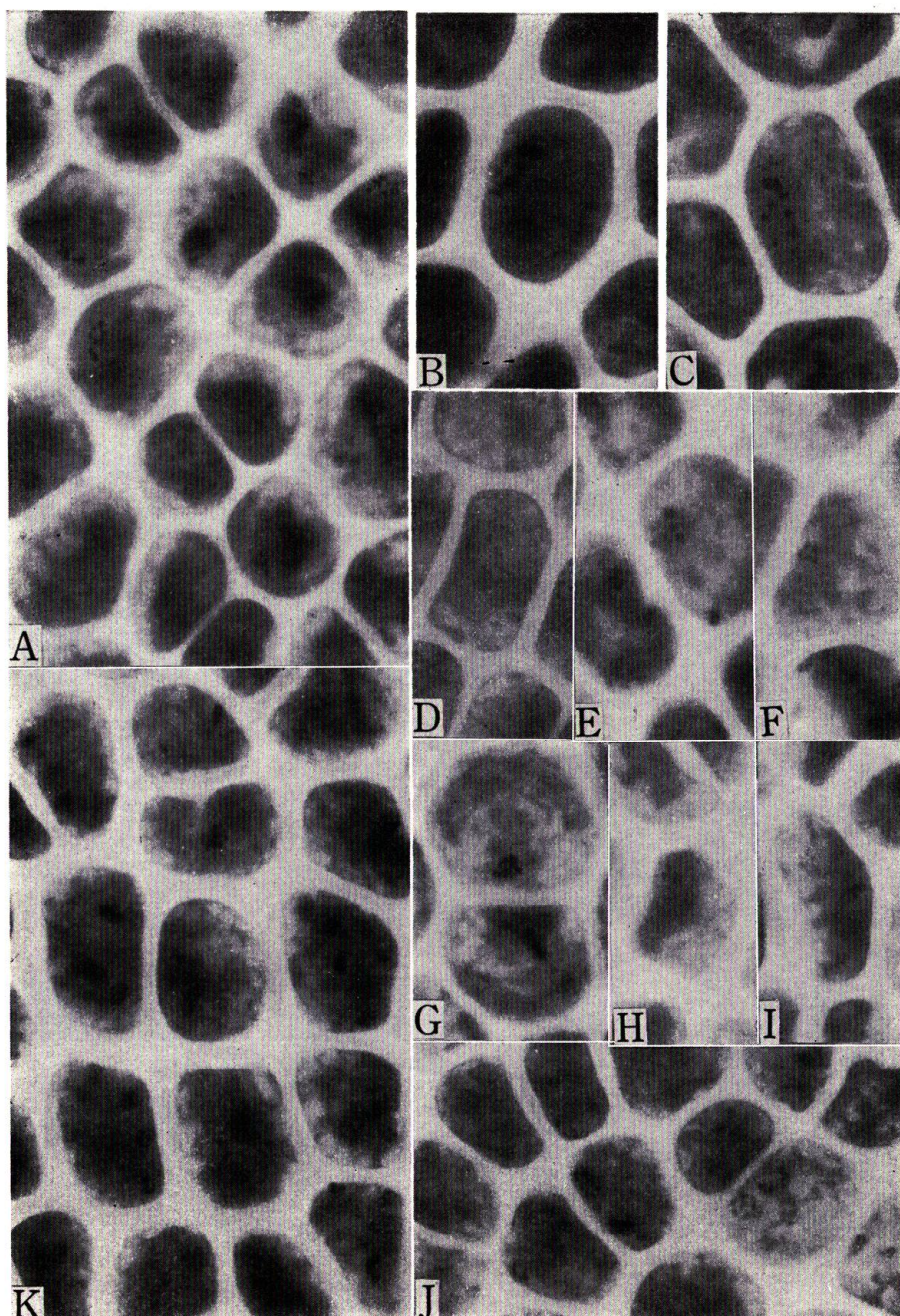
A. Portion of thallus, showing cells with nucleus at metaphase in the first division

B-I. Nuclei at prophase and metaphase in the first division; B, diakinesis; C-G, metaphase; H & I, metaphase in side view, showing precocious chromosomes each of which is removing forwards to the pole of the nucleus

J. Metaphase in the second division

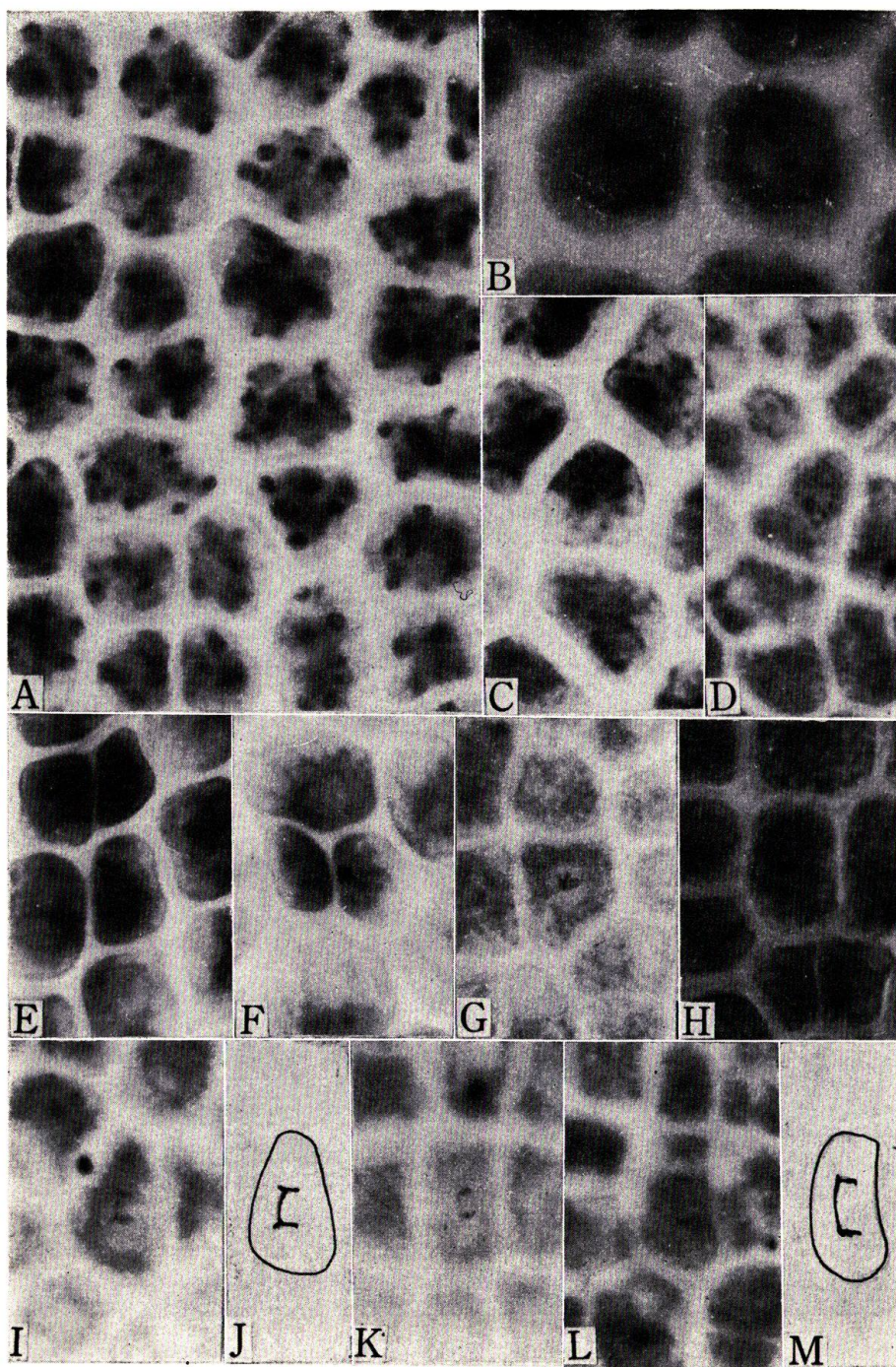
K. Part of thallus, showing nuclear and cell divisions in more advanced stages than Fig. A

(A-K,  $\times 1300$ )



H. YABU & C. H. PARK: Nuclear division in *Ulva pertusa*





H. YABU & C. H. PARK: Nuclear division in *Ulva pertusa*

## PLATE IV

*Ulva pertusa* Kjellm.

Nuclear divisions in gametophytes

- A. Portion of thallus nearly matured
  - B. Side views of metaphase in somatic cell divisions
  - C-M. The first nuclear divisions in fertile cells; C & D, late prophase; E-G, metaphase; H, side view of metaphase; I, K & L, anaphase; J & M, The same figures as shown in Figs. I & L, respectively
- (A, C-L,  $\times 1300$ ; B,  $\times 2000$ )