shorter than normal because of pretreatment effects, ranged from approximately 11 to 5 microns (23 to 11 mm as magnified for study). The centromeres of most of the chromosomes are located in a median position, but some, especially

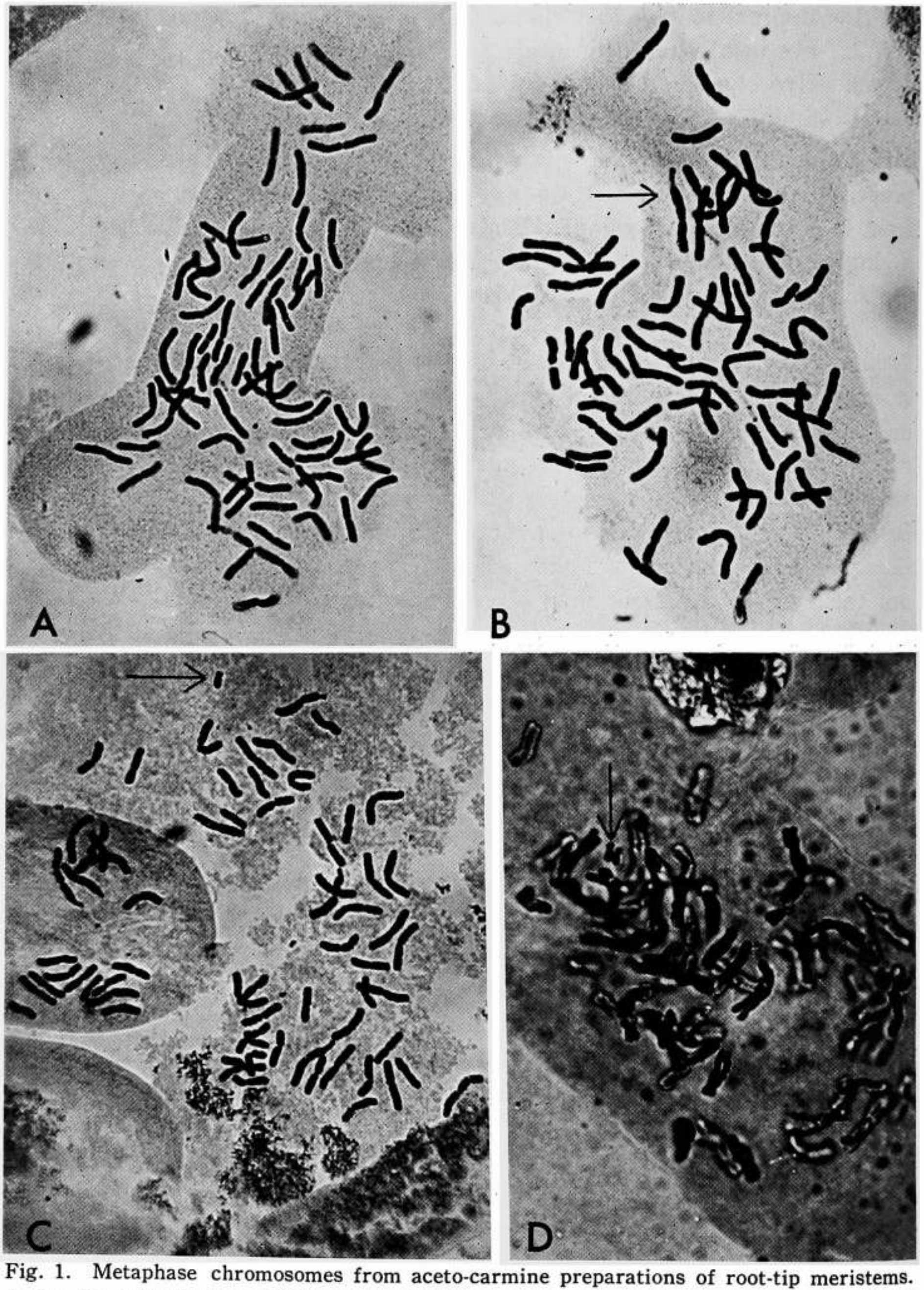

Fig. 1. Metaphase chromosomes from aceto-carmine preparations of root-tip meristems. A, 2n=66 chromosomes. ×800. B, 2n=66 chromosomes (arrow denotes a typical satellited chromosome). ×850. C, 66 normal chromosomes plus one accessory chromosome (arrow). ×750. D, normal replication of accessory chromosome (arrow). ×950.

adjacent positions ranged from 0 to 2.0 mm. Seventy-five percent of these differences were 0.5 mm or less, and the combined error term for the technique is of this magnitude. Under such conditions, the opportunity for chromosome reversals is quite high (Matérn and Simak 1967) and this should be taken into account in all references to the karyotype.

Although it is not possible to easily identify most of the chromosomes individually, they can be arranged into distinct groups according to morphological features. Unusually large differences in the gradually descending order of total lengths occur between adjacent chromosomes in several positions in the arrangement presented in Table 1. The breaks that occur between chromosomes 3-4, 6-7, 15-16, 24-25 and 30-31 are of special interest because they set off groups consisting of three chromosomes or some multiple of three. One of the six groups (chromosomes 7-15) delineated by chromosome length can be further subdivided by grouping together the three chromosomes with satellites. As a result a total of eight natural groups can be formed. This is of interest in that any natural ordering of the chromosomes in groups of three substantiates further the postulated hexaploid nature of this species.

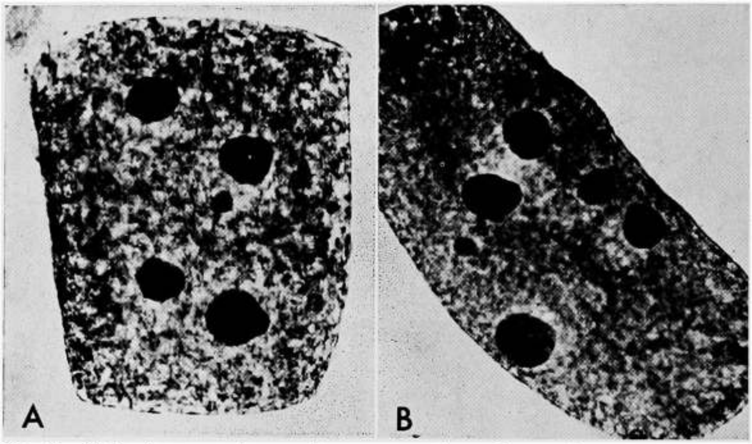

Fig. 2. Cells from aceto-carmine preparation of root-tip meristem. A, four large and one small nucleoli. ×672. B, four large and two small nucleoli. 760×.

The three chromosomes possessing satellites are the easiest to recognize, but because of similarities in size, it is not easy to distinguish between them. The total number of satellited chromosomes observed in the cells ranged from 0 to 6, with the average being slightly over three. Three of the 15 plates drawn had 6 satellited chromosomes; satellites were lacking in only one of the plates.

In most instances, the satellited regions were quite small (Fig. 1B). They were set off from the distal portion of the *a* arm by a region of varying length that stained much lighter than the euchromatic area of the chromosome. It is possible that the variation in length observed in the achromatic region was caused by differential reaction to the pretreatment or stretching that resulted from pressure applied during preparation of the slide. Although