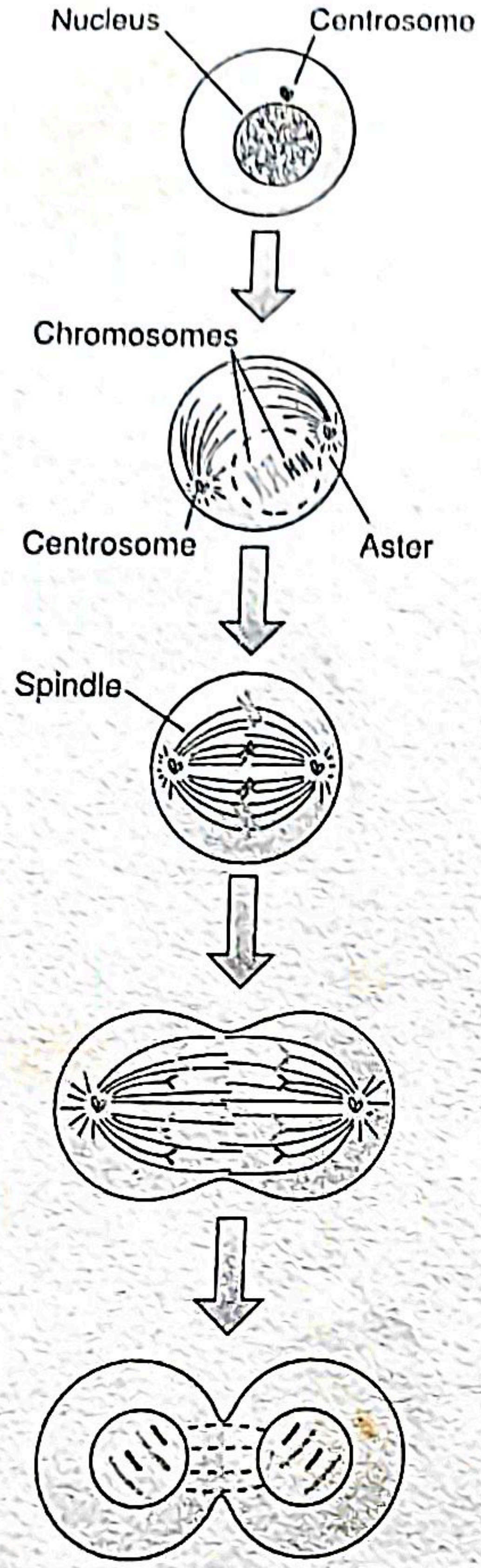

Interphase
- Cell growth
- DNA replication
- Centrosome duplication

Prophase
- Chromosome condensation
- Spindle assembly
- Nuclear envelope breakdown

Metaphase
- Chromosomes attach to spindle and move to spindle equator

Anaphase
- Centromeres split
- Paired chromatids separate and move to spindle poles
- Cytokinesis begins

Telophase
- Chromosomes uncoil
- Spindle disappears
- Nuclear envelopes form
- Cytokinesis completed

Figure 12-20 ***Summary of the Main Events Occurring During Mitosis in an Animal Cell***

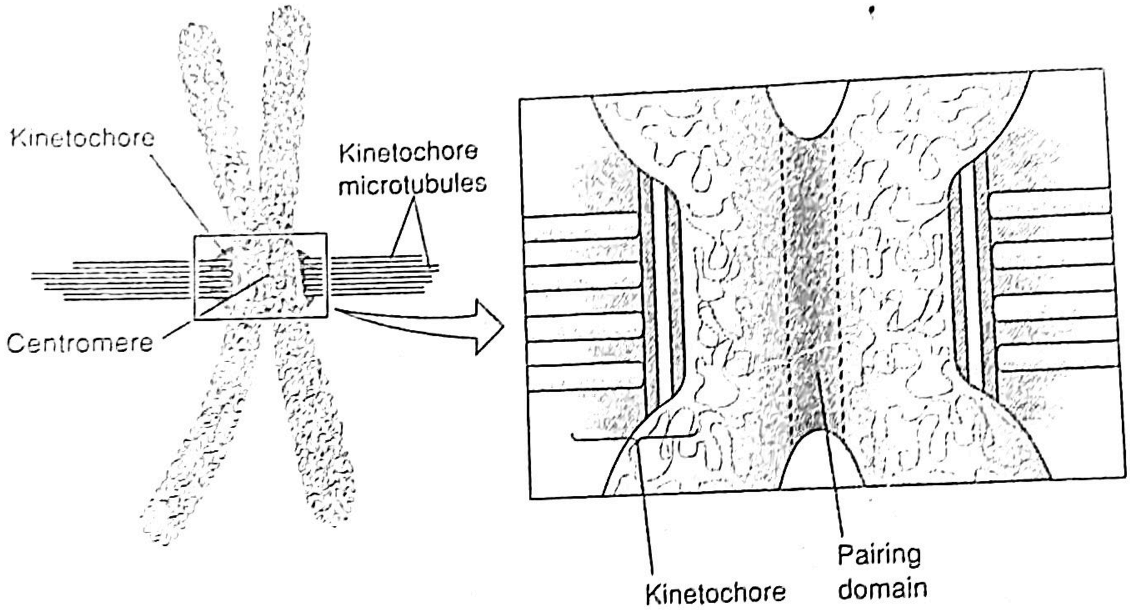

Figure 12-21 ***Organization of the Centromere and Kinetochore in a Mitotic Chromosome*** (Top) *The electron micrograph shows two kinetochores lying on opposite sides of a mitotic chromosome. Each kinetochore appears as a multilayered structure to which several microtubules are bound.* (Bottom) *The schematic diagrams summarize the relationship between kinetochores, kinetochore microtubules, and the centromere. The region of the centromere where the two chromatids come in close contact is called the pairing domain. Micrograph courtesy of M. Schibler.*

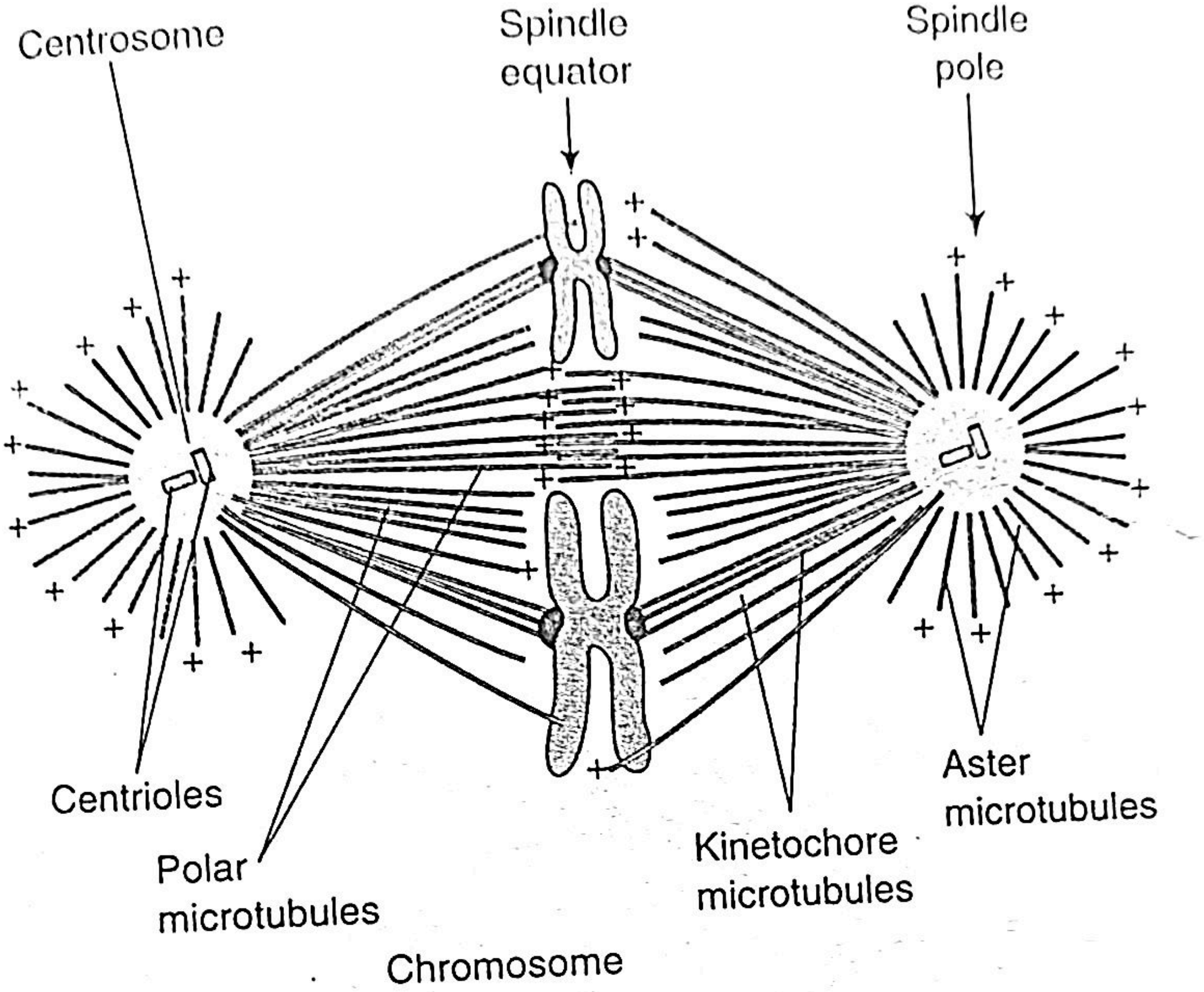

Figure 12-22 *Mitotic Spindle of a Typical Animal Cell* *Spindles contain three kinds of microtubules called aster microtubules, polar microtubules, and kinetochore microtubules. The plus signs indicate the orientation of the microtubules. The plus signs indicate the orientation of the plus ends of the microtubules. In most plant cells the spindle does not contain the pairs of centrioles pictured within each centrosome.*

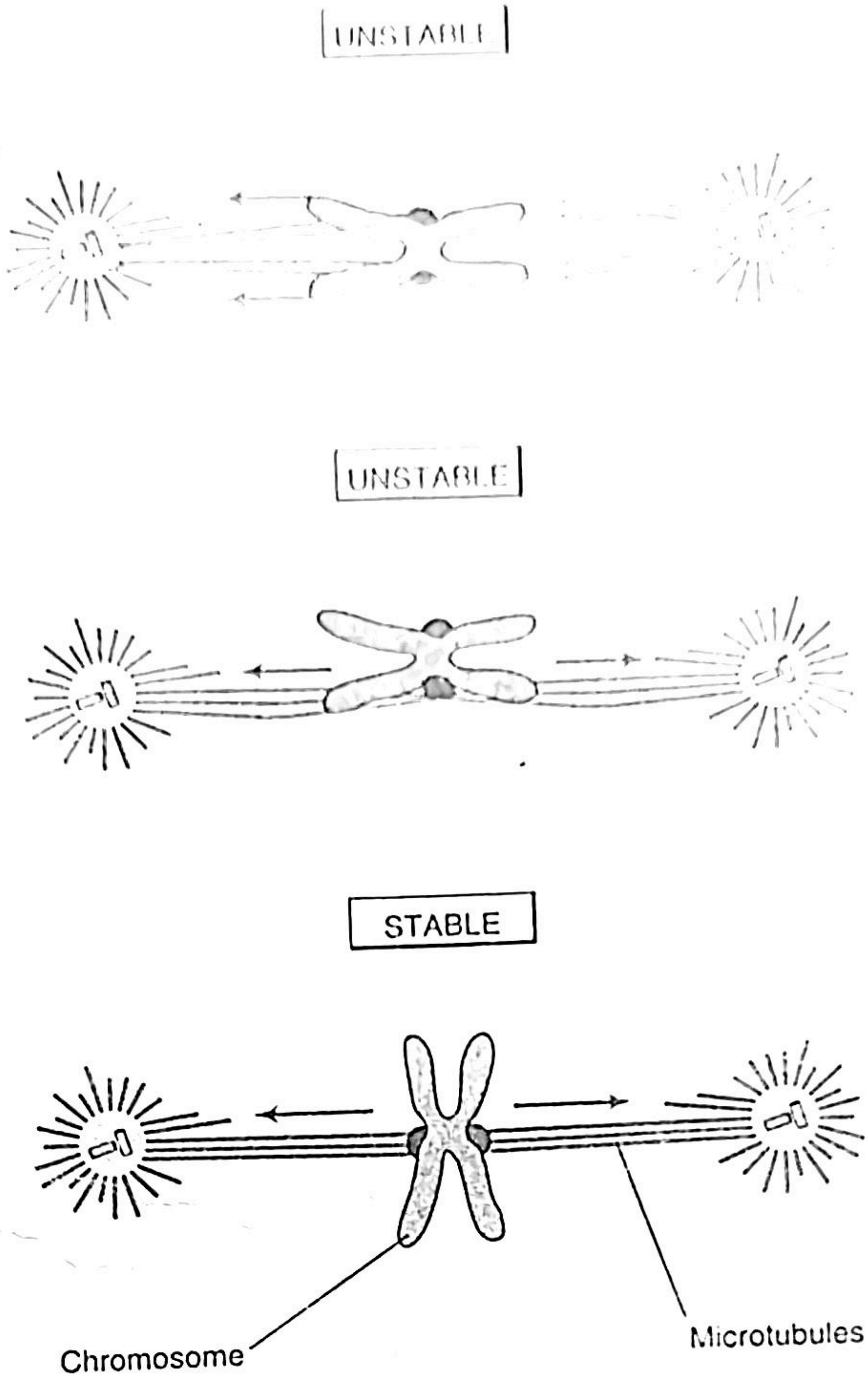

Figure 12-23 Mechanism for Attaching the Members of a Chromatid Pair to Opposite Spindle Poles *The two upper configurations represent mistakes in which two paired chromatids are attached to the same spindle pole, or one chromatid is attached to both poles. When such mistakes occur, the linkage between the kinetochore and the spindle microtubules does not persist. But when the two chromatids are pulled in opposite directions (bottom configuration), the linkage between the kinetochore and the spindle microtubules is stabilized, thereby ensuring that the chromatids will move to opposite poles during anaphase.*

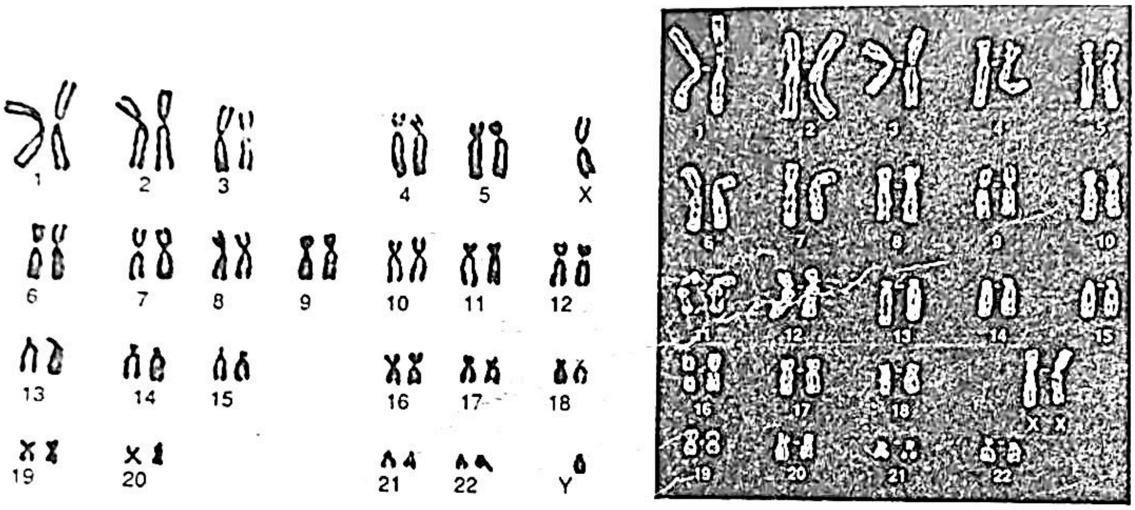

Figure 12-24 ***A Mitotic Karyotype of Human Chromosomes from Metaphase-Arrested Cells*** (Left) *This set of chromosomes obtained from the cells of a human male has been stained with a dye that reacts uniformly with the entire body of the chromosome. Human males contain 22 pairs of chromosomes, plus one X and one Y chromosome. The chromosomes in the karyotype have been arranged according to size and centromere position.* (Right) *This set of human female chromosomes has been stained with dyes that selectively react with certain chromosome regions, creating a unique banding pattern for each type of chromosome. Courtesy of J. F. Gennaro/Photo Researchers* (left) *and CNRI/Science Photo Library/Photo Researchers, Inc.* (right).

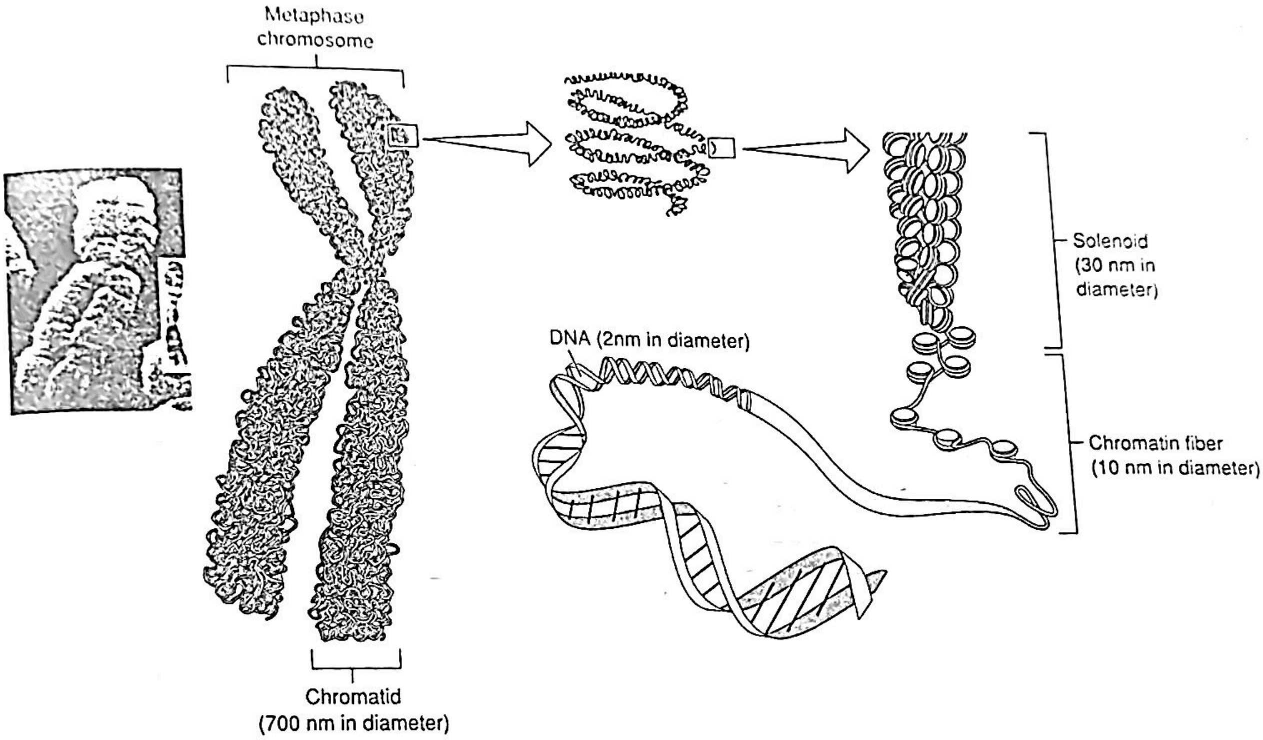

Figure 12-25 ***Structure of Metaphase Chromosomes*** (Left) *In scanning electron micrographs, metaphase chromosomes appear to be constructed from a tightly packed mass of fibers that are thicker than 10-nm or 30-nm chromatin fibers.* (Right) *A model illustrating how chromatin fibers may be packed in metaphase chromosomes. Micrograph courtesy of C. J. Harrison.*

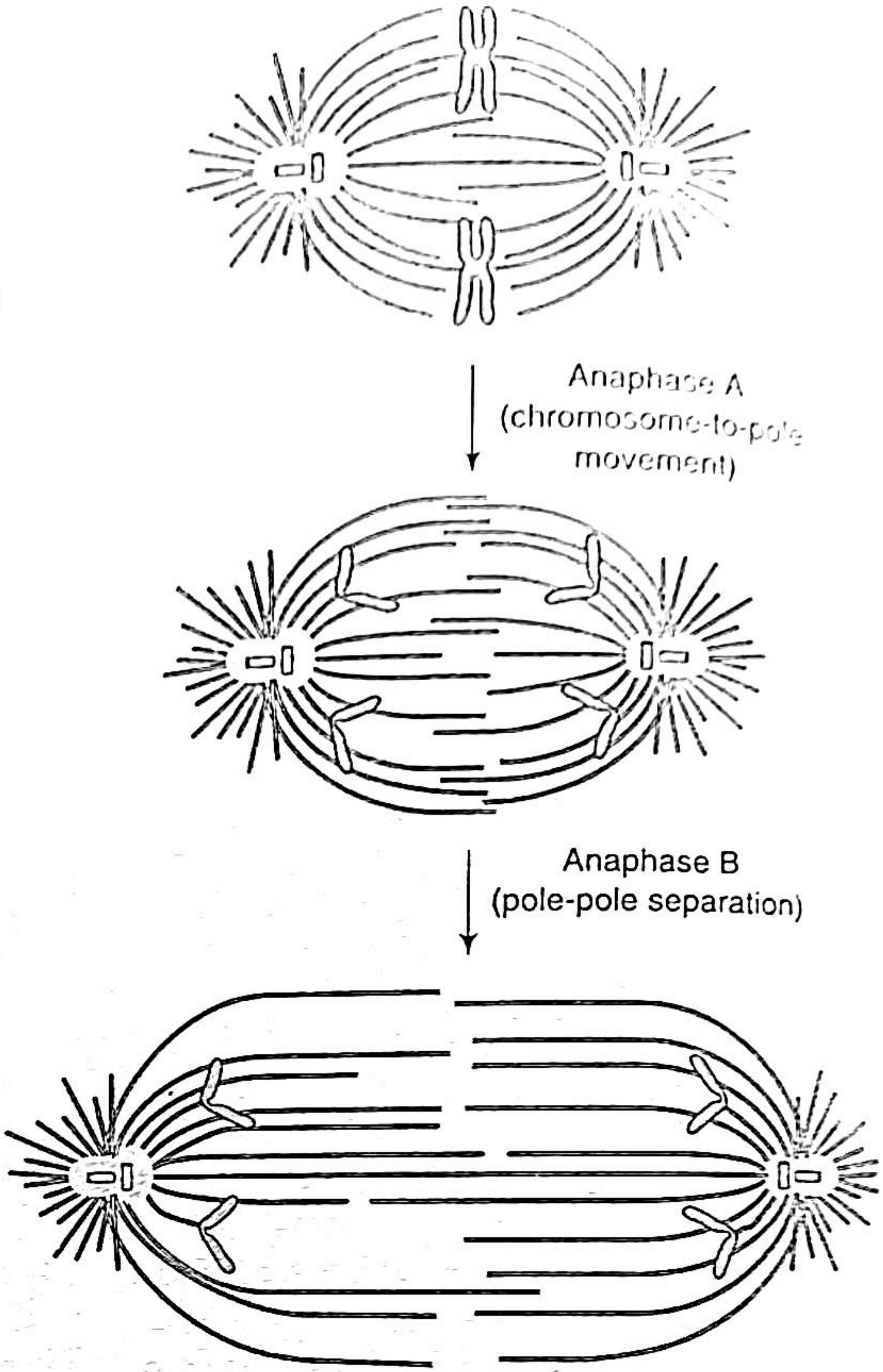

Figure 12-26 The Two Types of Movement Involved in Chromosome Separation During Anaphase *Anaphase A involves the movement of chromosomes toward the spindle pole to which they are attached. Anaphase B is the movement of the two spindle poles away from each other. Anaphase A and anaphase B may occur simultaneously.*

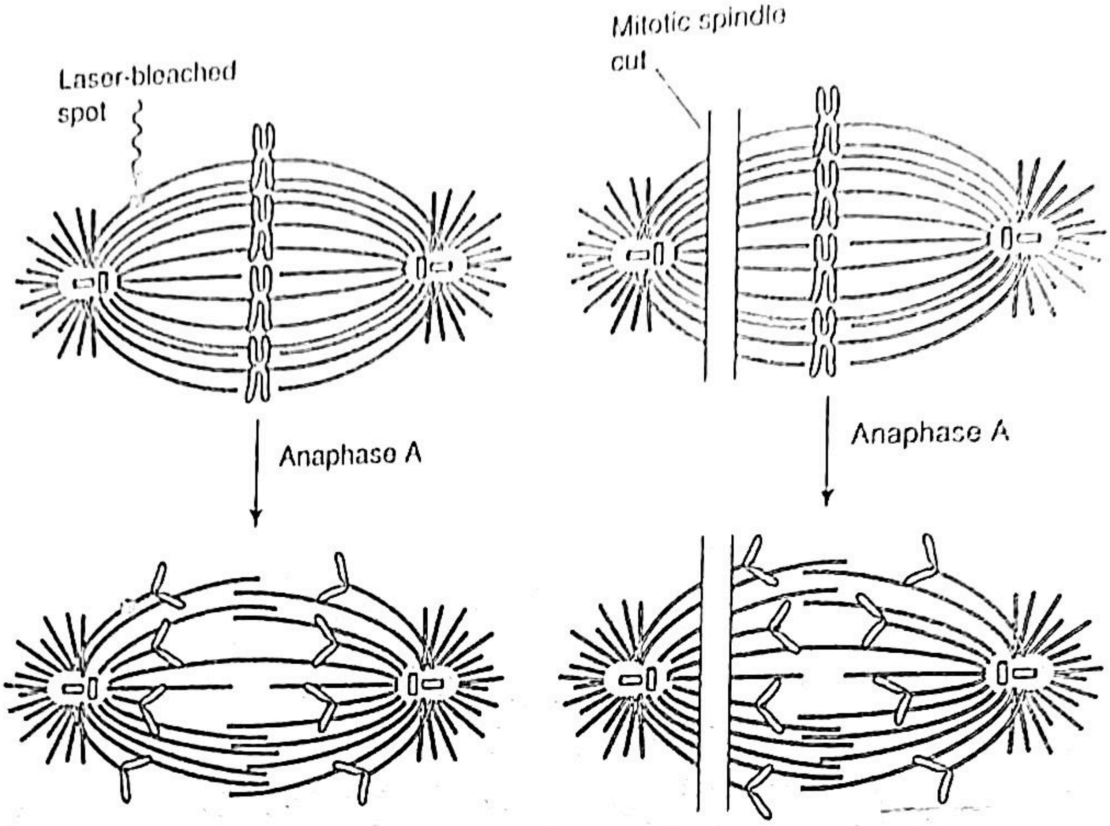

Figure 12-28 *Evidence That Kinetochore Microtubules Remain Stationary as Chromosomes Migrate toward the Spindle Poles* (Left) *Cells were injected with fluorescent tubulin and a laser microbeam was employed to bleach a small spot on one of the kinetochore microtubules. During anaphase A, the bleached spot remains stationary.* (Right) *A tiny glass needle was used to cut the mitotic spindle between the chromosomes and one of the spindle poles. Even though the kinetochore microtubules are no longer attached to the spindle pole, the chromosomes continue to migrate along the stationary kinetochore microtubules.*