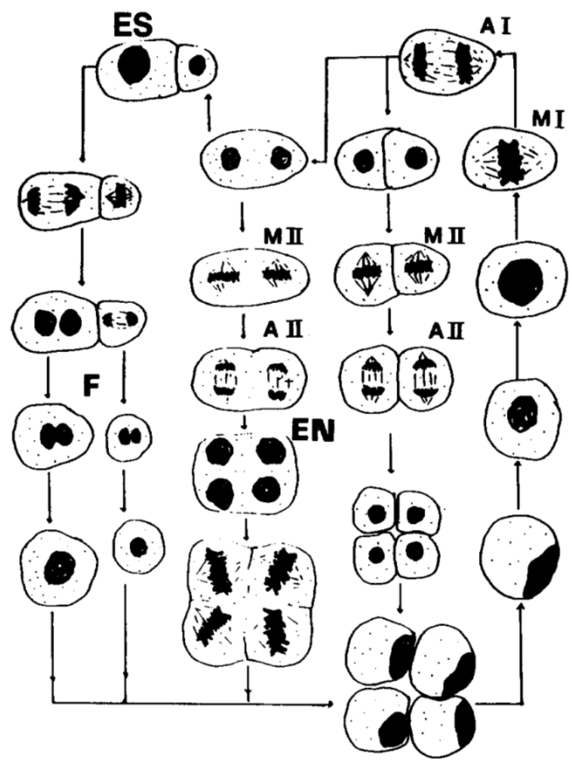
Somatic meiosis

Nuti Ronchi et al, 1992

- First identified in cultured carrot cells
- Verified in cultured arabidopsis cells in 2001 by Chen et al.

- In diagram, after anaphase I, cells may undergo cytokinesis or postpone it until after anaphase II.

- Endopolyploidization doubles the chromosome number, permitting the cycle to be repeated.



Achiasmate meiosis

In theory, chiasma would not be needed if there was an alternate mechanism that would provide the coorientation of the bivalents on the metaphase plate

- In a lot of lower animals, chiasma formation is substituted by a prolonged lateral association of the homologues
  - E.g., ♂ *Drosophila*, chromosome 4 of ♀ *Drosophila*, various dipteran insects, grasshoppers, mantids, mollusks, worms, scorpions, and copepods.
  - These all occur only the heterogametic sex. ‘
- In some cases, the association is maintained by the synaptonemal complex, in others by an unknown mechanism. Recent evidence indicates heterochromatin is involved
- Without, chiasma, there is no crossing over, and the whole chromosome behaves as one linked group
- Derived from chiasmate meiosis, and has evolved independently several times

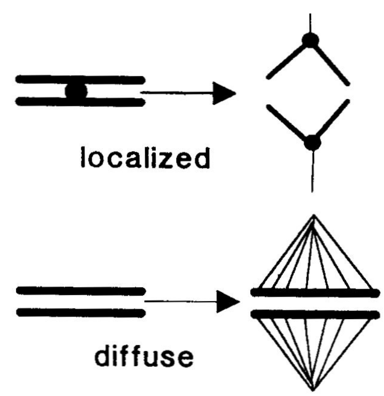
- The only example known in plants is in the PMCs of *Fritillaria*

Metaphase I in PMCs of achiasmatic Fritillaria

Early anaphase I (from John, 1990).

Inverse or inverted meiosis

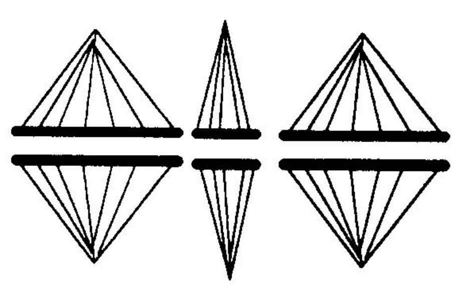
Meiosis in organisms with diffuse centromeres, i.e., the centromere is spread over the entire chromosome instead of being localized in one spot.



- NOT all organisms with diffuse centromeres have inverted meiosis
- Found in coccids, mites, and ticks, so appears to have evolved several times.
- In plants, it is found in *Luzula* spp. (Juncaceae or rushes) and in *Cyperus* (Cyperaceae or sedges). Also Myristicaceae, Melanthiaceae, and Cuscutaceae (*Cuscuta* spp).

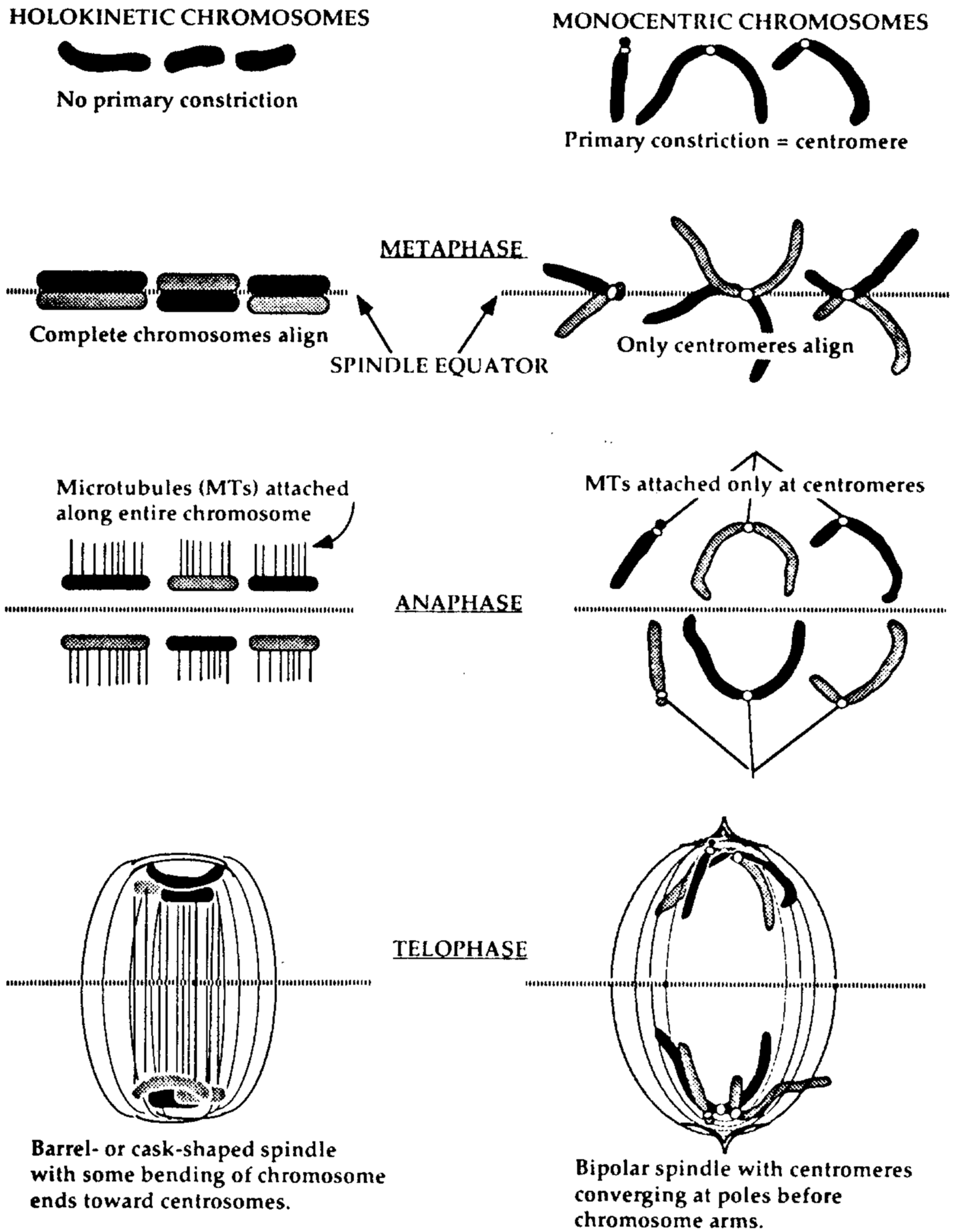
- Such chromosomes are called holocentric (from the Greek holos, meaning whole) + centric (meaning localized in the one place) which is an oxymoron. Another term is holokinetic.

- In centric chromosomes, acentric fragments are lost. In holokinetic chromosomes, fragments are maintained:



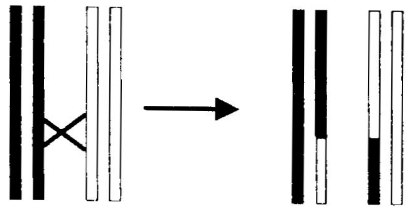
- Leads to agamatoploidy -ploidy based on chromosome fragments– high chromosome numbers are due to fragmentation rather than duplication

First, look at behavior of holokinetic chromosomes during mitosis:

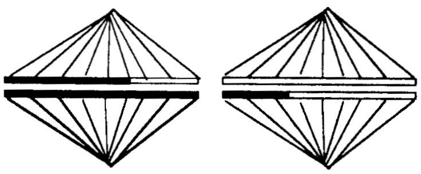


Mitosis with holokinetic chromosomes. Wrensch et al, 1994.

Meiosis with holokinetic chromosomes:



- **Prophase** is normal, although bivalents look more like a ⊙4 (called demibivalents):



- At **metaphase I**: - Chromosomes show auto orientation, as in mitosis
- - Each chromosome has its own spindle

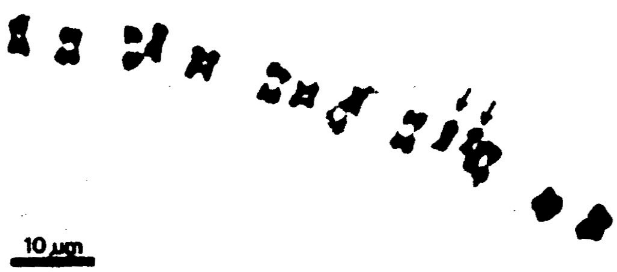
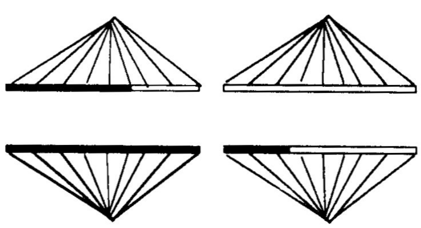


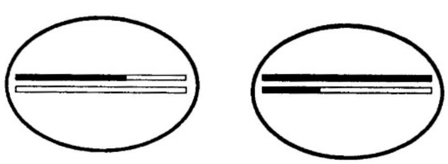
Image from Pazy & Plitmann, 1991.

- Met I in *Cuscuta brevistyla*. Note lack of "V" shape normally associated with this stage.
- Arrows denote a bivalent pair that has started to separate



Anaphase I

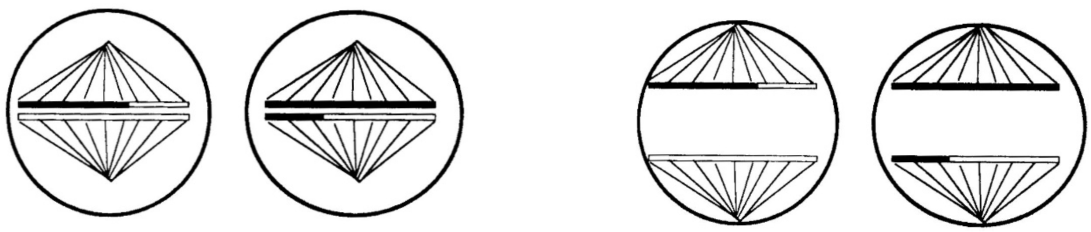
- - Chromosomes exhibit broadside movement
- - Chromosomes remain linear, not V or J shaped.
- - Division is equational in the non-crossover regions.
- This is the reverse from what normally happens.
- Hence the name of inverse meiosis.
- - In other words, sister chromatids (instead of homologues) separate during the first division.



Interphase

- Secondary "pairing" ¿of homologues? occurs

Metaphase II and **Anaphase II**



- This time, there is reduction of the non-crossover regions, which again is the reverse of what normally happens
    - That is, separation of homologues takes place instead of separation of sister chromatids.