By
Dr [illegible] Pradhan
Asso Professor
Marwari College

D II (Hons)
Paper III - Gr. B.

CHROMOSOMAL MAPPING.

Introduction :- Graphical representation of relative distance between linked genes of a chromosome is called genetic map or chromosomal map or cross over map. The chromosome maps display the exact location, arrangements combination of genes in a linkage group of chromosomes. Genetic map also determine the linear order and distance of separation among genes that are linked to each other along the same chromosome.

The method of construction maps of different chromosomes is called genetic mapping. The genetic mapping includes following processes:

1. Determination of linkage groups (No. of chromosome) of a species :-
   Before starting the genetic mapping of chromosome To know the exact number of chromosomes of that species.
   To determine the total number of genes of that species by undergoing hybridization experiments in between wild & mutant strains

2. Determination of Map Distance
   Map Unit - Genetics use an arbitrary unit to measure the intergene distance on the chromosomes that is map unit which describe distance between linked genes.
   A map unit is equal to 1% of crossovers (recombinants) that is, it represents the linear distance along the chromosome for which a recombination frequency of one percent is observed.

   Morgan Unit :- These distance can also be expressed in Morgan units: one morgan unit represent 100 % crossover. Thus 1% crossing over can also be expressed as 1 centimorgan (1 CM).

1. Two Point test cross:—

The Percentage of crossing over between 2 linked genes is calculated by test crosses in which a F1 hybrid is crossed with a double recessive Parent. Such crosses because involved crossing over at two points, so called two Point cross.

2. Three Point test cross:— (Trihybrid cross):—

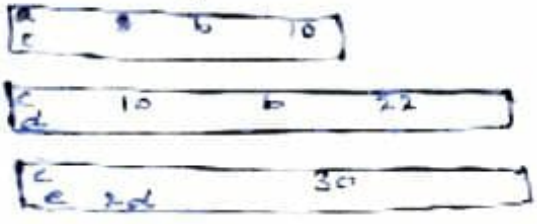
Double cross over usually don't occur between genes less than 5 centi Morgans apart. So for genes further apart, the three point test crosses are used. A three point test cross or trihybrid cross involving three genes gives us information regarding relative distance between these genes, and also shows us the linear order in which these genes should be present on chromosomes. Such 3 Point test cross may be carried out by if 3 points or genes loci on a chromosome Pair can be identified.

3. Determination of Gene order:—

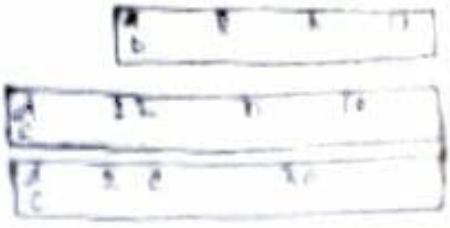
After determining the relative distances between the genes of a linkage group, it becomes easy to place genes in their Proper linear order.

4. Combining Map Segments:— The different segments of maps of a Complete chromosome are combined to form a complete genetic map of 100 centimorgan for a chromosome.

Examples: Suppose, we have to combine following three map segments.



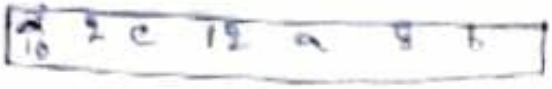
We can superimpose each of these segments by aligning the genes there in common.



Then finally we may combine the three segments, into one

The a to d distance = (d to b) − (a to b) = 99 − 8 = 91

The a to e distance = (a to d) − (d to e) = 111 − 2 = 13



Three-Point Mapping in Drosophila –

Criteria for a 3 Point mapping cross :—

Organism Producing cross over genes must be heterozygous at all loci to be studied.

All genotypes of gametes must be able to be determined from offspring phenotypes.

Sufficient ~~some~~ numbers of offspring must be produced to have a 'representative sample' of all crossover classes

Three Point mapping experiment : offspring are combination of Parental (most common), Single Crossover and double Crossover (least common) Phenotypes.

Gene Mapping in Haploid organisms :—

Common Organism :— Chlamydomonas & Neurospora

Neurospora :— ordered asci (Single asci).

Sacks containing 8 spores in a string.

Each spore has genetic information from one single strand of a DNA duplex from each tetrad in a original zygotes.

— x —

2. **Chromosome Maps of Maize** : Linkage maps of maize chromosomes have been drawn by **R. A. Emerson** and his associates. Several hundred genes studied in Maize have been arranged in ten linkage groups (See Fig. 10.3).

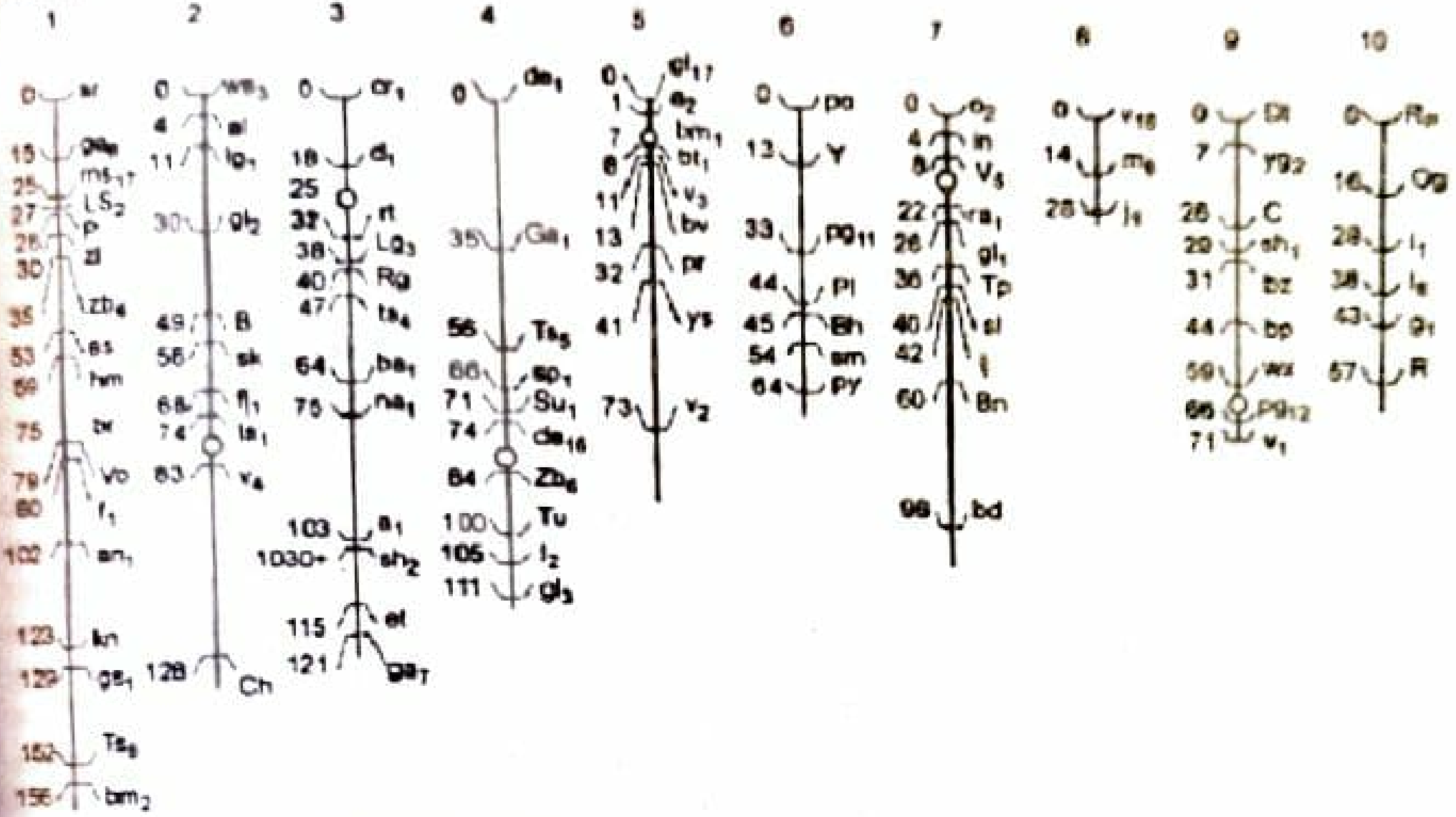


Fig. 10.3. Linkage map of chromosomes in Maize.

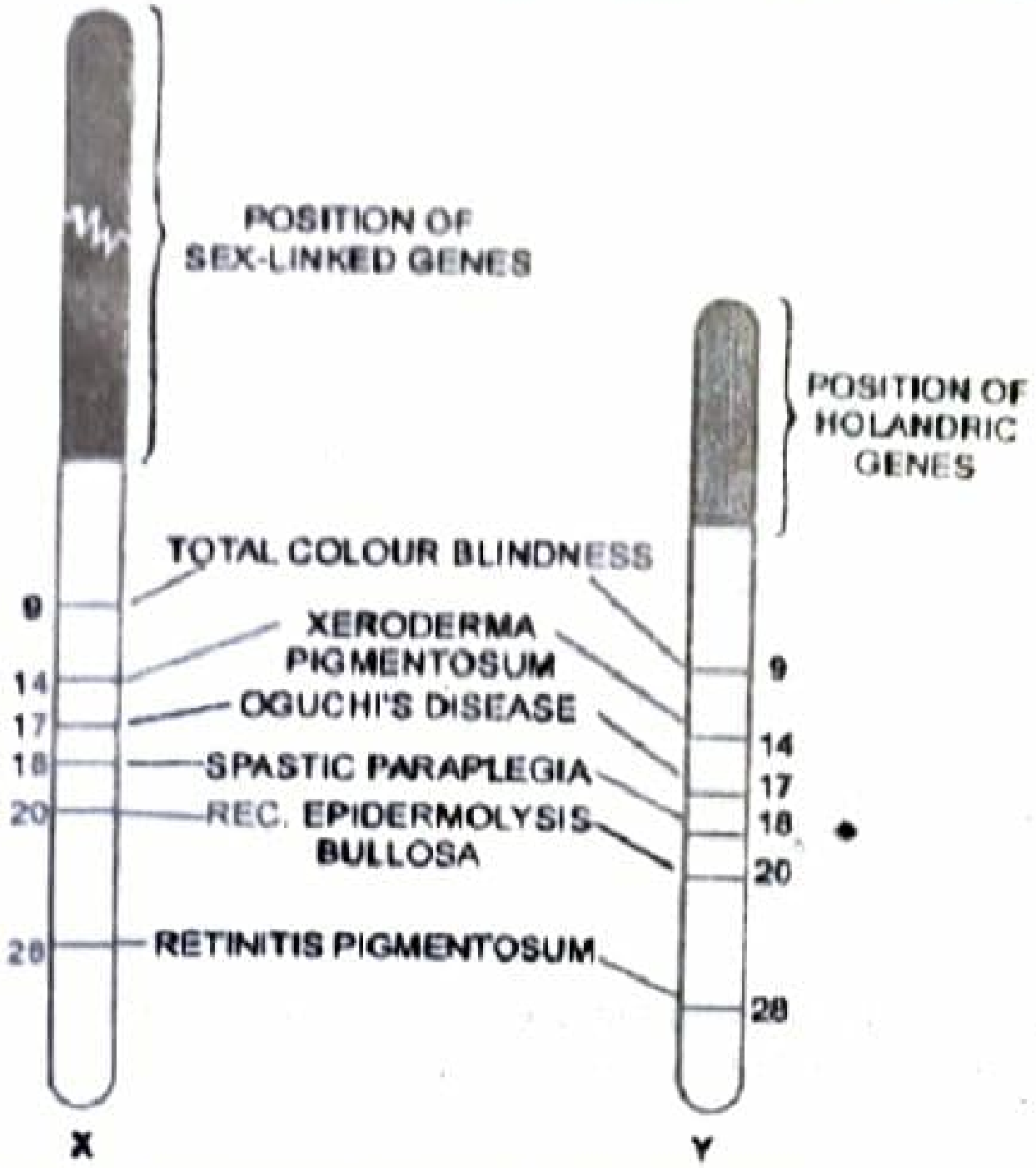


Fig. 10.4. Linkage map of X-Y-chromosomes of Man.