

**COURSE** : M.Sc. Botany PART-I PAPER-VII

**TOPIC** : POLYTENE CHROMOSOME  
(CELLBIOLOGY)

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# POLYTENE CHROMOSOME

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# INTRODUCTION

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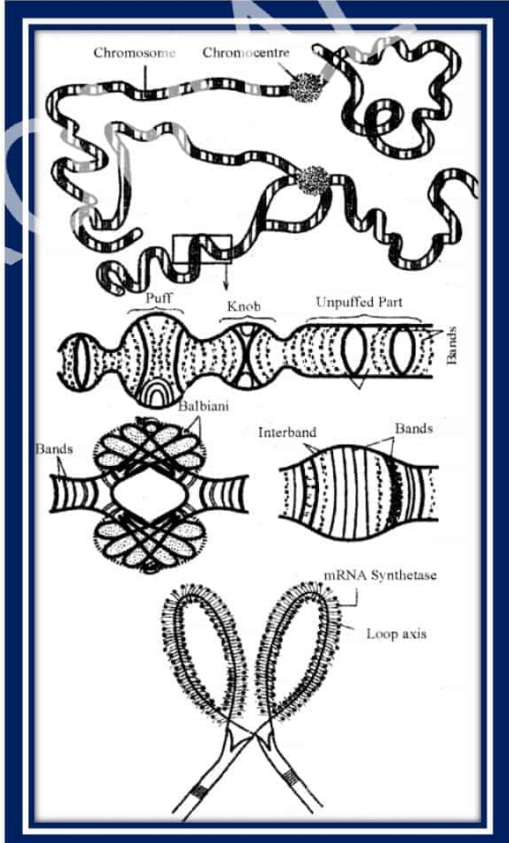
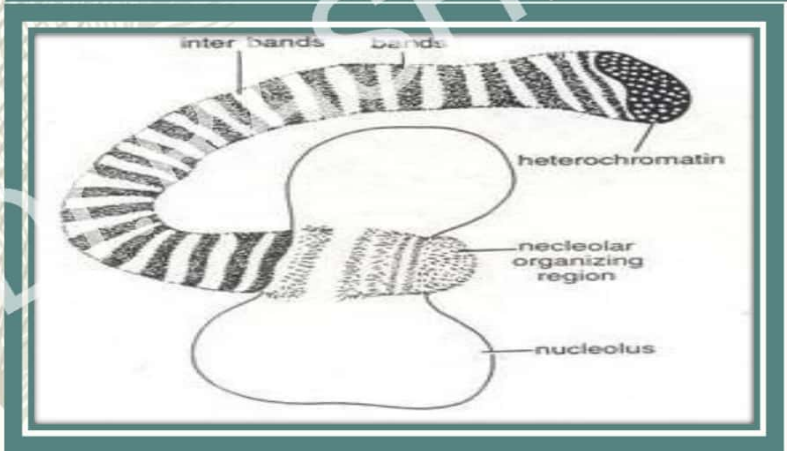
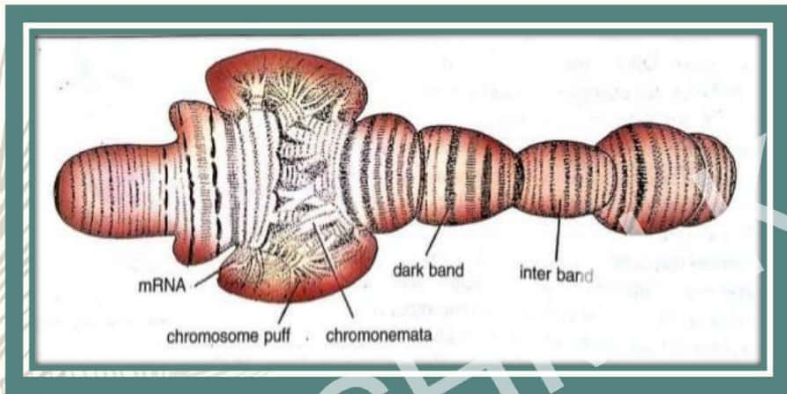
- Polytene chromosome was first observed by Balbiani in (1881) in the salivary gland of the non biting midge *Chironomous* (lake fly).
- These are large chromosomes having thousands of DNA strands and are also known as Giant Chromosomes / Giant Salivary Gland Chromosomes as they are found in salivary glands of Dipterans (fruit fly) larvae.
- Polytene chromosomes have been found in many tissues of the representatives of two orders of insects: Dipterans and Collembolan, in the macro nuclear anlagen of Infusorians, in certain organs and tissues of mammals and also in the cells of the synergids, antipodals and endosperm of angiospermous plants.
- Polytene chromosomes have been reported in immature seed tissues (*P. vulgaris*, *P. coccineus*) by W. Nagl in 1969 and in the cells of anther tapetum of *Vigna unguiculata* (Guerra and Carvalheira, 1994).



### **continued ...**

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- **Polyteny arises in tissues, organs and at developmental stages (when there is need for the rapid development of an organ at an unaltered high level of function). Organs containing cells with Polytene chromosomes are, as a rule, involved in intense secretory functions accomplished during a short time against a background of rapid growth.**
- **Polytene chromosomes are now considered to be very important objects for the analysis of numerous features of interphase chromosome organization and the genome as a whole.**
- **Painter (1934) and Bridges (1936) studied about the close relationship between band and genes.**
- **Polytene chromosomes develop from the chromosomes of diploid nuclei by successive duplication of each chromosomal element (chromatid) without their segregation. The newly formed chromatids remain associated lengthwise and together form a cable-like structure, referred to as Polytene chromosomes.**



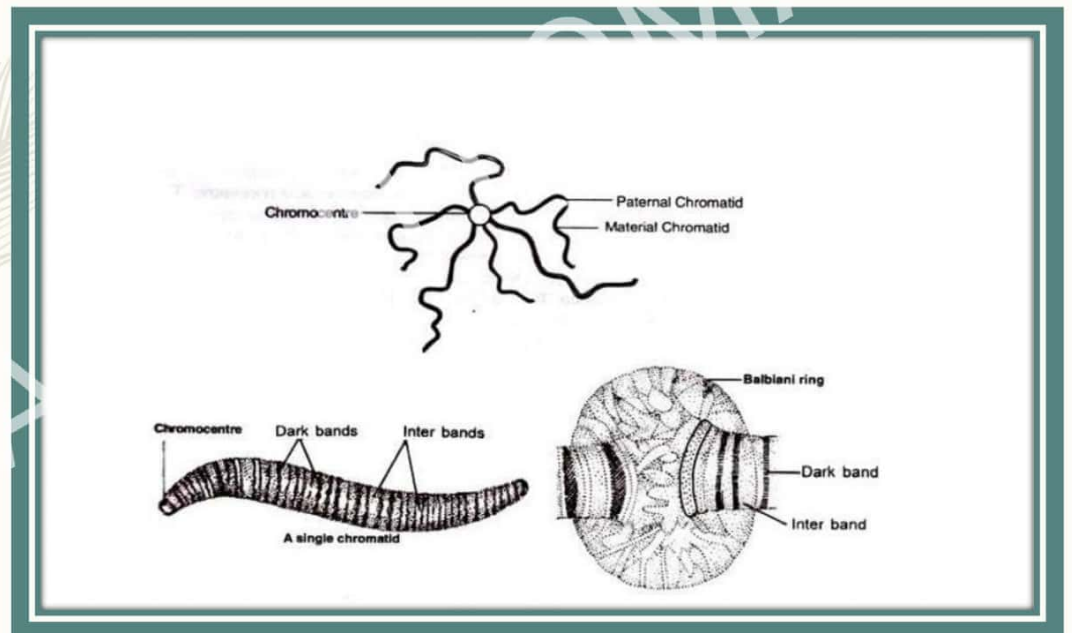


# STRUCTURE OF POLYTENE CHROMOSOME

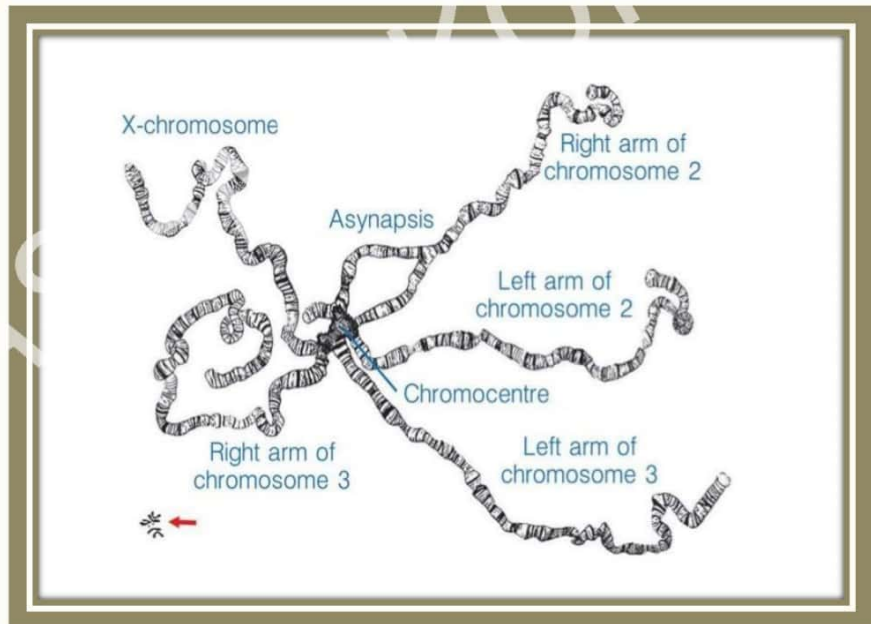
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- **Specific features observed in the four chromosomes of *Drosophila*—**
- **It shows linear series of Bands and Interbands**
- **Over 5000 bands have been observed in Polytene chromosomes of *Drosophila***
- **The Bands of Polytene chromosomes become enlarged due to uncoiling of individual chromomeres in a band which form swellings and are called chromosome puffs or Balbiani rings**
- **Polytene chromosomes are specific interphase chromosomes showing distinct thick and thin banding patterns. This characteristic band- interband morphology represents heterochromatin and euchromatin regions.**
- **Bands are regions of high DNA concentration whereas Interbands are regions of low DNA concentration.**
- **The pattern of bands and Interbands in each Polytene chromosome is specific for the species, and in general is characteristic of that particular chromosome in different species.**

# STRUCTURE OF POLYTENE



## DETAILED STRUCTURE OF POLYTENIC CHROMOSOME







# FUNCTIONS OF POLYTENE CHROMOSOMES

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- **Increases the volume of the cell's nuclei and causes cell expansion.**
- **Metabolic advantage as multiple copies of genes permit a high level of gene expression.**
- **In *Drosophila melanogaster* the chromosomes undergo many rounds of endo reduplication, to produce large amounts of glue before pupation.**
- **There is tandem duplication of various Polytene bands located near the centromere of the X chromosome which results in the Bar phenotype of kidney-shaped eyes.**



# SIGNIFICANCE OF POLYTENE CHROMOSOME

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- **Polytene chromosomes show somatic pairing.**
- **It helps in detection of chromosomal deletion, duplication and inversion.**
- **Polytene chromosome makes it possible to map any DNA segment to specific chromosomal loci by *in situ hybridization*.**
- **Polytene chromosomes, are seen to have distinct thick and thin banding patterns during interphase. These patterns were originally used to help map chromosomes, identify small chromosomal mutations, and in taxonomic identification.**
- **They are now used to study the function of genes in transcription.**



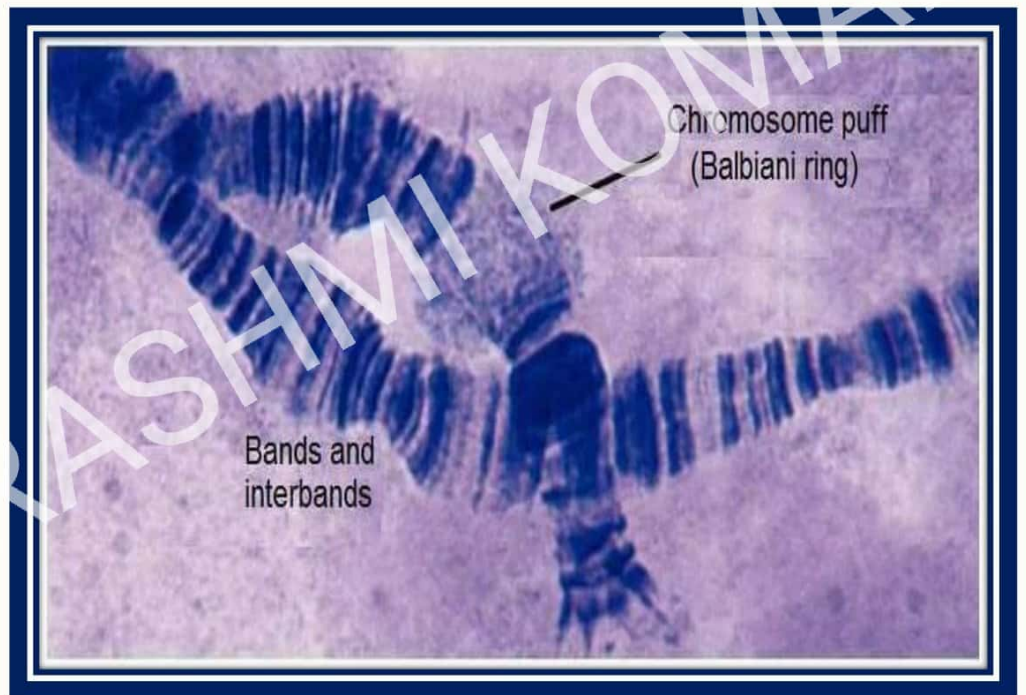
# BALBIANI RINGS

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- **Balbiani rings are exceptionally large puffs on the Polytene chromosomes in the dipteran *Chironomus tentans*. These puffs are particularly well suited for studies of the structure of active genes and the synthesis and transport of specific RNA-protein (RNP) particles.**
- **Puffs and Balbiani rings are regarded as the active centers for DNA duplication and RNA synthesis. Hence puffing is interpreted as a manifestation of gene expression. Since active DNA duplication occurs in puffs, they may contain heavy accumulation of redundant and repetitive DNA sequences.**
- **The bands of polytene chromosomes become enlarged at certain times to form swellings called puffs. The formation of puffs is called puffing. In the regions of puffs, the chromonemata uncoil and open out to form many loops. The puffing is caused by the uncoiling of individual chromomeres in a band.**
- **These are the main characteristics of Polytene chromosome present in dipteran**



# BALBIANI RINGS





**THANKYOU**