Chromosomal Theory of Inheritance

Chromosomal Theory of Inheritance

Mendel published his work on inheritance of characters in 1865 but it remained unrecognised till 1900.

Causes:

1. Lack of communication – as communication was not easy in those days and hence, his work could not be widely publicised.
2. His concept of **genes** (or **factors**) as stable and discrete units that controlled the expression of traits and of the pair of alleles which did not 'blend' with each other, was not accepted by his contemporaries. He gave this explanation for continuous variation seen in nature.
3. Mendel's approach of using mathematics to explain biological phenomena was totally new which was unacceptable to many of the then biologists.
4. Though Mendel's work suggested that factors (genes) were discrete units, he could not provide any physical proof for the existence of factors.

In 1900 three Scientists, viz. Hugo de Vries, Carl Correns and von Tschermak independently rediscovered Mendel's results on the inheritance of characters. By this time, scientists were able to carefully observe cell division. This led to the discovery of detail structures of nucleus. These were called **chromosomes** (*colored bodies*). By 1902, the chromosome movement during meiosis had been worked out.

Walter Sutton and **Theodore Boveri** observed that the behaviour of chromosomes was parallel to the behaviour of genes and used chromosome movement to explain Mendel's laws. The important things is that chromosomes as well as genes occur in pairs. The two alleles of a gene pair are located on homologous sites on homologous chromosomes.

During Anaphase of meiosis I, the two chromosome pairs can align at the metaphase plate independently of each other. Let us compare the chromosomes of four different colour in the left and right columns. In the left column (Possibility I) orange and green is segregating together. But in the right hand column (Possibility II) the orange chromosome is segregating with the red chromosomes.

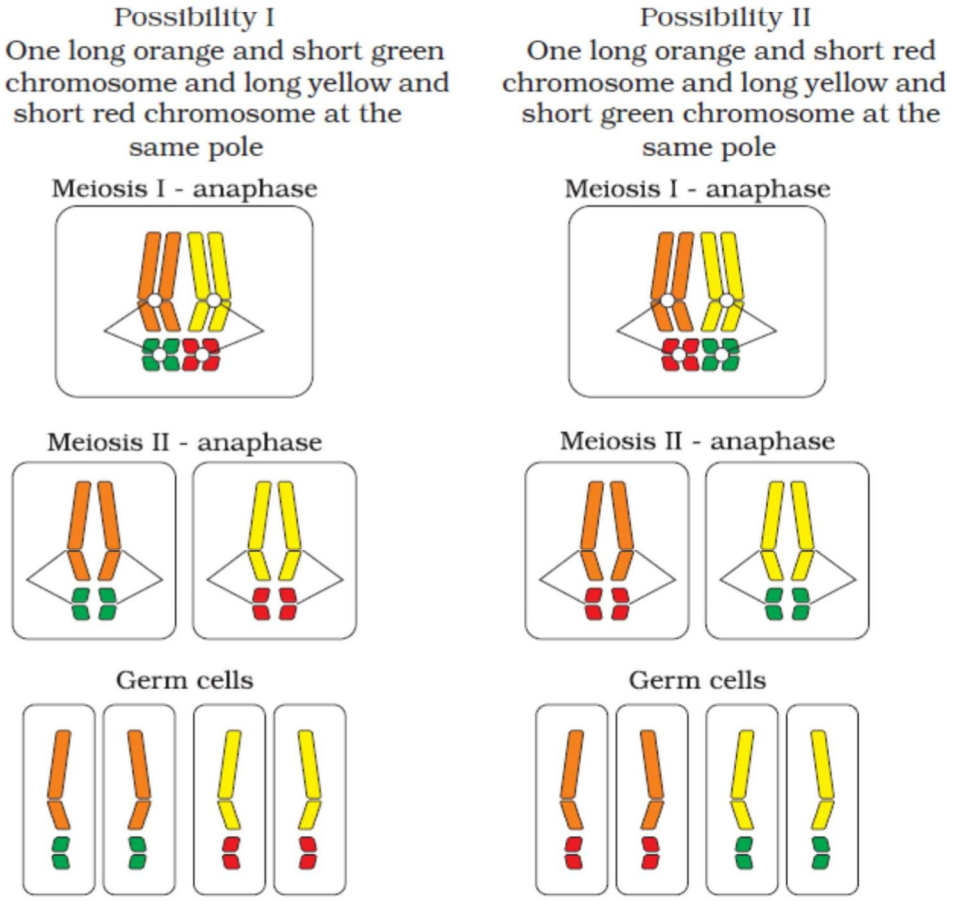

Figure Independent Assortment of Chromosomes

The Chromosomal Theory of Inheritance was consistent with Mendel's laws and was supported by the following observations:

1. During meiosis, homologous chromosomes migrate as discrete structures.

2. Sorting of chromosomes from each homologous pair into pre-gametes is random.
3. Each parent forms gametes containing only half of their chromosomal complement.
4. Though male and female gametes differ in size and morphology, they have the same number of chromosomes, suggesting equal genetic contributions from each parent.
5. Gametic chromosomes combine during fertilization and produce offspring with the same number of chromosome as their parents.

Sutton and Boveri reasoned that the pairing and separation of a pair of chromosomes would lead to the segregation of a pair of factors they carried. Sutton united the knowledge of chromosomal segregation with Mendelian principles and called it the **chromosomal theory of inheritance**.

Following this synthesis of ideas, Thomas Hunt Morgan and his colleagues carried out experimental verification of the chromosomal theory of inheritance and this led to discovery of the basis for the variation that sexual reproduction produced. Morgan worked with the fruit files, ***Drosophila melanogaster***, which were found very suitable for such studies. They could be grown on simple synthetic medium in the laboratory. They complete their life cycle in about two weeks, and a single mating could produce a large number of progeny flies. There was a clear differentiation of the sexes – the male and female flies are easily distinguishable. It has many types of hereditary variations that can be seen with low power microscopes.