The Modern Concept of Gene

According to the classical concept of gene which primarily developed from the Mendelian analysis of genetic data, a gene is an indivisible entity and at once a unit of function, recombination, and mutation. This notion implies that a given segment of the chromosome responsible for a particular genetic activity would, as a whole, be the basis of various genetic functions, like segregation, recombination and mutation.

More sophisticated analysis of these genetic phenomena on a molecular level in recent years has provided a new, more comprehensive understanding of the gene. As a result, the old, classical concept of gene has changed drastically. In the modern enlightened sense, the gene is no longer to be considered a unit of function, recombination and mutation but, on the other hand, these phenomena are now known to occur at different molecular levels. For instance, a unit of recombination and or mutation is not a unit of function. These three units are not of the same dimentions. The unit of function is much large than the units of recombination and mutation, the latter two units (recombination, mutation) being enclosed within the former (function). Since these units have different entities, they are named differently. The unit of function is called "cistron", the unit of recombination "recon", and the unit of mutation "muton".

Structure of Gene

Chemically speaking, the genetic material present in the chromosomes is DNA (Deoxyribonucleic acid) and a gene is represented by a given sequence of the nucleotides, of which the DNA is composed. There are four kinds of nucleotides in the DNA corresponding to the four nitrogenous bases namely (i) adenine, (ii) guanine (purines), (iii) cytosine and (iv) thymine (pyrimidines). Each of these four bases along with pentose sugar and inorganic phosphate makes a nucleotide. These nucleotides are the building blocks of the DNA molecule which is a double-stranded, helical structure with enormous molecular weight. The DNA molecule provides the basis of life and is rightly recognized as the master molecule.

As shown from the DNA structure illustrated, the two strands are intertwined around each other in opposite directions. Between the two strands, adenine pairs with thymine and guanine with cytosine and are held in position by hydrogen bonding. The two strands open out to permit DNA replication. According to more recent studies, the DNA replication can take place with unopened strands. Anyway, the process and mechanism of replication are quite intricate. DNA not only replicates itself but also directs the synthesis of RNA (ribonucleic acid). Unlike

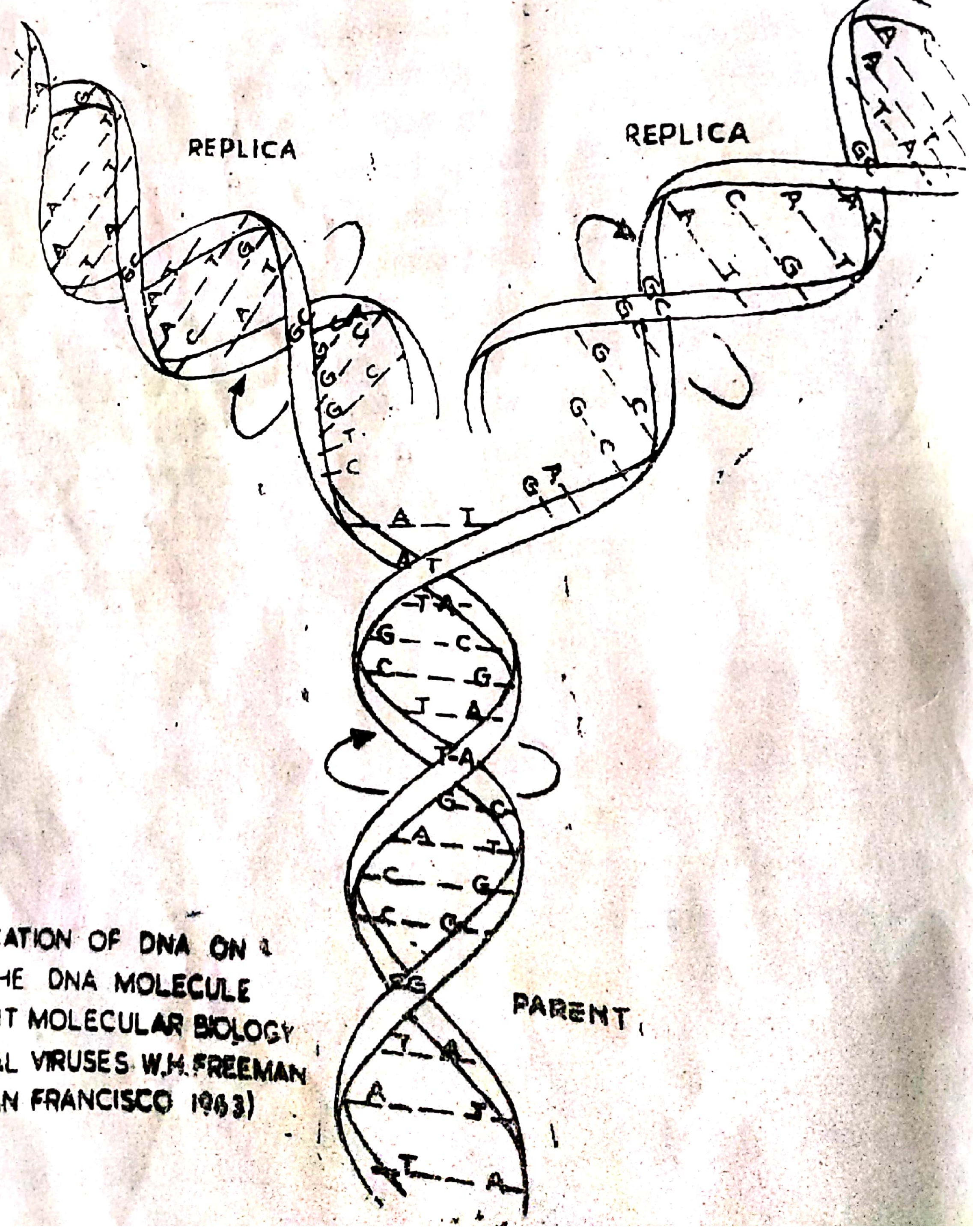

FIGURE 4 REPLICATION OF DNA ON UNWINDING OF THE DNA MOLECULE (AFTER G.S STENT MOLECULAR BIOLOGY OF THE BACTERIAL VIRUSES W.H.FREEMAN AND COMPANY SAN FRANCISCO 1963)

DNA, RNA is a single-stranded molecule consisting of the same nucleotides except thymine which is substituted by uracil. It acts as a messanger between DNA and the cytoplasmic factory for protein synthesis.

Protein Synthesis

As explained above, a certain sequence of the nucleotides is equivalent to a particular gene. This sequence (gene) is transcribed into RNA and carried to the cytoplasm to direct the synthesis of a specified portion of protein. A protein molecule consists of twenty different amino acids arranged in a particular sequence which is determined by the sequence of the nucleotides in the DNA. In other words the amino acid specificity is the function of the nucleotide specificity.

Important steps in protein synthesis are mentioned briefly. The genetic information contained in the DNA for the synthesis of a protein is copied out in the form of RNA, which carries it to the cytoplasm. This RNA is called the messenger RNA. Several molecules of the messenger RNA take part in carrying all the information needed to construct a certain portion of protein. The messenger RNA arranges itself in the proper position at the ribosome, the site of protein synthesis in the cytoplasm. Also present in the cytoplasm are different amino acids and 20 different transfer RNA's corresponding to each amino acid. A particular transfer RNA will form a complex with a particular amino acid. Before this complex is formed, the amino acid is activated by ATP, (adenosine triphosphate) the energy-rich compound. This activated complex moves to the ribosome and the amino acid is thus inserted in the protein chain at the proper place with the help of the messenger RNA. Likewise, other, amino acids that are needed in the synthesis of the protein are brought to the ribosome and the desired molecule of protein obtained.

The protein thus synthesised under the direction of DNA produce a given phenotypic effect. It should be clearly understood that a phenotypic expression is the direct outcome of the DNA activity and any change in the protein structure shall have no effect on the DNA; that is why acquired characters cannot be inherited.