precisely at higher frequency $(10^{-3} \text{ to } 10^{-4})$, resulting in deletion of part of the host genome without deletion of the IS element. IS elements are usually polar in both orientations, although some carry a strong promoter that can regulate adjacent structural genes in one of their orientations.

Rapid progress in the identification, mapping, and characterization of IS elements has been made possible by the development of powerful techniques for the analysis of DNA structure, most notably DNA heteroduplex methods and the use of restriction endonucleases. These techniques have shown that multiple copies of IS elements are normal constitutents of the bacterial chromosome and also of extrachromosomal genomes. The location of the IS elements on several bacterial plasmids suggests that they may play a key role in chromosome evolution, a possibility that is discussed in the book by several authors. In several cases identical IS elements in the same orientation have been located at the boundaries between specific blocks of genetic information governing functions such as antibiotic resistance, conjugal transfer, and plasmid replication. This is precisely what would be expected if the IS elements serve as sites for the fusion of two progenitor genomes, each of which originally carried a collection of specific genes and one copy of the IS element, to form a more complex genome specifying all the functions of each partner.

The alarming spread of multiple drug resistance among bacterial pathogens also appears to be a manifestation of the genetic plasticity made possible by DNA insertions. Experiments in several laboratories have shown that most drug-resistance genes on bacterial plasmids are flanked by repetitious DNA sequences, usually in inverted orientation, some of which have been identified as IS elements. The Tn elements thus constituted can be used to study the mechanism of transposition because their insertion into any site on the genome is accompanied by the acquisition of drug resistance. And because drug-sensitive cells must lack Tn elements it is also possible to monitor the lineage of a Tn element once it has been introduced into a bacterial strain, as is not possible with IS elements because of the multiple copies present.

The third and fourth sections of the book provide an interesting comparison of IS elements with more complex elements that insert into prokaryotic genomes. Temperate bacteriophages like μ (section 3) and λ (section 4) can exist as prophages inserted into the bacterial

chromosome; after induction, they can excise and undergo autonomous replication prior to being packaged into virus particles. Thus, as a number of the authors note, the study of their life cycles should make possible a more systematic analysis of the mechanism of DNA insertion and excision. The properties of μ are reviewed most comprehensively in papers by Bukhari et al., Toussaint et al., and Chow and Bukhari. When μ inserts into a host chromosome during lysogeny, it integrates at random sites. During the lytic cycle of the phage, μ DNA continuously inserts and excises at many different sites on the host chromosome, acquiring different host DNA sequences at its ends. Why μ behaves in this way is a mystery, but the behavior is certainly reminiscent of the promiscuous insertion of IS elements, albeit at a much higher frequency and under conditions that are more amenable to experimentation. Mu can also mediate the integration of chromosomal genes into plasmids and thus may function in a manner analogous to IS elements in chromosome evolution.

The mechanism of insertion and excision of λ is now known in considerable detail. Although λ has a single highly preferred site for integration, the phage uses a variety of secondary sites when the normal integration site is deleted. There are a number of analogies between λ and IS and Tn elements, but it is not clear whether λ can be considered a Tn element.

There are increasing indications that repetitious DNA segments and Tn elements may also mediate the control of gene expression and chromosome interactions in eukaryotes. These possibilities are discussed briefly in the seven papers in section 5. For over 25 years, controlling elements having many of the characteristics of Tn elements have been hypothesized to explain differences in gene expression in maize. More recently, related models have been invoked to explain unstable phenotypes in Drosophila and mating-type interconversions in yeast. Analysis of the DNA from a number of eukaryotes and their viruses has also revealed the existence of inverted repetitious sequences.

The characterization of IS and Tn elements has led to the development of new methodologies that should be of broad applicability in the study of genetic rearrangements. A number of the techniques are described in section 6. The final 185 pages of the book contain four appendixes that provide detailed information about the genetic and physical structure and properties of IS elements, bacterial plasmids, and a number of temperate bacteriophages as well as a list of the restriction endonucleases and their recognition sites that were known at the time of publication.

The selection and organization of the contributions to the volume are commendable. Although there are a large number of contributors, the style of the papers is remarkably uniform. Most papers end with a concise presentation of their principal conclusions. The book should remain a unique and important contribution for years to come.

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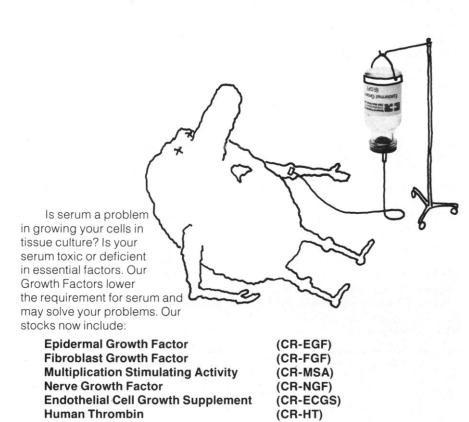
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