

Preface and Introduction

The success of genetic analysis and breeding using Mendel's laws, Johannsen's concepts of genotype and phenotype, Weismann's germ-plasm continuity hypothesis, Morgan's linear arrangement of genes on chromosomes, and Muller's mutation theory leads to a belief—all genes are given by parents and stay the same except for having mutation occasionally caused by external mutagens, somatic cells have no contribution to inheritance, the gene transcript abundance is purely determined by the promoter activity and RNA stability, and clones are genetically identical.

However, as shown in the present book, the somatic genome (the sum total of genetic materials in the cytoplasm and somatic nucleus) actually has environmental and developmental variations; for example: (1) many antibody genes are somatically produced; (2) some ciliate somatic genomes are generated using RNA templates and are therefore phenotypes of the germline genomes but are also the genotypes for many other traits; (3) gene transcription and some endogenous enzymes can induce mutation; (4) certain foods and drinks affect DNA stability and tumor growth; (5) the DNA fingerprint of an animal or plant has certain variations among somatic tissues; (6) various somagenetic and epigenetic variations are transgenerational, and some DNA is translocatable among cells; (7) some genes and repetitive DNA have copy number variation; (8) the chloroplast and mitochondrial genomes vary in ploidy and DNA amount; (9) some DNA sequences are functional through protein binding or DNA-fragment release; (10) DNA damage is sometimes not repaired; (11) clones are genetically mosaic to a certain degree; and (12) the average ploidy level varies among tissues.

This book attempts to assemble the evidence of somatic genome variation in microorganisms, plants, animals, and humans, update various basic concepts in genetics and breeding, determine the implications of somatic genome variation for human health and agriculture, and propose an updated synthesis of inheritance.