INTRODUCTION

Genomic Tales

OUR ORGANS TELL STORIES. A PATHOLOGIST, FOR EXAMPLE, CAN LOOK AT A LUNG and recognize a lifetime of toiling in a mine. Our genes tell stories, too. By comparing the genomic sequences of an ever-increasing number of organisms, we are now uncovering how our bodies came to be the way they are. Evolution, it seems, is a tale of détente: The need to adapt to changing environments is in a tug of war with the demand for precisely functioning biological machinery. The stories presented in the special section (and the graphic, p. 1912) emphasize different facets of this complex saga. They are not just historical lessons; they have implications for understanding disease mechanisms as well as basic physiology.

When it comes to the story of the human brain, we are still stuck on the preface, Pennisi explains in a News story (p. 1908). Researchers are turning to comparative genomics to identify the main genetic characters that helped differentiate our brain from those of our primate cousins. They are finding evidence of positive selection for genes that are key to the size and complexity of the cortex, as well as provocative changes in gene copy number and expression.

Fernald, in discussing the evolution of the eye (p. 1914), notes that despite the seeming diversity of eyes, there has been a lot of reinvention and reuse. Nothing is wasted. Duplication of an ancestral opsin gene resulted in photoreceptor cells with very different light sensitivities and capacities. Organisms appear to have capitalized on a variety of excess proteins by diverting them into lens production; in some cases, lens proteins still have multiple functions.

Olson (p. 1922) emphasizes the staying power and flexibility of the regulatory networks that coordinate gene expression in the heart. A primordial regulatory network of five transcription factors has been conserved for at least 500 million years. Complexity has been generated by pulling in other genes and networks.

Animals have become morphologically sophisticated thanks to Hox genes. They were intimately involved in the evolution of bilateral symmetry, and changes in the number and expression of members of the Hox gene family may underlie much of life’s current morphological diversity (Lemons and McGinnis, p. 1918).

Three articles at Science’s STKE highlight the regulatory mechanisms by which gene expression profiles pave the way for complex structures. Bondos covers how Wnt signaling and Hox gene–expression networks work together to specify cell fate and tissue formation in Drosophila and Caenorhabditis elegans. Shamovsky and Nudler discuss the role of a large noncoding RNA in vertebrate organogenesis. Lamont and Childs discuss arterial versus venous specification.

Genome issues always have more exciting stories than can fit under one theme, and this issue is no exception. Out of a growing foundation of insights into the genetic infrastructure needed to build our bodies are coming new ways to diagnose and fight diseases. See Science Careers for vignettes of young researchers tackling these problems.

Like the tales of Scheherazade, one story leads into the next, and we can only look forward to the upcoming chapters.

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