

## Origins of the Human Genome Project\*

The human genome project was borne of technology, grew into a science bureaucracy in the United States and throughout the world, and is now being transformed into a hybrid academic and commercial enterprise. The next phase of the project promises to veer more sharply toward commercial application, harnessing both the technical prowess of molecular biology and the rapidly growing body of knowledge about DNA structure to the pursuit of practical benefits.

Faith that the systematic analysis of DNA structure will prove to be a powerful research tool underlies the rationale behind the genome project. The notion that most genetic information is embedded in the sequence of DNA base pairs comprising chromosomes is a central tenet. A rough analogy is to liken an organism's genetic code to computer code. The goal of the genome project, in this parlance, is to identify and catalog the 75,000 or more files (genes) in the software that directs construction of a self-modifying and self-replicating system — a living organism. The main scientific justification for the genome project is not that it will explain all of biology. By the software analogy, studying the structure of DNA cannot directly approach problems of hardware — cells and organs — or of networks — social and environmental interactions. Biology has from its inception made clear the importance of adaptability. The complexity of the brain and its connections, with tens of billions of cells and trillions of connections, or the immense adaptability of the immune system, responding to countless external threats (including infectious organisms) and internal disruptions (including cancer), make clear that the human body is more than the simple expression of tens of thousands, or even hundreds of thousands, of genes.

The genome project is premised on the claim that genetic maps and new technologies will be among the most useful scientific approaches to highly complex biological phenomena, not that these maps will be the end of biology. The genome project is a biological infrastructure

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