

among individuals. While the order of genes and chromosome segments is generally quite stable, it is individual variations that are often of greatest interest. Gene maps help by laying out the overall structure, while much interesting biology comes from understanding how variations come about and what they cause.)

The seminal technology that led to the genome project was a group of techniques for determining the actual sequence of base pairs in DNA. In 1954, just a year after Watson and Crick described the double helical structure of DNA, George Gamow speculated that DNA sequence was a four-letter code embedded in the order of base pairs [Gamow, 1954 #1017]. In 1975, Fredrick Sanger announced to a stunned audience that he had developed a way to determine the order of those base pairs efficiently¹⁻³. Alan Maxam and Walter Gilbert at Harvard independently developed a completely different method that same year. This method was announced to molecular geneticists late in the summer of 1975 at scientific conferences, and circulated as recipes among molecular geneticists until formal publication in 1977⁴. Half a decade later, many groups began successfully to automate the process, in North America, Europe, and Japan. The first practical prototype was produced by a team at the California Institute of Technology in 1986, under the direction of Lloyd Smith, as part of a large team under Leroy Hood⁵. This prototype was quickly converted to a commercially available instrument by Applied Biosystems, Inc., and reached the market in 1987.

The new technologies for DNA sequencing spread through the biomedical research community like wildfire. By 1978, it was becoming apparent that sequence information needed to be catalogued systematically to make it useful to the scientific community. The idea of a database to contain this information emerged as a priority from a meeting at Rockefeller University that year. After several years of often intense and acrimonious discussion, twin databases were established under the European Molecular Biology Laboratory in Heidelberg at as GenBank at Los Alamos National Laboratory⁶. These databases were established just as personal computers were beginning to prove their immense power in biology laboratories. The

Origins of the Human Genome Project

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