

TIMELINES in Science

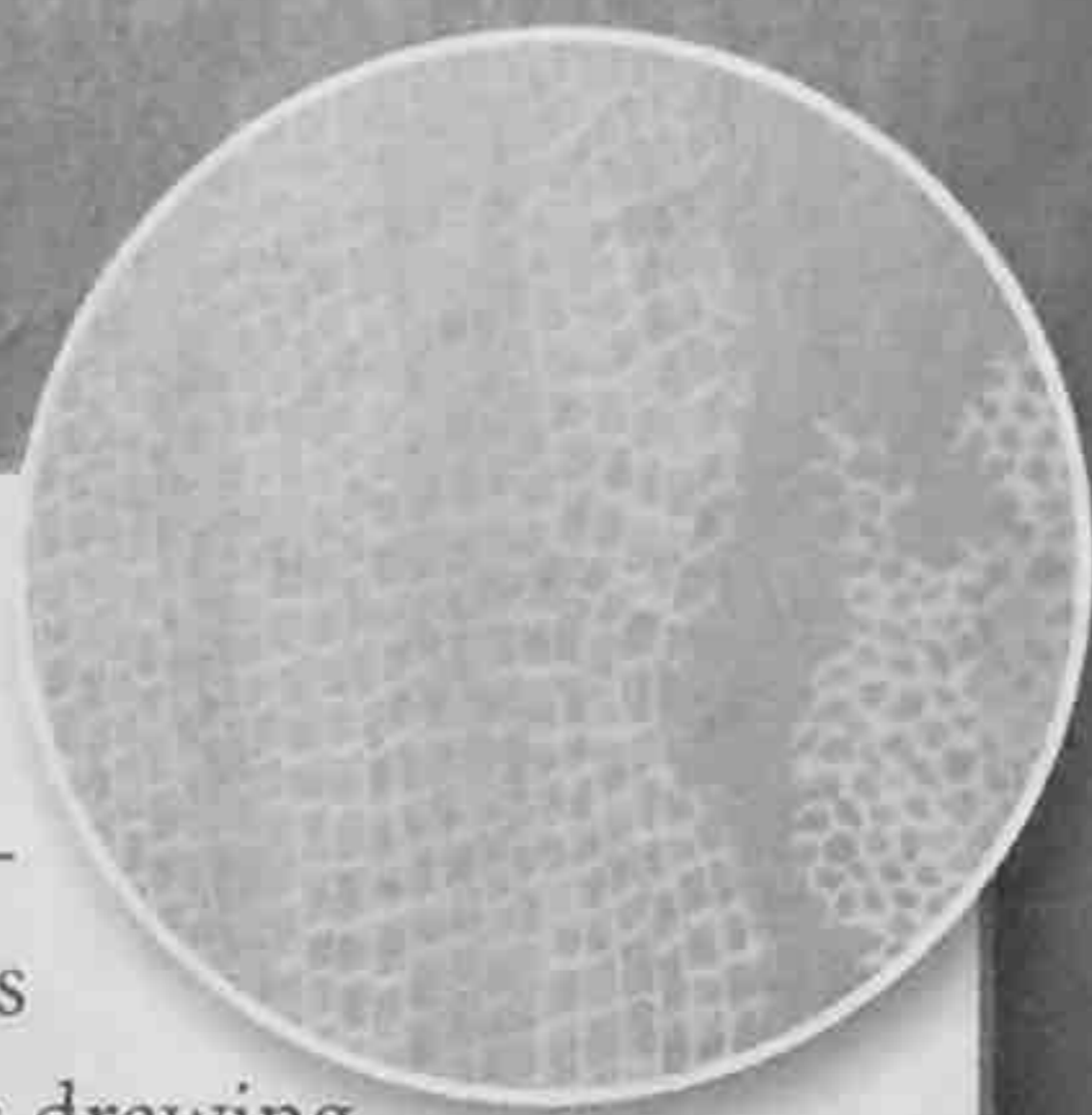
THE STORY OF Genetics

The human genome project, DNA evidence in criminal cases, cloning—news about genetics is everywhere. Some of the most exciting research in science today involves genes. The timeline shows that some important concepts that underline the study of genetics were discovered relatively early. You will notice the influence of two major advances in technology—the development of the microscope during the 1600s, and the development of computer technology during the later half of the 1900s. The boxes below the timeline show how technology has led to new understanding and to applications of those understandings.

1665

Cells Discovered

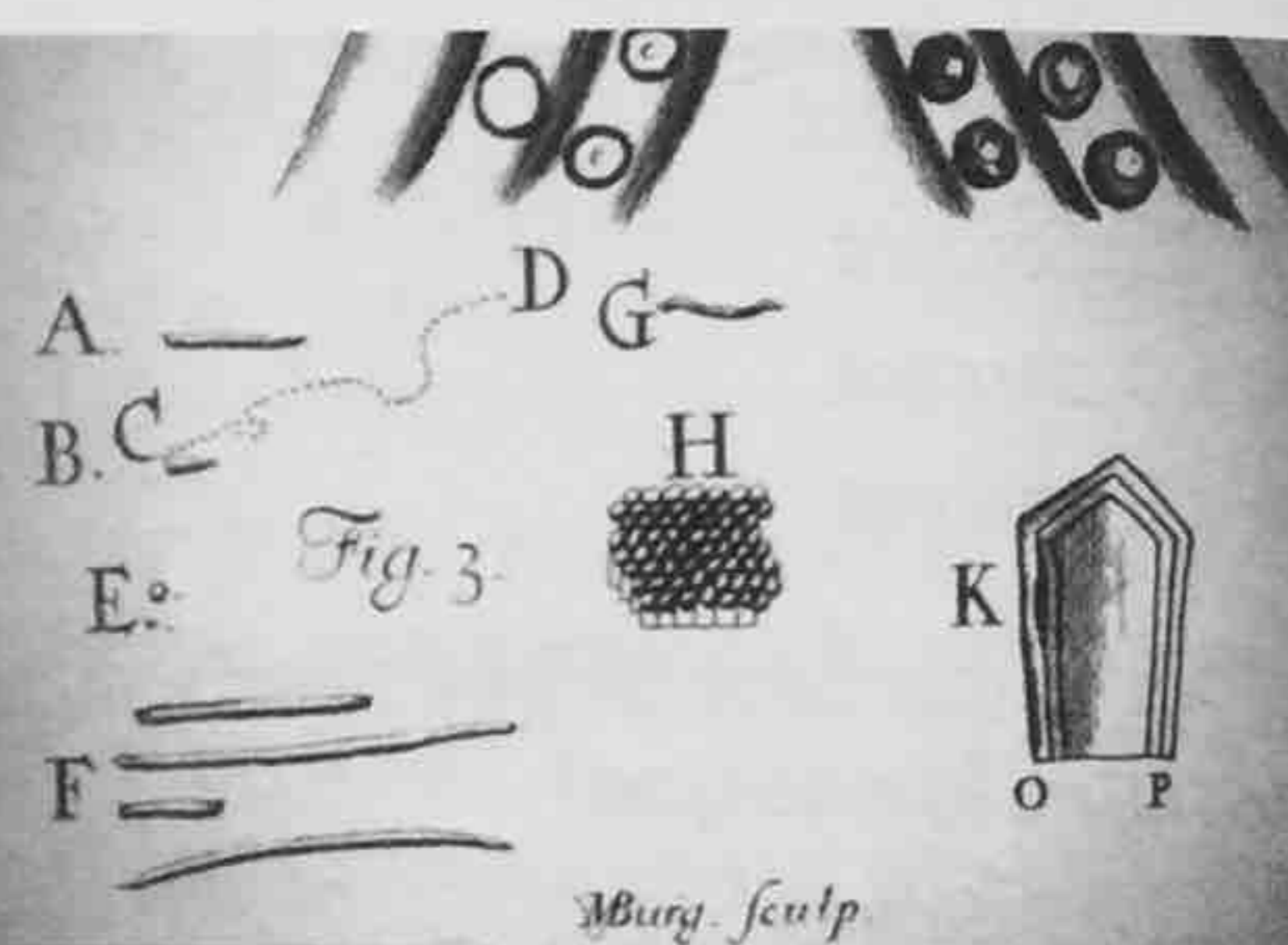
Robert Hooke uses a microscope to study living matter. What he sees and then records in this drawing are tiny repeating units, which he calls cells.



1674

Cells Are Everywhere

Anton van Leeuwenhoek uses a microscope to study pond water and discovers the water is full of microscopic organisms, some made of single cells. These drawings show some of what he saw.



EVENTS

1650

1660

1670

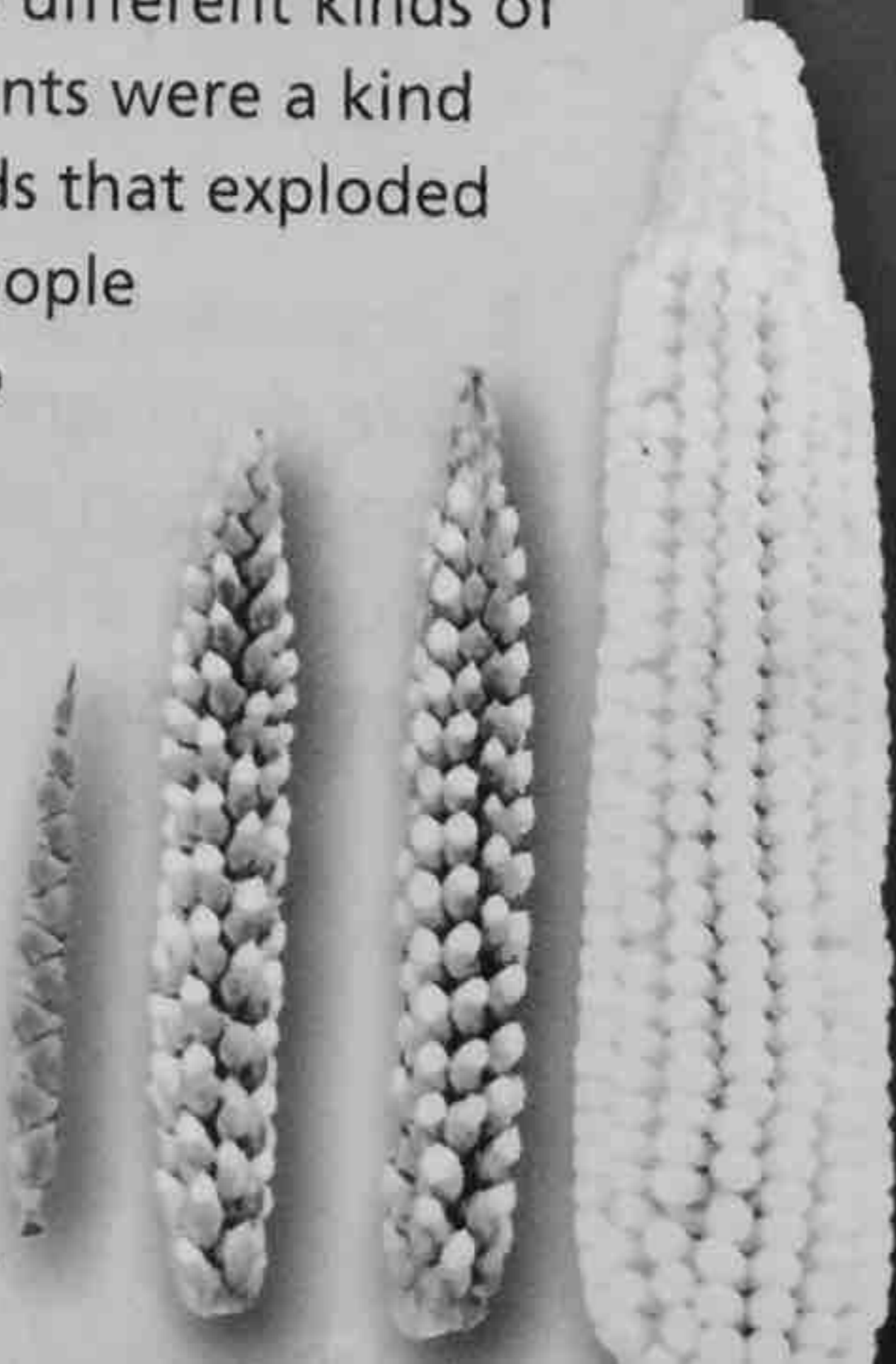
1680

APPLICATIONS AND TECHNOLOGY

APPLICATION

Corn in Every Shape and Size

Native Americans grew 700 different kinds of popcorn. Their popcorn plants were a kind of grass with big, hard seeds that exploded when they were heated. People who didn't want to have to explode their corn to eat it chose plants with softer seeds and grew them, and then chose the softest of those seeds to plant. Over hundreds of years, by choosing which plants to grow, people produced what we now eat as corn on the cob.



TECHNOLOGY

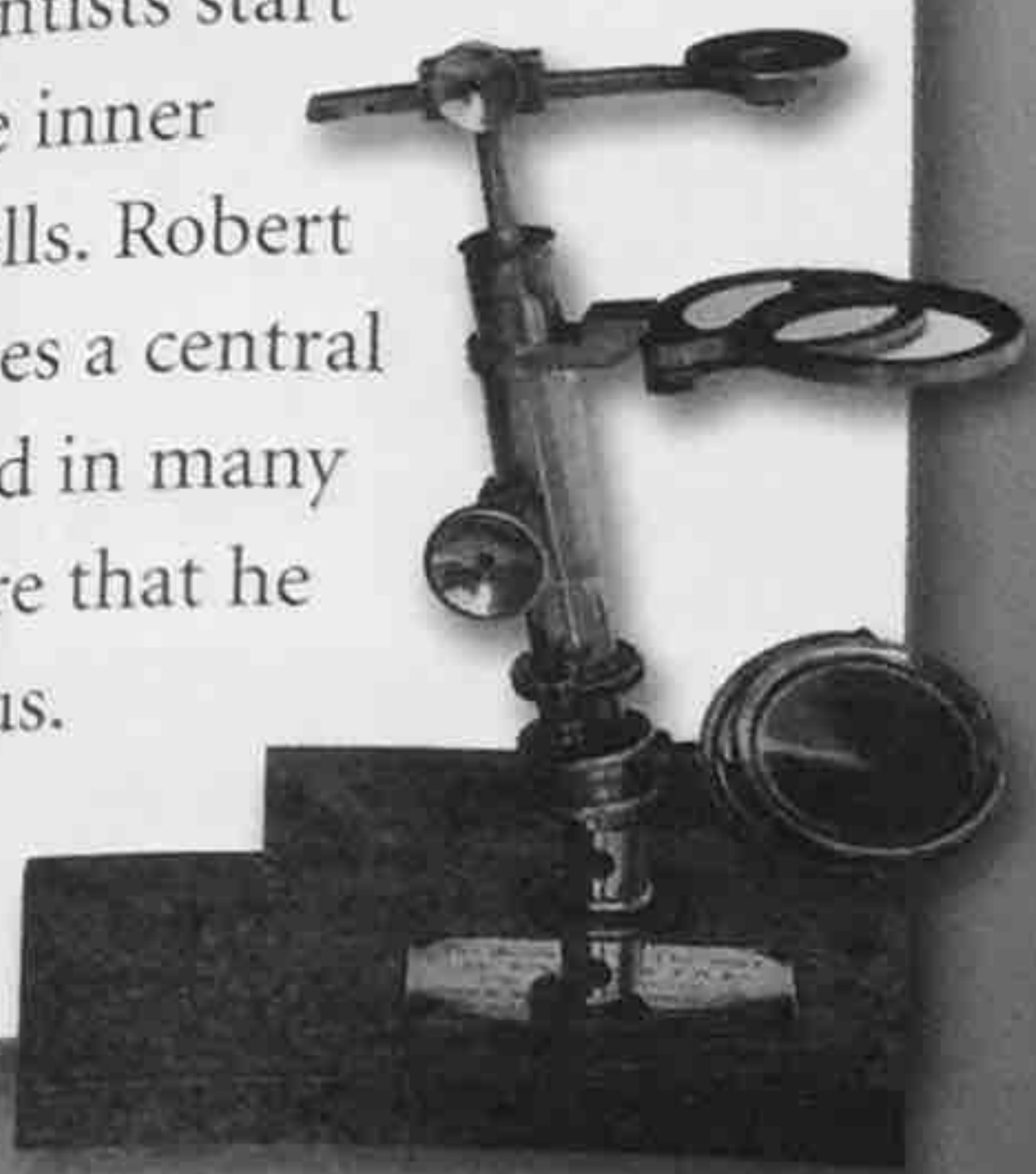
Seeing into the Cell

Single-glass lenses, such as the one van Leeuwenhoek used, were available as long ago as 1267. The compound microscope was first made in 1595, but it was over 200 years before it provided clear images. Until the 1930s, all microscopes focused light on objects. Eventually, light microscopes could magnify objects up to 2000 times.

1831

Cells Have Structure

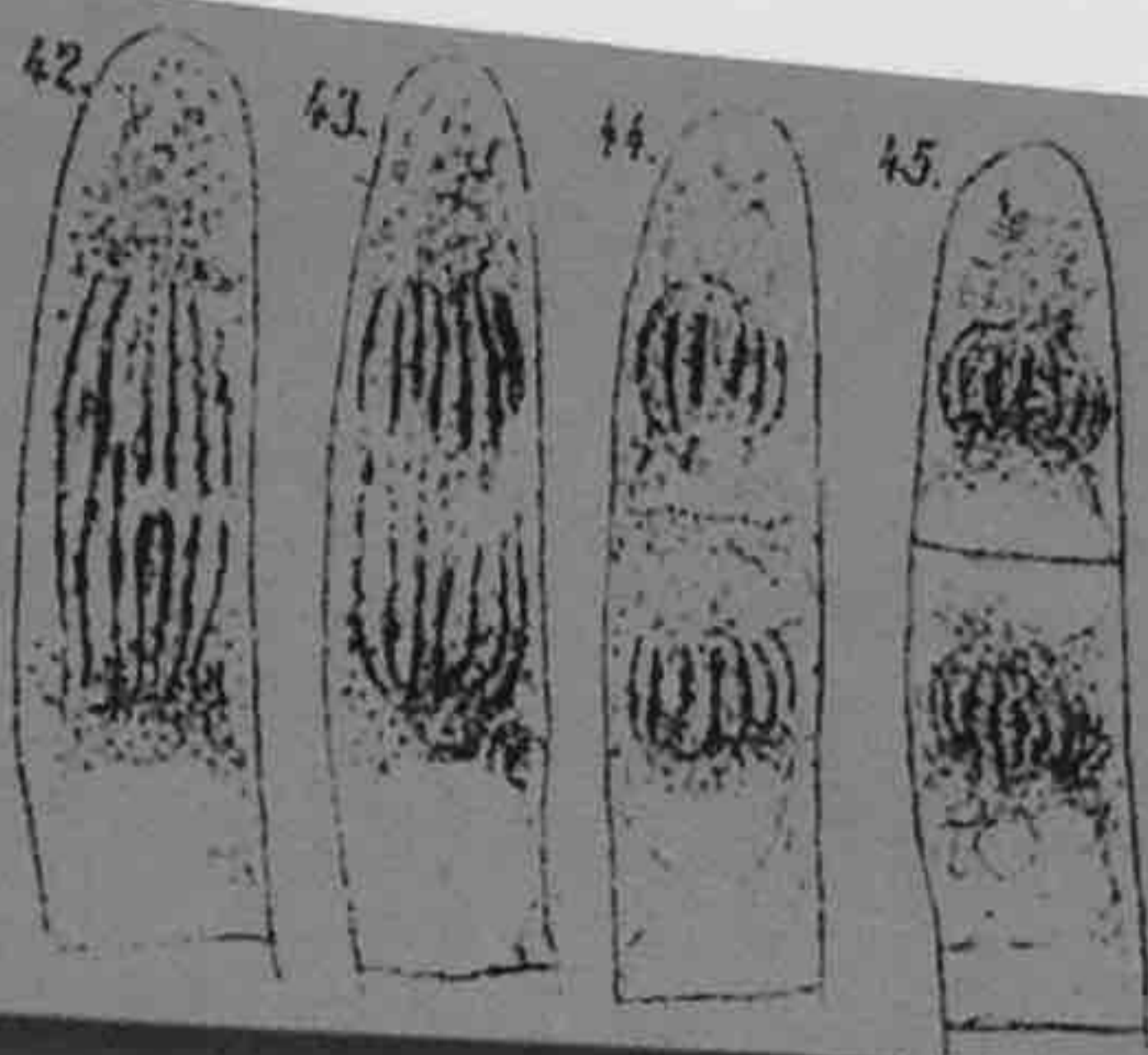
As the power of microscopes improves, scientists start to describe the inner structure of cells. Robert Brown describes a central structure found in many cells, a structure that he calls the nucleus.



1882

Cells Divide, Chromosomes Split!

Scientists observe how cells divide. Walther Flemming describes how structures within the cell separate. These structures are the chromosomes. Chromosomes determine the traits of living things.



1928

Researchers Study the Chromosomes of Fruit Flies and Find Genes

Working with fruit flies, Thomas Hunt Morgan discovers that genes are found in specific locations on chromosomes.



1866

Austrian Monk Describes Patterns of Heredity

Gregor Mendel's experiments with garden peas show that traits are passed on from parents to offspring in predictable patterns.



1830

1840

1850

1860

1870

1880

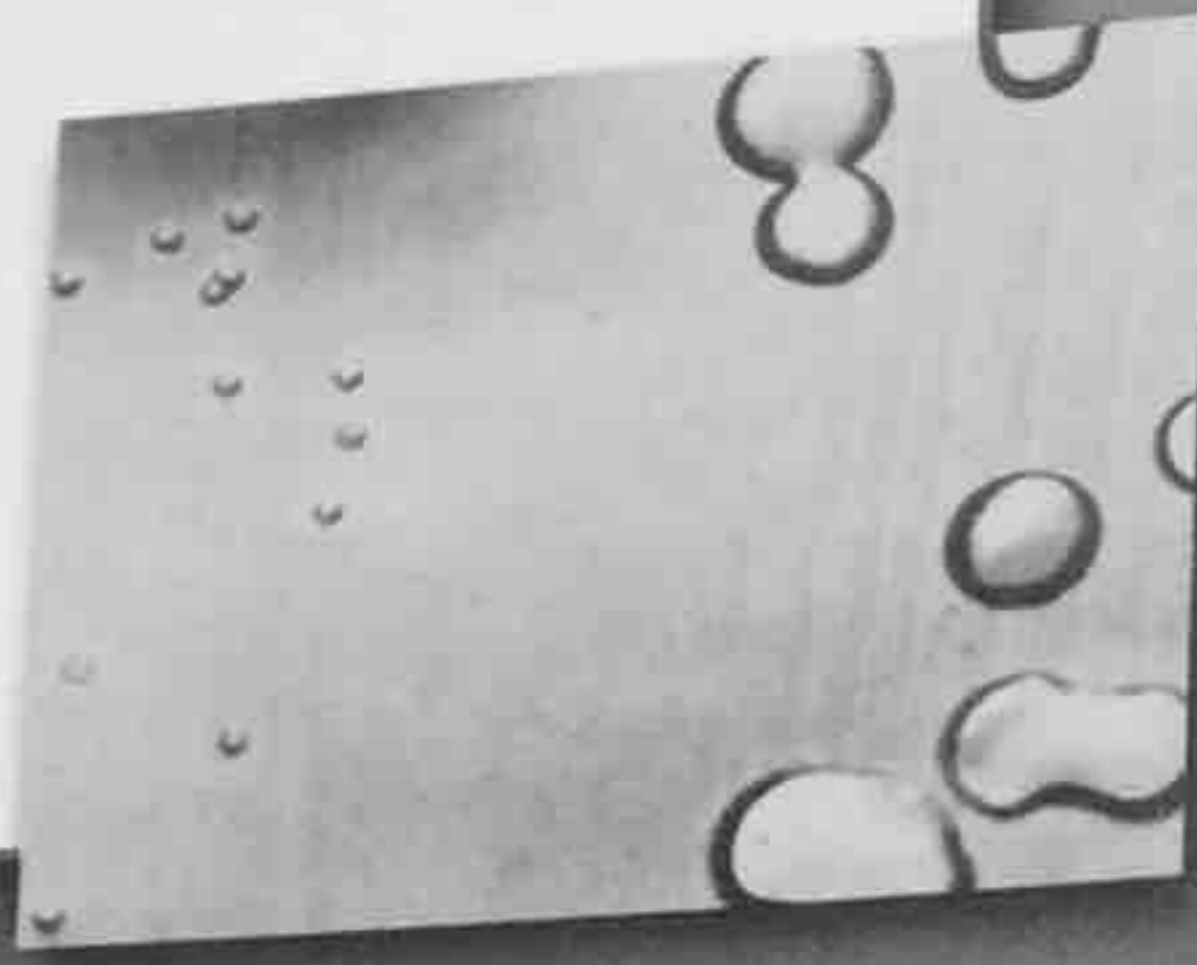
1930

Cells have a highly organized structure. Color dyes are used to help us see the different parts of a cell.

1944

DNA—Genetic Material

Researchers studying *Streptococcus* transformation find that bacterial cells get their characteristics from DNA.



1973

DNA Recombined

In an amazing breakthrough, scientists have cut DNA from two different sources and recombined the DNA. The new DNA molecule reproduces when placed inside a bacterium. Such bacteria can be used to make proteins useful to humans.



1951

Scientists Capture Image of DNA

Scientists searching for the secret of DNA structure get an enormous clue when Rosalind Franklin uses x-ray crystallography to create an image of DNA. Maurice Wilkins, James Watson, and Francis Crick are awarded the Nobel Prize in 1962 for building a model of the DNA double helix molecule.



1984

Chinese Scientists Alter Fish!

In an effort to produce fast-growing fish for food, a team working with Zuoyan Zhu has made the first genetically modified (GM) fish.

1950

1960

1970

1980

TECHNOLOGY

Seeing Molecules

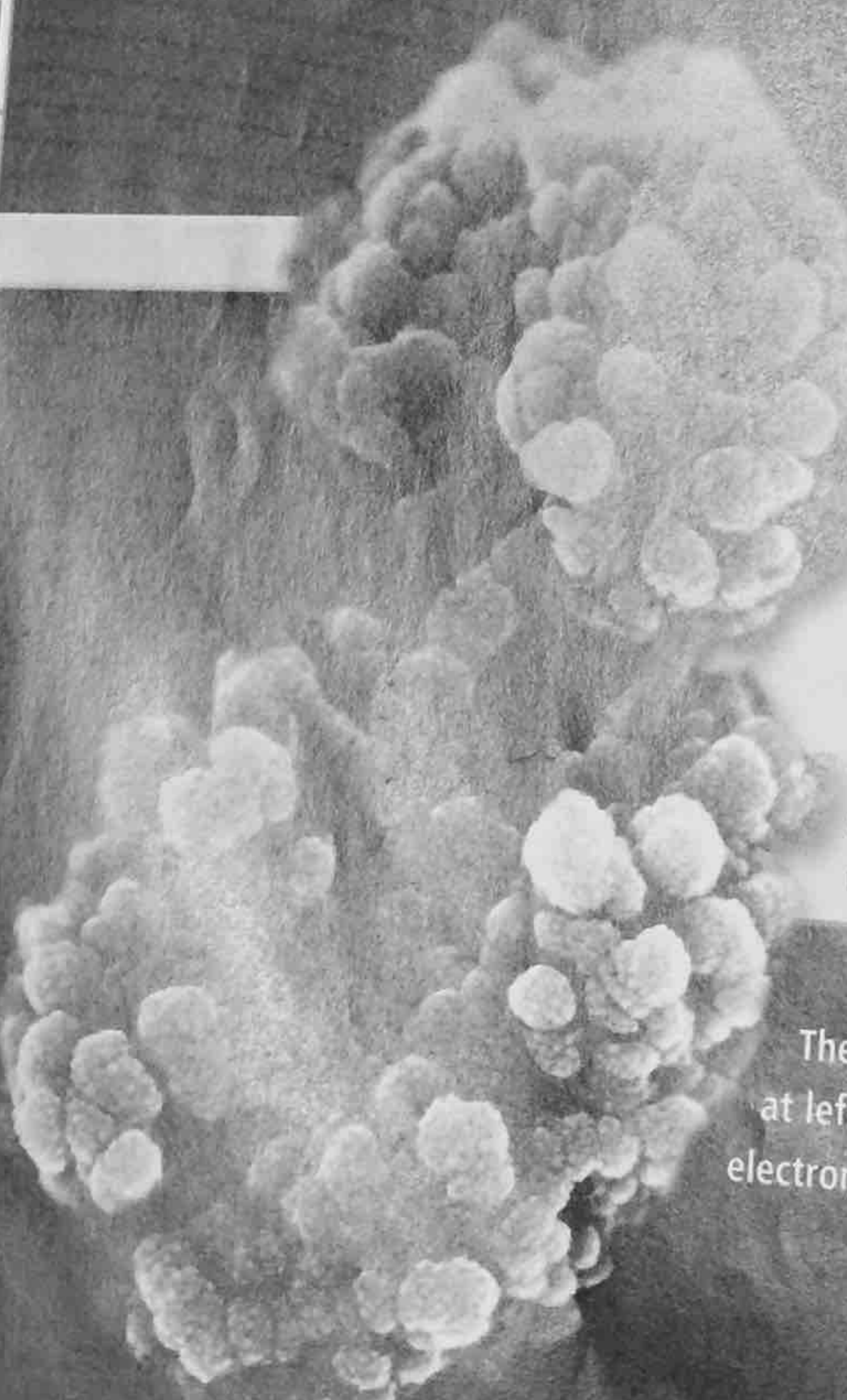
In the 1930s, a microscope came into use that focuses a beam of electrons, instead of a beam of light, on an object. Now we can see things as small as the molecules inside cells.

The image of the chromosome at left was made using an electron microscope.

APPLICATION

DNA Frees Innocent Prisoner

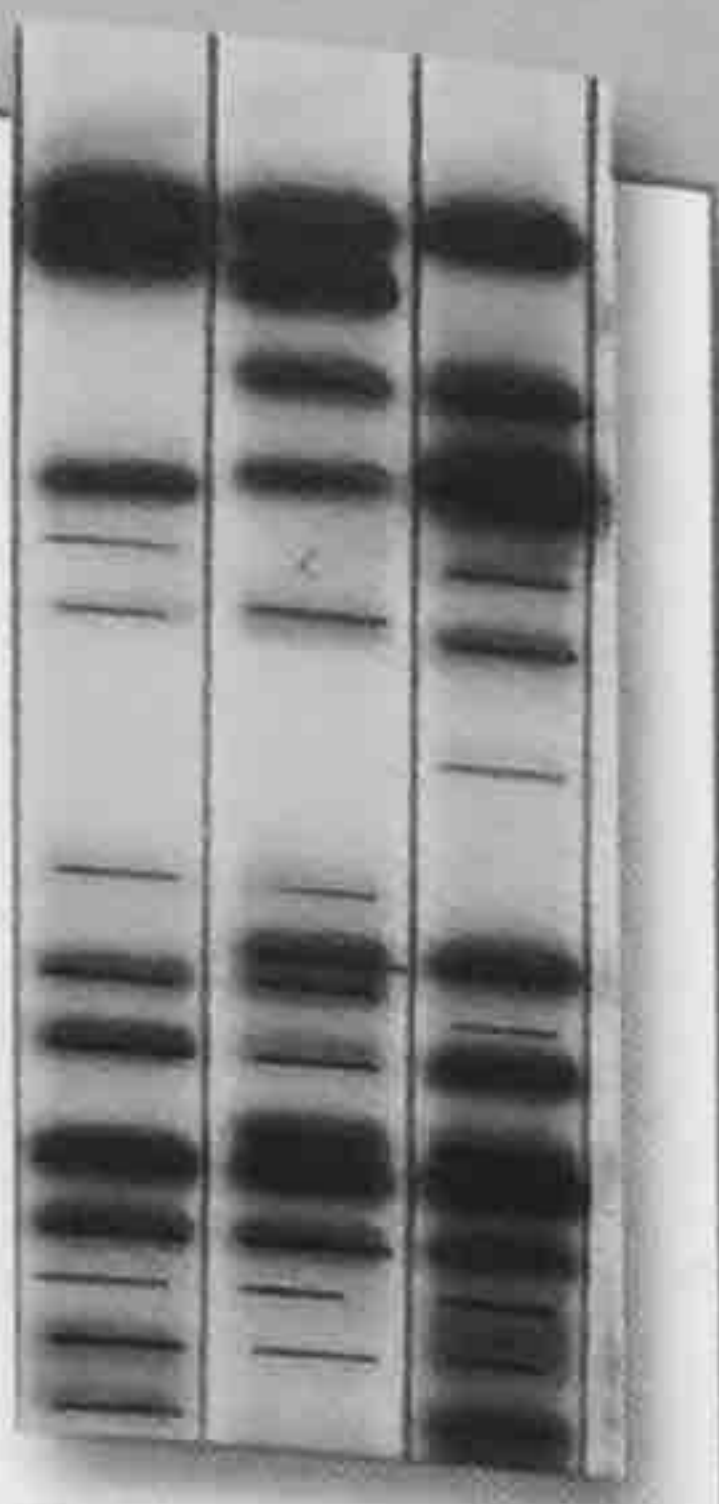
Kevin Green was convicted of murder and spent 16 years in prison. While he was in jail, the California Department of Justice created a DNA database that contained the DNA fingerprints of many other convicted felons. When Green's defenders compared the DNA found at the murder scene with DNA fingerprints in the database, they found that it matched someone else's fingerprint. The real murderer confessed, and Green is now a free man, thanks to genetics.



1984

Living Things Have Genetic Fingerprints

Human fingers have their own unique fingerprints. In a similar way, the DNA of different people has its own unique patterns. These DNA fingerprints are compared here.



2000

Scientists Sequence Human Genome

Two groups of researchers, Celera and the Human Genome Project, succeed in publishing the first draft of the sequence of DNA for all the chromosomes in the human body.



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1990

2000

Today

APPLICATION

Saved by a Gene Donor

In 1986 a baby girl named Ashanti DeSilva was born. One single mistake in her DNA meant that Ashanti's body could not make an important disease-fighting protein.

In 1981, researchers had figured out how to move a working gene from one mammal to another. Ashanti became the first person ever to receive a gene from someone else. Ashanti's doctors injected some of her white blood cells with healthy copies of the sick gene. Now her white blood cells worked. Researchers and doctors are trying to apply the same techniques to other genetic disorders. There is still much work to be done.



INTO THE FUTURE

Genetics is a young science. The timeline spans 350 years, but the real study of genetics began in 1900 with the rediscovery of the work of Gregor Mendel. Since then, scientists have determined the structure and function of DNA—and ways to use this knowledge.

In medicine, genetics is used to identify genes that play a role in inherited diseases. Questions remain about how this knowledge can be used to treat or even prevent disease.

In agriculture, genetics is used to modify the genes of plant and animal stocks to give them desirable traits, such as resistance to disease. Questions remain about what effect modified genes might have once they enter a population of plants or animals.

In biology, genetics is used to determine how different types of organisms have changed over time and how one species relates to another. Questions remain about whether similar genes found in different organisms behave in the same way.

In society, genetic profiles are used to help solve crimes or make identifications. Questions remain about how to protect individuals and their personal information.

ACTIVITIES

Reliving History

Use a hand lens or microscope to study water from a pond or puddle. See if your sample contains structures similar to those drawn by van Leeuwenhoek in 1674.

Writing About Science: Biography

Sharing information is important to scientific discovery. Learn more about individuals or groups involved in the discovery of DNA structure or sequencing the human genome. How important was cooperation in their work?