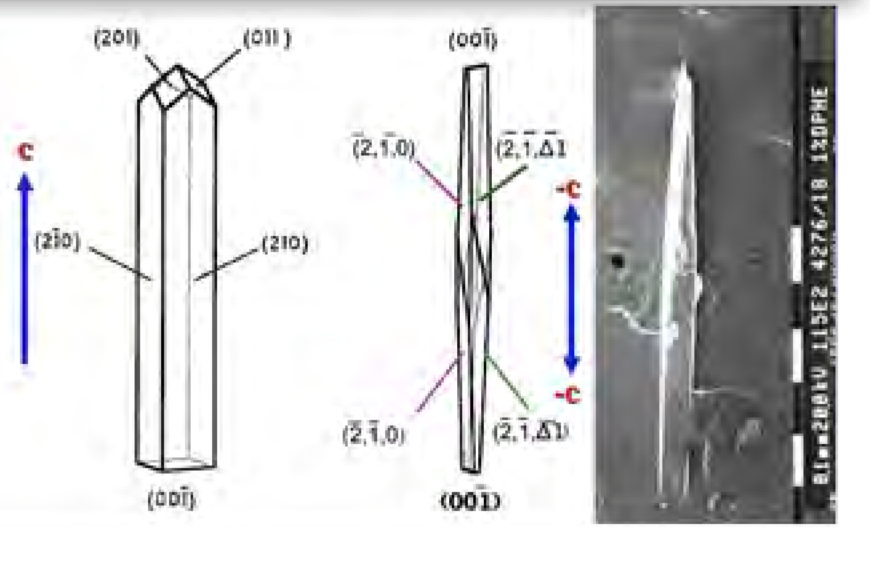
1971

The Institute's various departments were, for the first time, organized into faculties. These faculties – the same ones, more or less, that exist today – were Biology, Biophysics-Biochemistry, Chemistry, Physics and Mathematical Sciences, plus the Feinberg Graduate School. The Chemistry Faculty included the Chemical Physics, Plastics Research, Isotope Research and Chemistry Departments.

1971

Institute scientists have been credited with founding the field of crystal engineering. Using their knowledge of chemistry in crystals, they proposed, and showed experimentally, that the characteristics of a crystal's individual molecules and the interactions between them can be used to predict crystal structure. They were the first to demonstrate methods for chemically manipulating crystals to produce desired results.

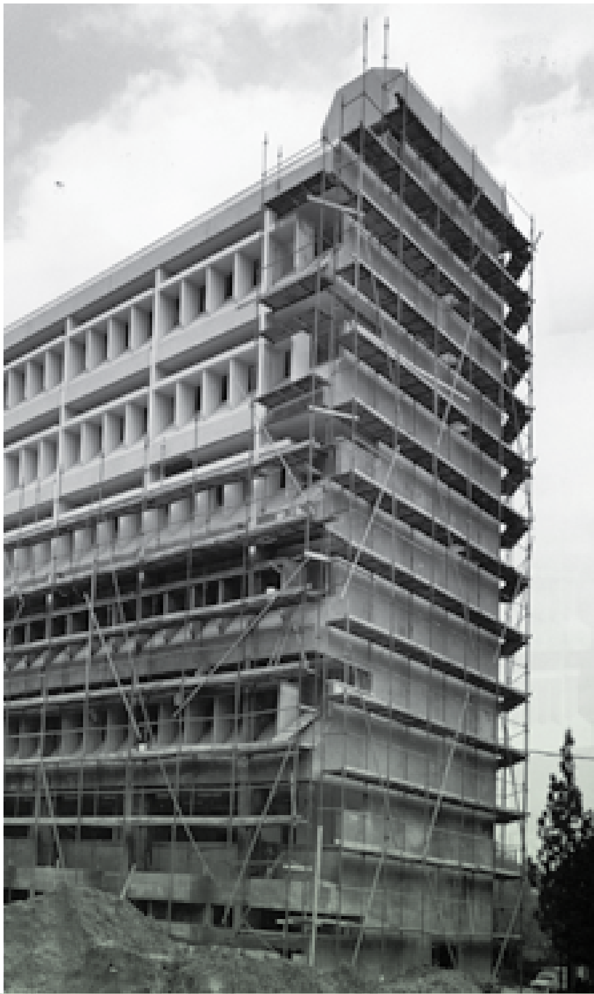


1974

Environmental and industrial safety research was taken up by a number of Institute scientists early on. They worked to improve industrial processes by developing alternatives to the heavy metals, carcinogens and volatile substances emitted in many types of manufacturing. Much of this research focused on the creation of new polymers for various applications, such as those developed for use in ion exchange membranes employed in water desalination systems.

1974

The Perlman Institute of Chemical Sciences and the Perlman Chemical Science Building were dedicated in a festive ceremony that coincided with the 100th anniversary of the birth of Dr. Chaim Weizmann and the 40th anniversary of the Daniel Sieff Research Institute. Thanks to the special relationship Harold Perlman of Chicago enjoyed with the first Dean of Chemistry and Scientific Director of the Institute, Prof. Gerhard Schmidt, a gift was made in 1969 to construct the 7,435 sq. m. facility, named for Perlman's late parents and built especially to provide space for the labs and advanced equipment of the Chemical Physics Department. Later, thanks to another generous gift by Harold Perlman, an NMR unit was added on to the building. Today, in addition to the the Chemical Physics Department, the building houses the Materials and Interfaces Department - a testament, in a way, to the prescience of Perlman's vision. Highlights of Schmidt's scientific research can be found on pages 21 and 27.

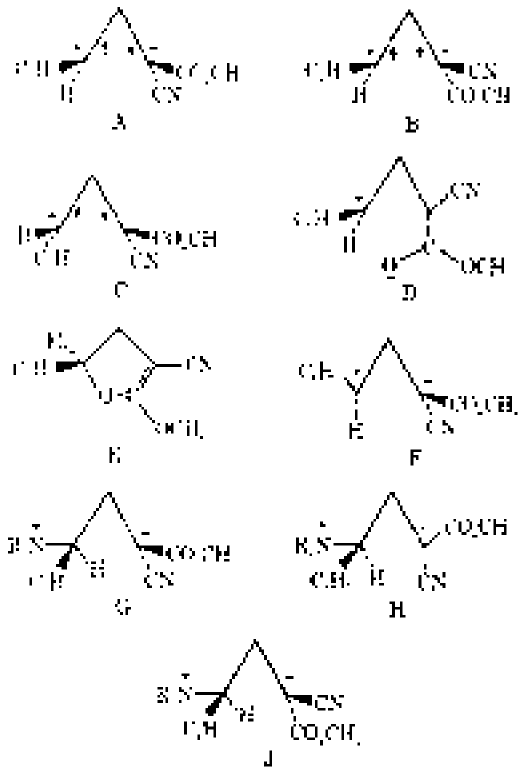


1975

Solar collectors used for heating water in Israel and other countries owe some of their efficiency to the Weizmann Institute scientists who developed optically selective surfaces, which are particularly good at absorbing and converting energy, and have excellent durability.

1976

Weizmann Institute scientists took the idea of using light to direct chemical reactions to a higher level. They developed cheap, simple and efficient ways of using light to break the bonds between carbon and the other atoms it tends to bind to – oxygen, nitrogen and sulfur – in biological molecules. These methods became important tools in biochemical research, helping scientists to generate "molecular libraries" of peptides, sugars and phosphates, and they enabled the development of techniques for rapidly sequencing genomes.

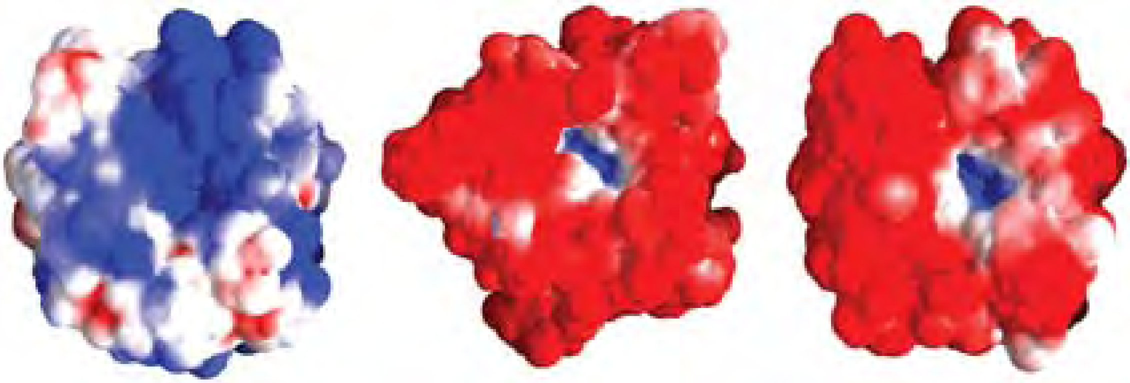


1976

Institute chemists developed a radical new approach to the solar cell. While standard photovoltaic cells are based on solid materials in which electrons move when sunlight hits their surface, the new system is set up more like a battery. Two electrodes are placed in a chemical solution. One of these electrodes absorbs sunlight, causing electrons to move between the electrodes. Adding a third electrode enables the cell to deliver energy day and night, as it not only converts sunlight to electricity, but also stores part of it.

1979

How do organisms survive in such extreme environments as the ultra-salty Dead Sea? When Institute scientists determined the three-dimensional structure of a particular protein from a Dead Sea bacterium – ferredoxin – and compared it with its freshwater counterpart, they found the salt-loving bacterium's protein contained an addition. This structural add-on gives the molecule's surface a net negative charge, which then attracts water molecules that form a protective envelope around the protein. Further research in this field has revealed a number of adaptations in bacteria and algae to salty environments, and has implications for human kidney research as well as for developing modified organisms adapted to harsh environments.

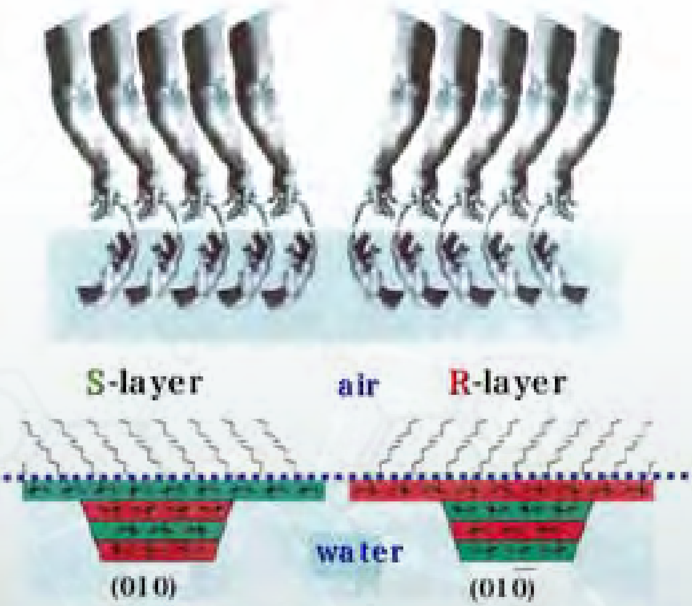


1979

The light-induced, reversible color change in the photochromic materials created at the Institute had some very practical applications, including photochromic plastic lenses. In additional developments, photochromic liquid crystal polymers and photochromic films with non-linear optical properties for laser frequency doubling (second harmonic generation) were discovered.

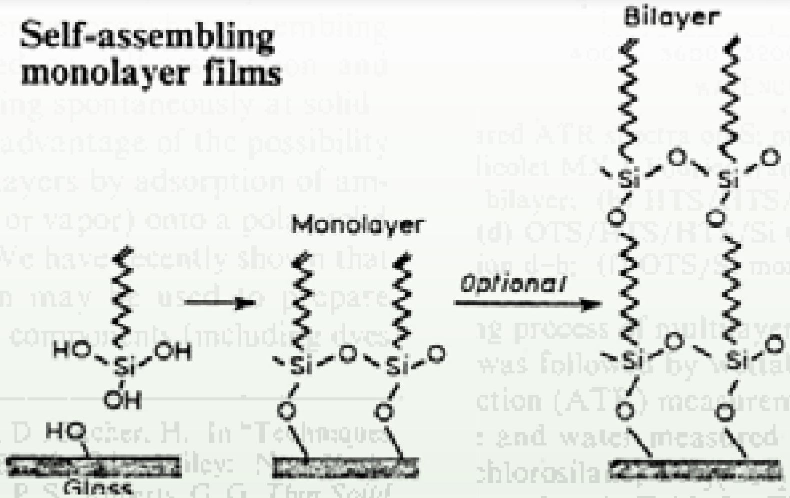
1982

Louis Pasteur first discovered that molecules of a specific chemical crystallize in mirror-image forms in 1848. This fact has plagued chemists and drug-makers, as the opposing forms often perform different actions. Institute scientists developed a method for controlling the shape and orientation of such crystal structures. Introducing “tailor-made” additives into the process, they were able to direct crystal growth in any direction they desired. The method can also be used to separate the different forms of a molecule, and it has given scientists some clues as to why biological molecules of single “handedness” evolved in the pre-biotic world.



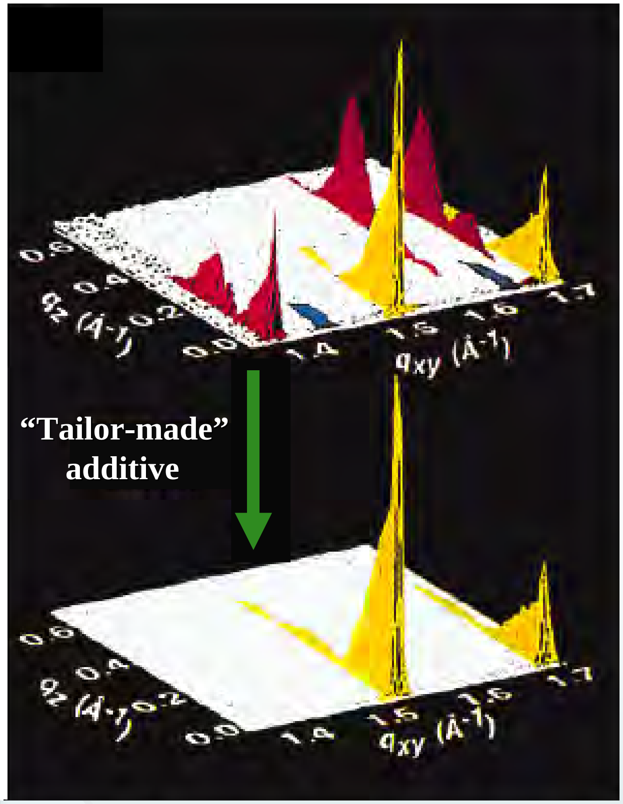
1983

Films only a molecule-or-so thick deposited on glass or another surface have numerous uses in optics and electronics. Weizmann Institute chemists pioneered a new method of creating such films – one in which the molecules assemble themselves into a neat layer, enabling fine control over the film's structure and properties. The chain-like molecules created in the Weizmann chemistry labs line up like posts, binding to the solid surface at one end. The free end can be either non-reactive chemically, stopping another layer from forming, or designed to support a second layer of molecules.



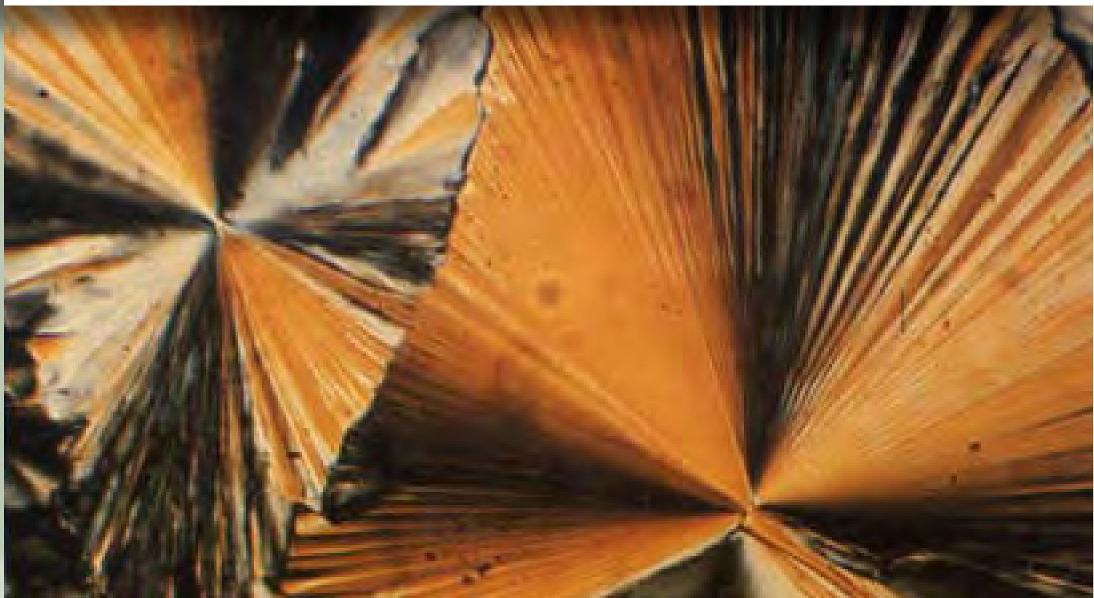
1984

How do molecules appear when they float on the surface of water? Oily substances, for instance, take on a unique configuration as they spread out in a thin layer. Members of the Chemistry Faculty developed a method for determining the two-dimensional configuration of these molecules. They then used the method to unravel the beginning stages of the process of nucleation – when oils begin to crystallize into thickened, "waxy" layers. This research has shed light on biological structures such as lipid membranes, as well as suggesting solutions to such industrial problems as diesel clogs in cold engines.



1985

Liquid crystals, today a staple of electronic displays, are something between a solid crystal, with its highly organized molecules, and a liquid, in which the molecules are arranged randomly. Institute scientists, together with German colleagues, were the first to create a new group of liquid crystals composed of cone-shaped molecules. (Until then, liquid crystal molecules had only come in cigar or coin shapes.) Studies of these molecules using NMR and other methods revealed a connection between the structure of the molecules and the organization of the liquid crystals.



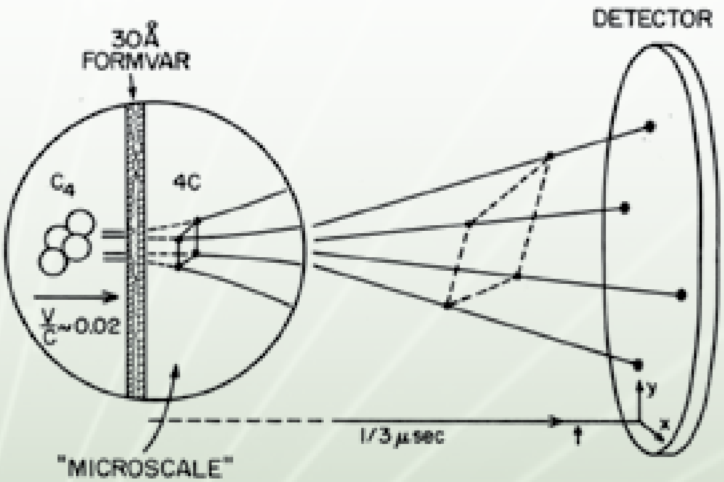
United States Patent [19] [11] Patent Number: 4,857,473

1986

What's in the water? Institute chemists developed a method to examine water reserves that reveals the water quality at different depths. They used the multilayer tester, in which the water is separated into different cells, to assess the water in the Dead Sea and the Sea of Galilee. Because the system is based on many small samples, it can be used to detect contaminants at an early stage, when steps to prevent wide-scale pollution may still be possible.

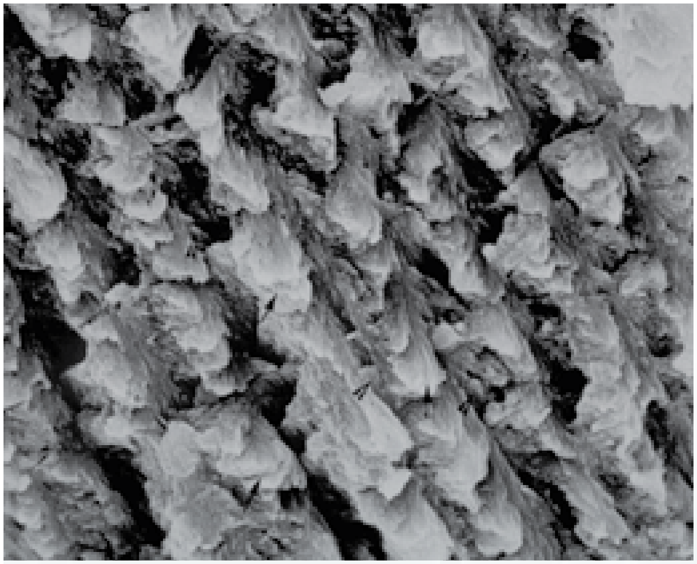
1986

Institute scientists developed a new imaging method to determine the structure of molecules. Molecular ions (with one surplus electron) are accelerated to very high speeds and then bombarded with a laser beam. The resulting high-energy molecules are passed through a thin foil, tearing away the electrons that hold the atoms together. The molecule – now a cloud of positive ions – expands as the ions repel each other, and the molecular structure, a billion times its normal size, can be observed.



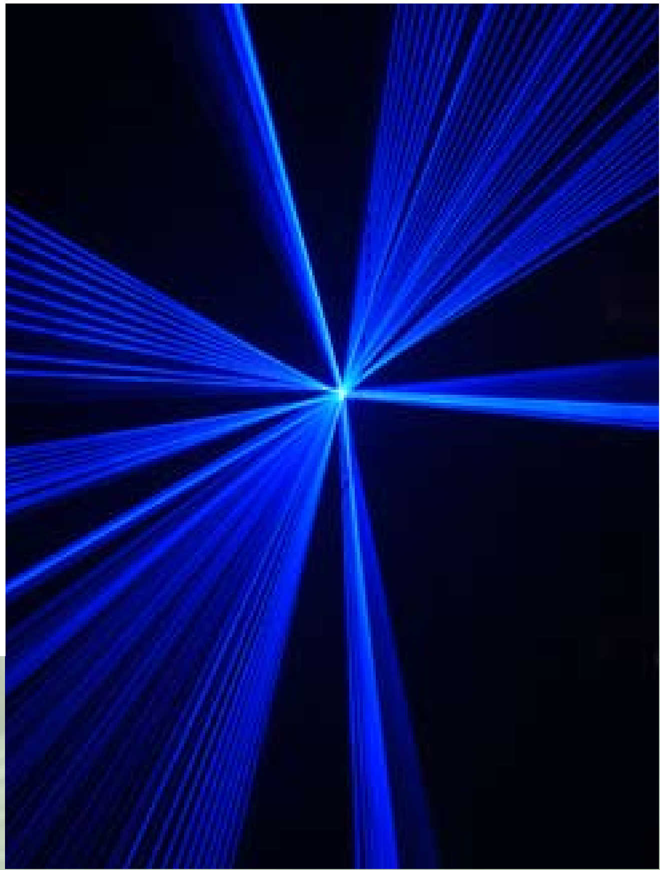
1988

Institute scientists investigating the microscopic structure of bone discovered that one common type of bone owes some of its strength to a formation similar to plywood. It contains layers of collagen fibers, each one aligned at a 30 degree angle to the one below it. These fibers create a sort of mold in which calcium phosphate crystals form. Together, the fibers and crystals make a natural composite material that is both hard and strong. The scientists developed a mathematical model to calculate the connection between bone structure and its mechanical properties.



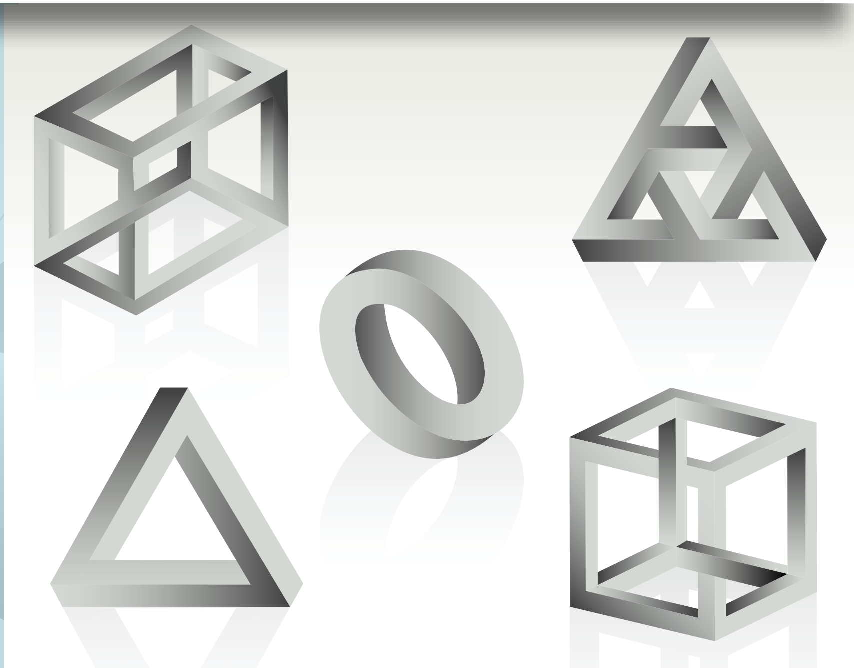
1990

A laser beam is made up of parallel light waves that are all the same length; that is, they're limited to one color. A team of Institute scientists created lasers from sunlight. First they concentrated the sunlight with a powerful system developed at the Institute and then separated the intense light by wavelength into precisely colored beams.



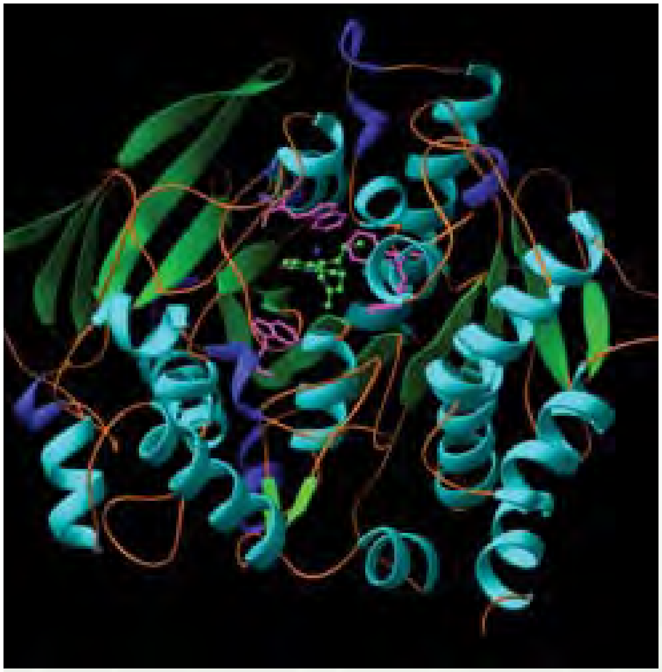
1990

The Chemistry Faculty assumed the organizational structure it has borne until today. The faculty's five departments are: Chemical Physics, Environmental Sciences and Energy Research, Materials and Interfaces, Organic Chemistry, and Structural Biology.



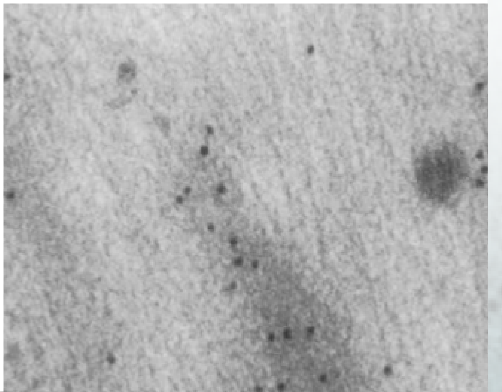
1991

When messages are passed between nerves or from nerve to muscle via the neurotransmitter acetylcholine, an enzyme called acetylcholinesterase (AChE) acts at the junction between them, breaking down the neurotransmitter and "resetting" the gap through which the messages pass. AChE is a promising target for treatments for Alzheimer's disease, which is characterized by acetylcholine deficiency. A team at the Weizmann Institute was the first in the world to determine the three-dimensional structure of AChE. In further studies, they have determined precisely how it behaves and how various drugs and toxins affect its activity. These results have implications for the design of new therapies and protection against toxins.



1991

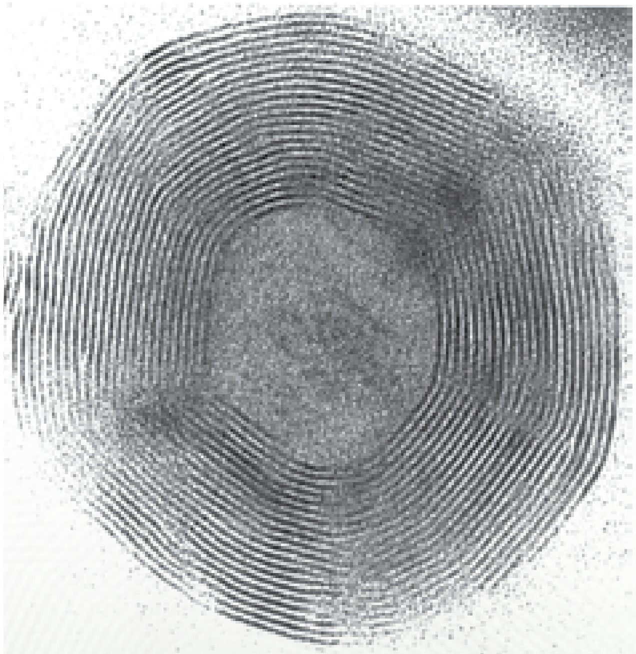
Weizmann Institute research is often on the cutting edge of scientific technique. For years in electron microscopy, the mainstay of biological research, specimens had to be dried or coated to preserve them in the microscopes' vacuum chambers. Weizmann Institute chemists and biologists teamed up to develop a method for freezing and slicing specimens that enables them to be viewed in a more natural state: Tissue samples are flash frozen and prepared in thin slices, which are then viewed in the microscope. The sections can be viewed at various angles, and computerized reconstructions allow researchers to investigate spatial phenomena.



10nm

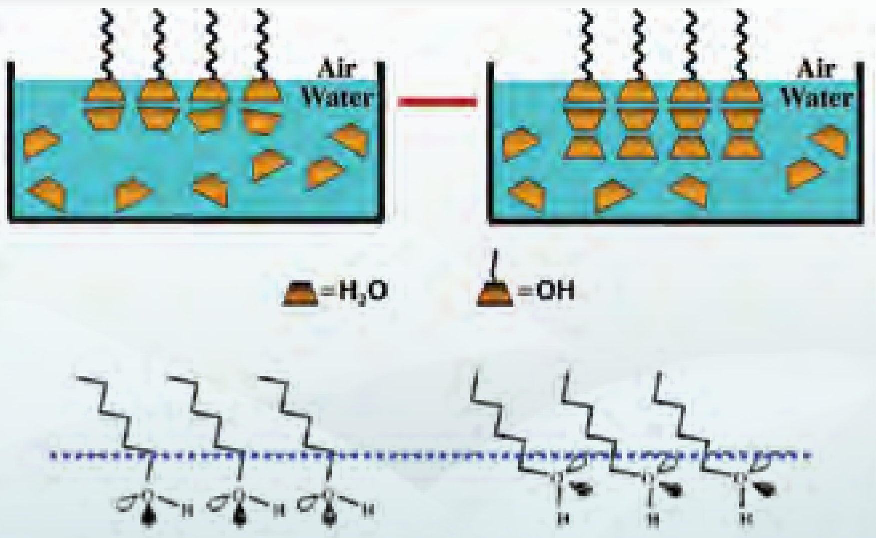
1992

Institute chemists created a new nanomaterial that, among other things, is about two and a half times as efficient at reducing wear and tear on machinery as conventional lubricants. Molecules of this material – tungsten disulfide – resemble a soccer ball. The first molecules to be identified in this shape – fullerenes and nanotubes – were made of interlocking carbon atoms, and scientists had assumed that only carbon-containing molecules could form these kinds of spheres and tubes. The Institute scientists were the first to show that inorganic (non-carbon containing) molecules could be shaped like fullerenes and nanotubes, and that this shape gives them special properties.



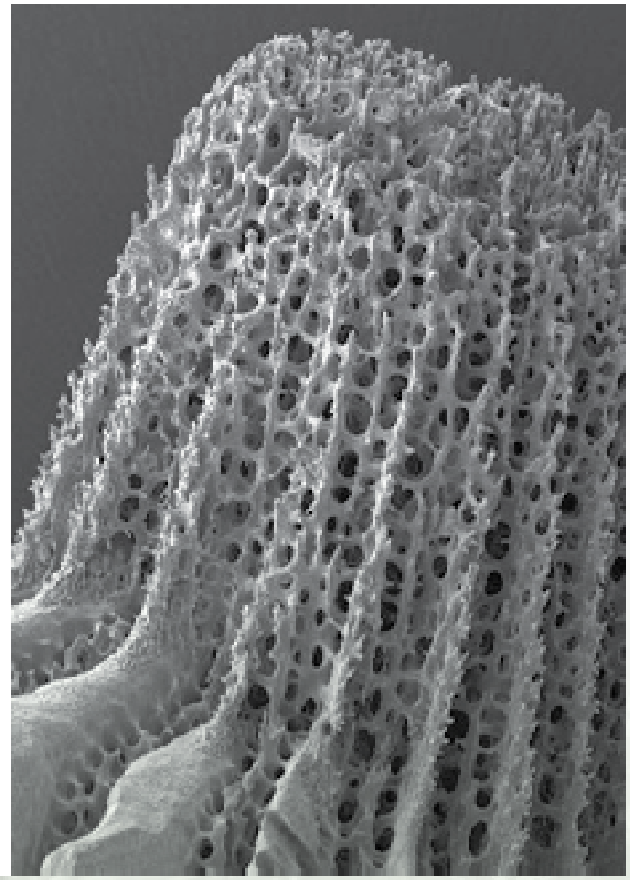
1992

Cloud seeding to increase rainfall involves coaxing the water in clouds, which can remain liquid at temperatures well below freezing, to turn to ice crystals. Materials such as the widely-used silver iodide are "seeds" around which the ice crystals coalesce. The downside of silver iodide is that the water must be very cold to get the ice to form: about -20°C. Institute scientists discovered that certain alcohols can freeze the water drops at much higher temperatures. Especially long-chained alcohols with a specific chemistry can work at temperatures just below 0°C. Recent research in this area has led to a patent.



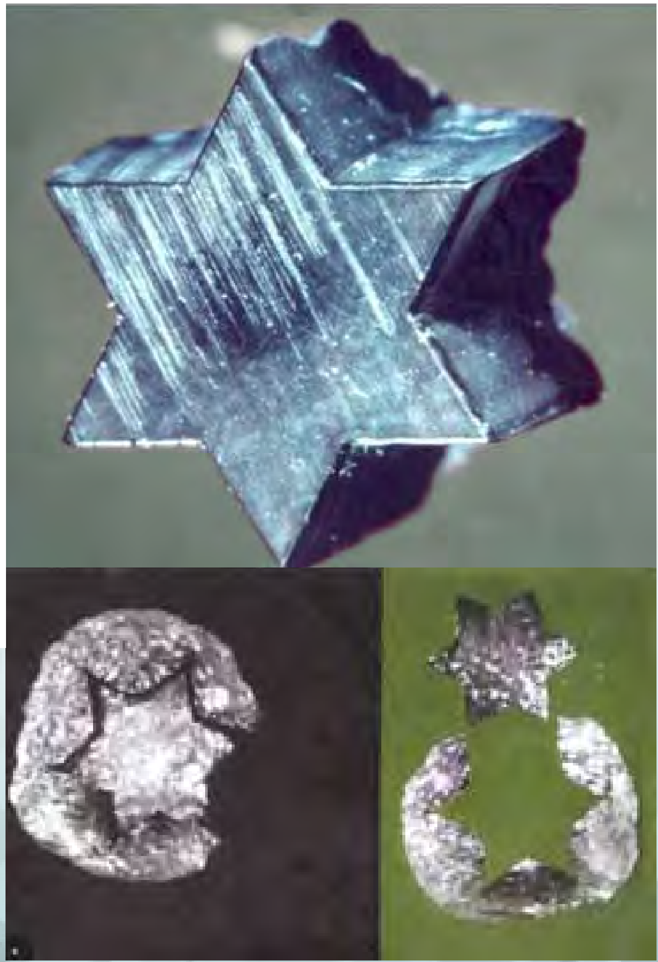
1992

How do sea urchin spines, composed of a single calcite crystal, manage to be strong yet flexible? Institute scientists found that the spine material is a composite in which rod-like protein molecules are entrapped within the crystal structure. These proteins prevent cracks from spreading. Later research by these scientists also revealed how the sea urchin repairs broken spines, depositing layers of an amorphous material that crystallizes in stages. These studies may prove useful to materials engineers wanting to create strong synthetic materials with the properties of single crystals.



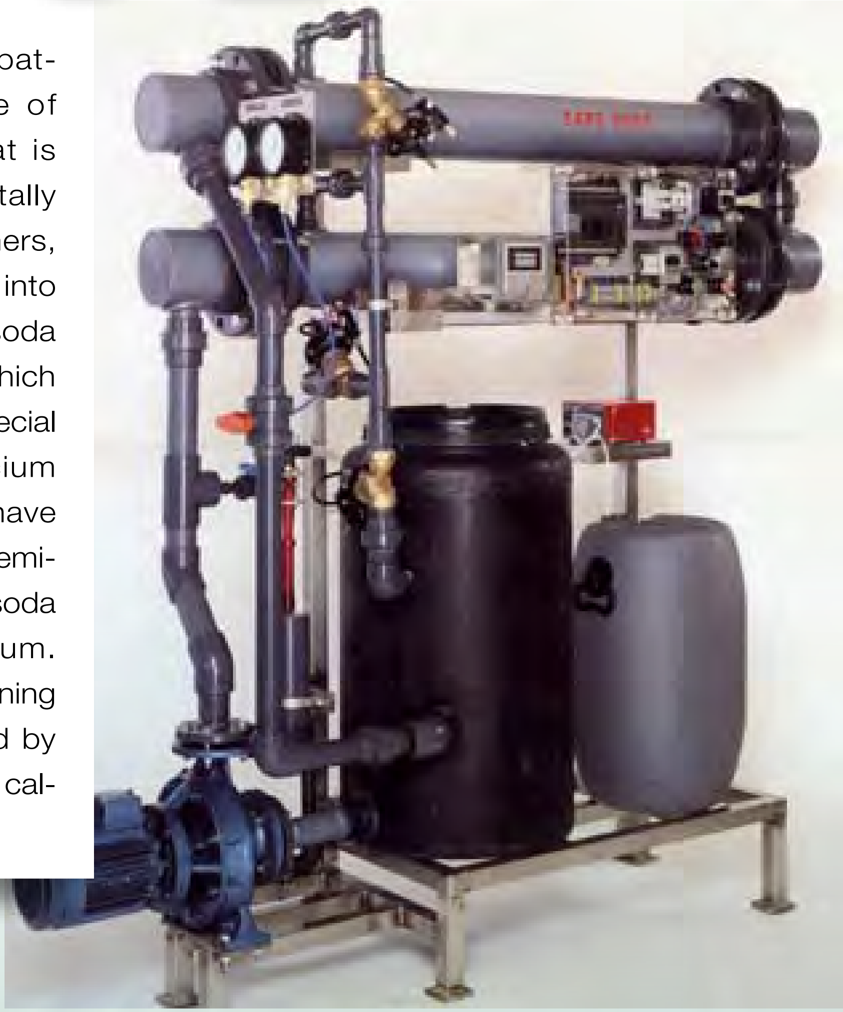
1992

A method for cutting diamonds with lasers, developed at the Weizman Institute, promised to reduce losses in the stone's weight and enable diamond cutters to create unusually shaped stones, regardless of the diamond's internal structure. The technique was eventually used to introduce Computer-Aided Design and Computer-Aided Manufacturing (CAD-CAM) to the diamond processing industry.



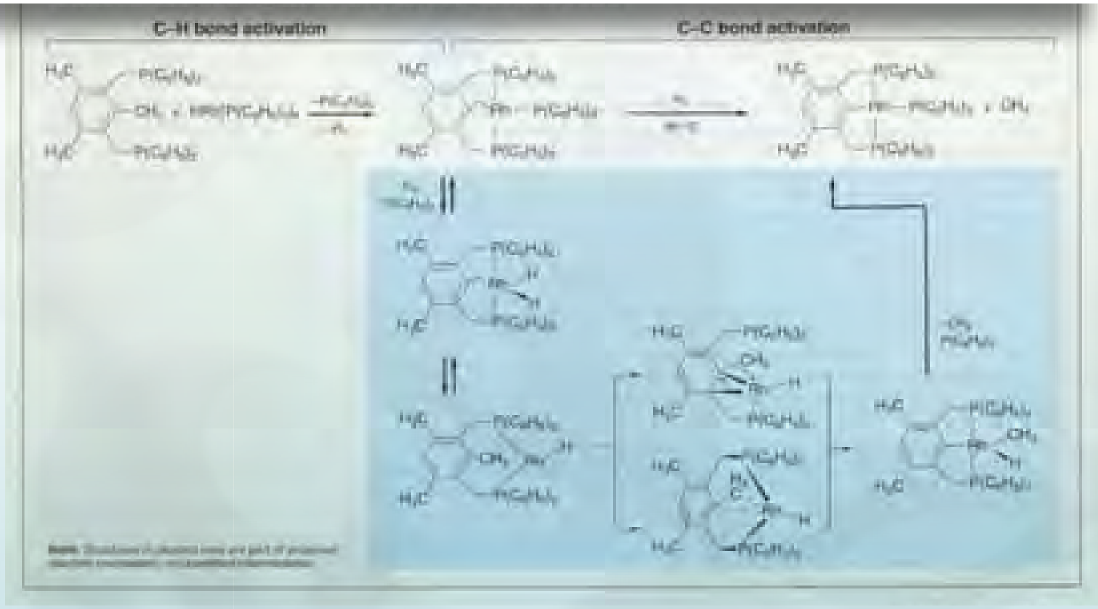
1992

Institute scientists patented a new type of water softener that is much more environmentally friendly than older softeners, which dump tons of salt into water systems. Caustic soda is added to the water, which then passes through a special filter carrying small calcium carbonate crystals that have precipitated through a chemical reaction between the soda and the dissolved calcium. The excess calcium remaining in the solution is removed by the rapid growth of further calcium carbonate crystals.



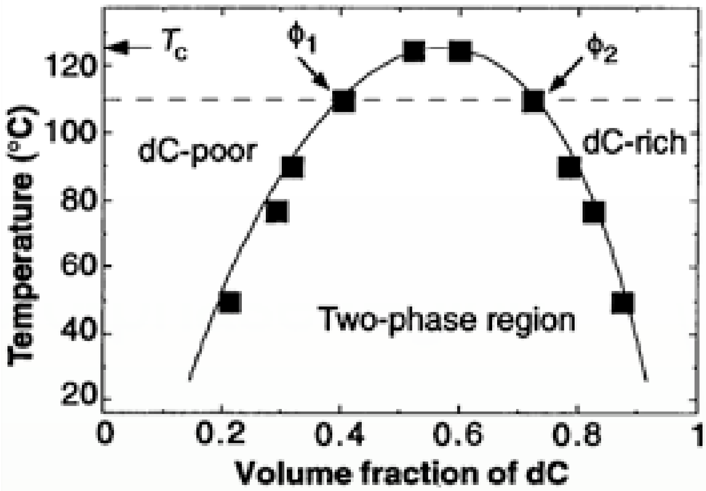
1993

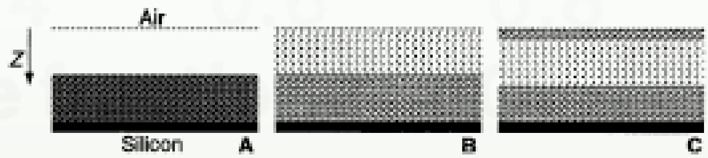
Bonds between carbon atoms are among the strongest and the most common in nature. Industrial methods of breaking carbon bonds, in petroleum, for instance, are not selective and require heating the material to very high temperatures in the presence of hydrogen and catalysts. Institute scientists discovered that it is possible to break a strong carbon bond by inserting a metal complex between the carbon atoms – the first time anyone had succeeded in doing so. This transformation, which takes place at low temperatures and is selective, is of fundamental importance and may lead to new chemical processes of industrial significance.

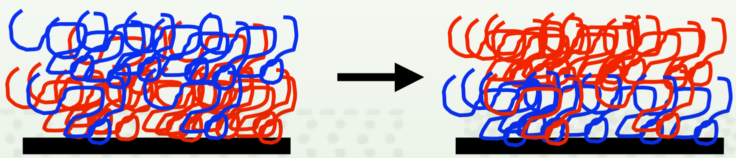


1994

Many modern materials are mixtures. When materials are blended, is the resulting substance consistent all the way through? Materials scientists ask this question because the properties at the surface of the material often determine its usefulness: Sliding, friction, reflection or radiation absorption and cleaning all take place at the surface. Institute chemists discovered that when such a mixture consists of two chemically similar polymers, the more flexible one will concentrate in the layers nearer the surface. These findings should aid in many areas of practical materials research.

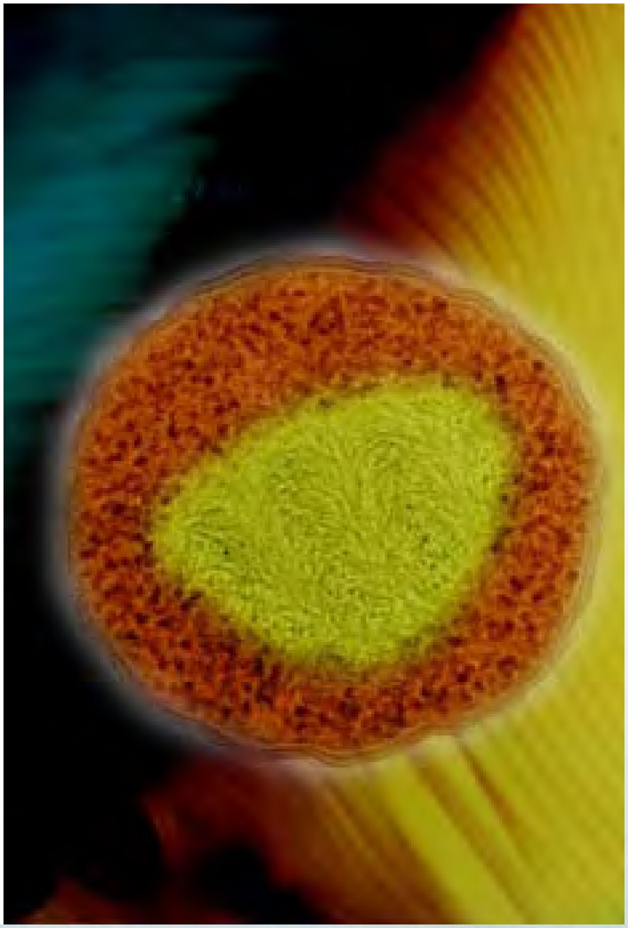






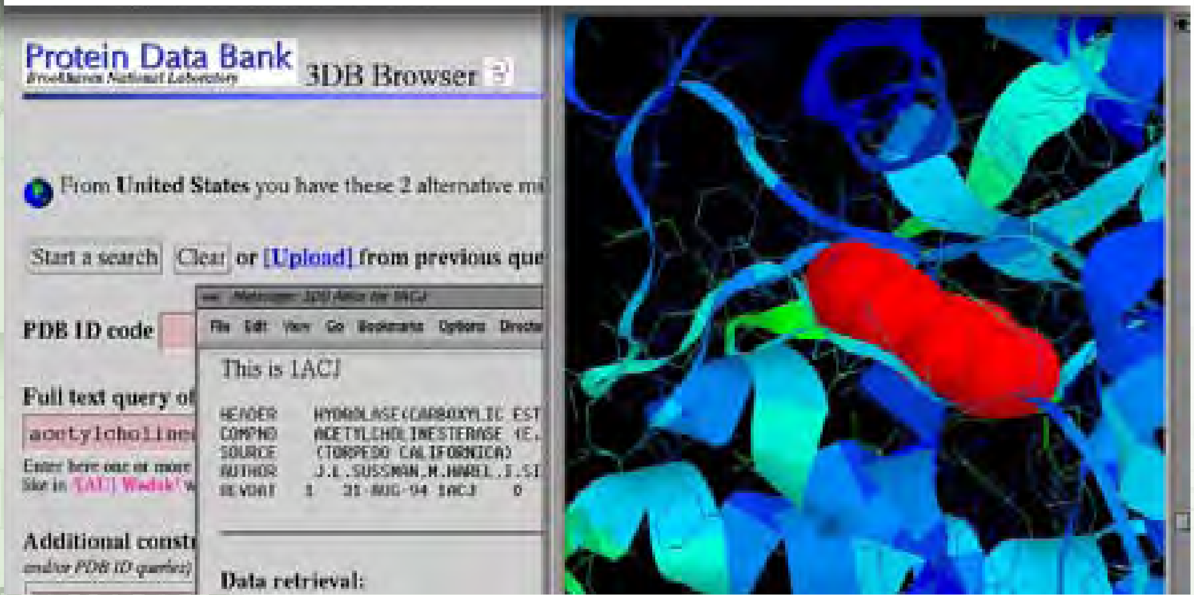
1994

Institute scientists found that DNA in stressed bacteria compacts into a structure similar to a liquid crystal. This doesn't happen, however, in DNA that is contained in a cell nucleus, and the scientists proposed this is due to the packaging of eukaryotic DNA: It's wrapped into bead-shaped structures called nucleosomes that may preserve DNA structure. A notable exception to this rule seems to be sperm cells, in which the DNA does appear to take on a liquid crystal form. Institute research suggests this arrangement may play a role in fertility.



1995

Weizmann Institute researchers and colleagues in the Brookhaven National Laboratory, USA, wanted to make the protein data bank – amassed in Brookhaven since the mid-seventies – accessible to scientists around the world. They developed a software bridge between the information-heavy files on the approximately 7,000 protein structures stored on the Brookhaven computers and the Internet, allowing scientists to download the information quickly and easily and see the structures in three dimensions.



1995

It's known as the porcupine – a receiver studded with hundreds of ceramic pins arranged to absorb concentrated solar radiation and efficiently transfer the heat to the air flowing over the pins. In front of the porcupine, a special thin conical quartz glass window that can withstand high internal pressure enables the concentrated sunlight to reach the pins. In this unique apparatus, designed at the Weizmann Institute, pressurized air is pumped past the ceramic pins, heating it to over a thousand degrees. This super-hot air is then used to power an electricity-generating gas turbine.

1995

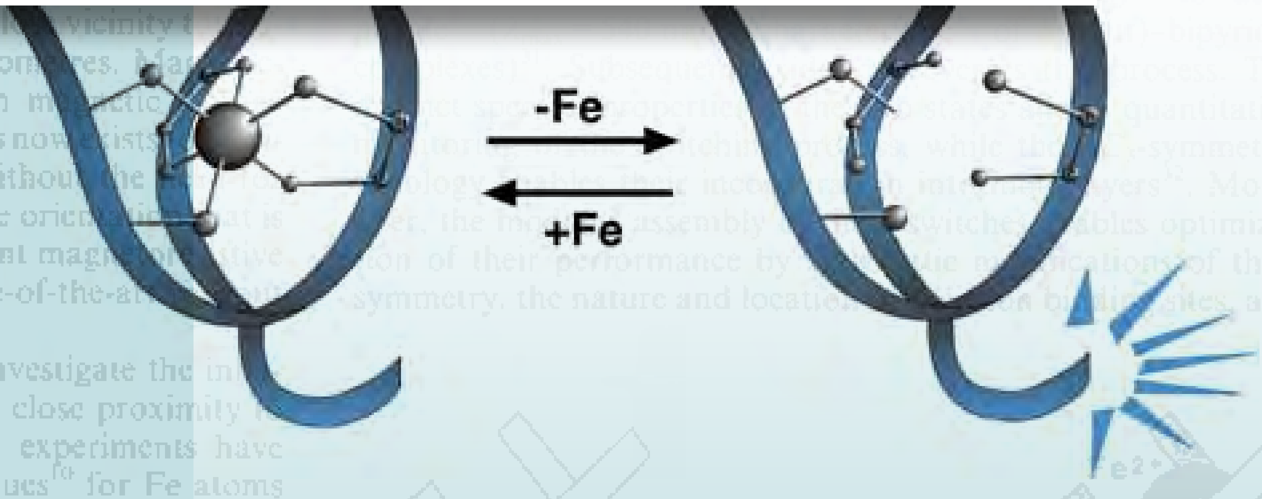
The Bergmann Building was enlarged and rededicated as the Helen and Milton A. Kimmelman Building. Today, it houses the Structural Biology Department, part of the Organic Chemistry Department, and a number of scientific centers that help Institute scientists stay at the leading edge of their fields.

1995

How do plants grow right on the salty Dead Sea shore? An Institute scientist found that the plants are able to distinguish between salt water and the occasional flood water that comes their way from the Judean Hills, and absorb only the sweet runoff. Understanding how the plants accomplish this may make it possible to understand how new ecosystems are formed in harsh environments.

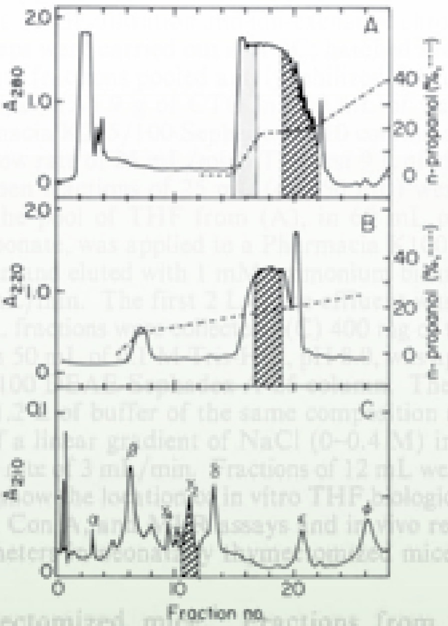
1995

Designers of molecular switches for ultra-miniaturized electronics face several hurdles: The “on-off” movement must be reversible, as well as easily detectible and controllable. Institute chemists combined organic complexes with metal atoms to create a triple-stranded molecule that binds an iron ion at one of two sites. A simple, reversible chemical reaction causes the ion to move from one to the other, changing the color of the molecule between brown and purple in the process. This research has become the basis of a new approach to developing tiny electronic components and sensors.



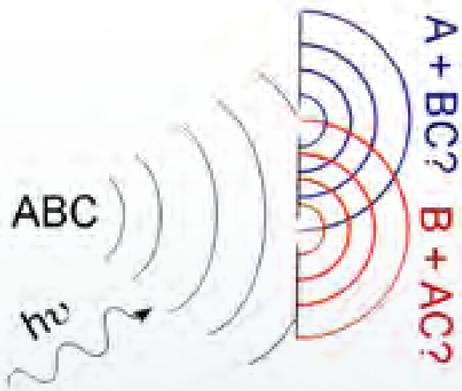
1996

Weizmann Institute chemists isolated and synthesized the thymus hormone, which is a short peptide called THF gamma 2. The hormone works in the human immune system, where it plays an important role in rehabilitating the system after viral infection, chemotherapy, or radiation treatment.



1996

Many chemical reactions are driven by light and, theoretically, light can be used to manipulate these reactions. But scientists attempting this had found that molecules quickly "forgot" their interactions with light. A method developed by an Institute chemist, called "coherent control," overcame this problem. The method is based on a principle of quantum mechanics – wave-particle duality – and it uses coherent laser light to selectively interfere with molecular waves, enhancing or suppressing chemical reactions. This theoretical work has become a standard technique, leading to the creation of numerous applications, including ultra-fast electronic switches and methods of directing current in semiconductors.



1996

The Sussman Family Building for Environmental Sciences was dedicated. The building was planned and constructed with a number of environmentally-friendly features, including architectural and engineering elements for keeping the internal space comfortable and well-lit with a minimum of energy use.

1996

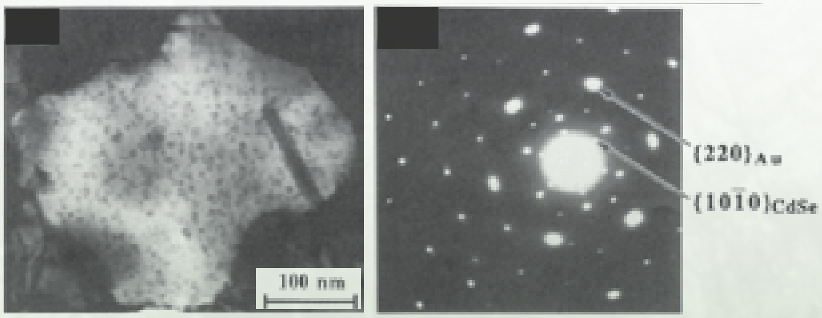
Charcoal, wood and other organic materials can be burned directly for fuel, or they can be converted to a liquid or gas that burns more cleanly and efficiently. Institute chemists found a way to make this process even more environmentally friendly: They used solar energy to convert the organic material to fuel.

1996

Archaeologists had a hard time finding evidence for the use of fire, until Weizmann Institute scientists developed a method for identifying minute traces of ash from ancient hearths. Most of the minerals in ash are unstable, undergoing chemical changes over time that render them unidentifiable. However, the scientists found that about two percent of the ash is relatively stable, and this amount can be analyzed. The scientists developed their method on archeological sites in Israel, and were later permitted to try it out at a Chinese site believed to contain remains of the first humans to use fire.

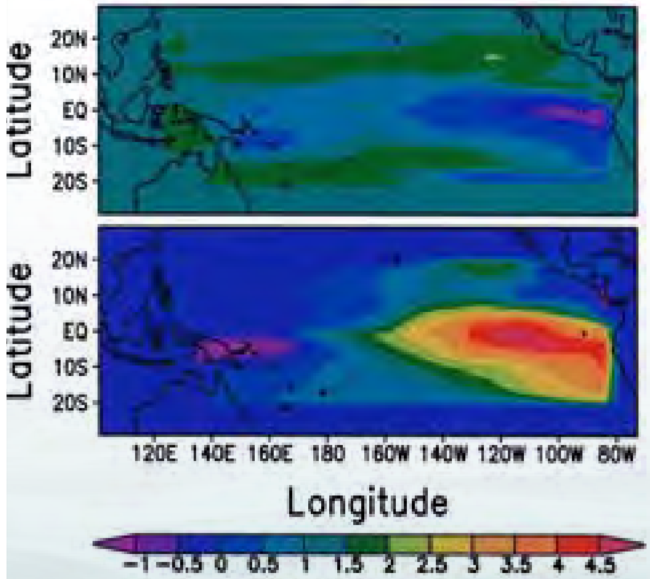
1996

When creating ultra-tiny crystals for nanoelectronic or optics applications, controlling crystal size becomes an issue. Institute chemists studying electrochemical growth of nanocrystals found that a mismatch between the substrate on which the crystal is grown and the atomic structure of the growing crystal may be key to limiting the crystal's size. This is because the crystal becomes "stretched" in its attempt to align with the substrate, and the strain eventually halts its growth. Fine-tuning the mismatch through small additions of other substances into the crystals, the scientists succeeded in growing uniform nanocrystals sized to order.



1997

El Nino, with its irregular, often catastrophic worldwide weather consequences, occurs every three to seven years. It is expressed as an occasional unusual warming in the equatorial Pacific Ocean. Scientists at the Weizmann University and Columbia University suggested that the irregularity and unpredictability of El Nino's cycle are due to chaos driven by a succession of seasonal weather conditions acting on deep ocean waves, combined with other non-linear processes. Understanding the reasons for the irregularity of the El Nino cycle may aid in long-term forecasting, as well as help us predict which factors in a changing global climate may affect El Nino-driven global weather patterns.

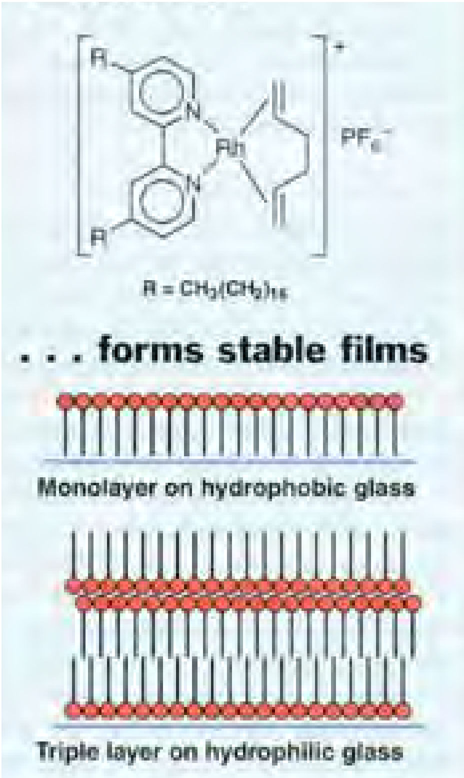


1998

Has Earth undergone rapid, dramatic climate change in the past? Institute researchers trekked to Mt. Kenya to take core samples from lake sediments. Analysis of the ratios of the isotope oxygen 18, which is more prevalent in cooler times, to the common isotope oxygen 16, revealed that central Africa had undergone sudden, significant warming around 350 BCE.

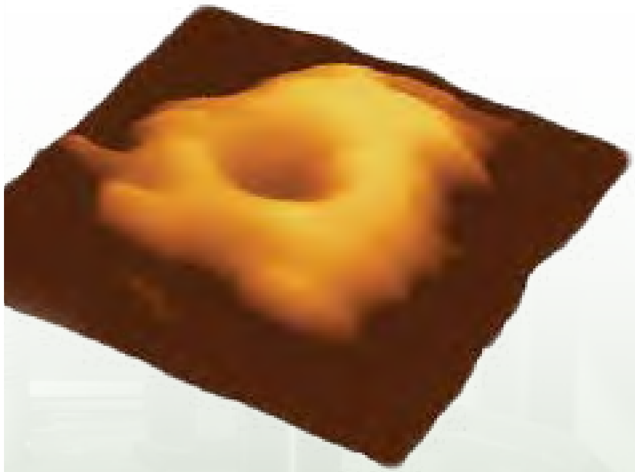
1998

Catalysts – materials that when used in minute amounts can dramatically facilitate a chemical reaction without being consumed – are crucial to much of the world's industry. Institute chemists found that a common type of catalyst that normally performs its function while in solution actually works many times more efficiently when arrayed as a very thin (one molecule deep), tightly packed film on a glass surface with its molecules all pointing in the same direction. This neat arrangement also enabled the scientists to exercise more control over the process, as it was more selective in the reactions it produced.



1998

How small can miniaturized electronic components get? Using the stylus of an atomic force microscope and a low electric current, Institute scientists redistributed atoms called dopants inside a semiconductor material. About 100-200 of these atoms, which were arranged in a hemisphere, were enough to produce an area of higher electrical conductivity – essentially creating what was then the world's smallest transistor. They then developed a method to measure the conductivity of the device using the atomic force microscope.



1999

A compound used in solar cells – copper indium gallium diselenide – is extremely stable, even though it should, theoretically, break down easily. Institute scientists had shown that copper atoms can move around in this material – a total anathema for electronics. The scientists, working with colleagues from France and Germany, discovered that the reason for the surprising stability is... the moving copper atoms. These atoms are attracted to breaks in the molecular structure and can repair them, explaining why the materials works so well in harsh environments, such as outer space. This work helped pave the way for commercial solar cells made with this material.