

The **W** Mirror

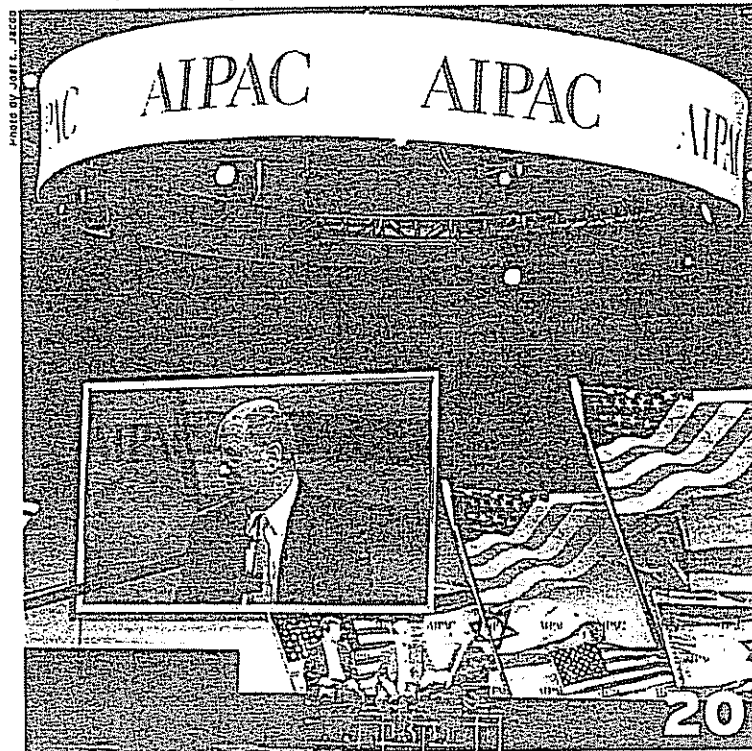
The Weizmann Institute and the Media

October 2009 – May 2010

No. 30

AIPAC Forum Revisited

Dr. Daniel Zajfman, president of the Weizmann Institute of Science in Rehovot, Israel, was keynoter at the AIPAC conference in Washington last week, discussing the Jewish state's innovation and technology.



The New York Times

Date: Thursday, October 08, 2009
 Location: NEW YORK, NY
 Circulation (DMA): 1,120,420 (1)
 Type (Frequency): Newspaper (D)
 Page: A25
 Keyword: Weizmann Institute of Science

er half of the ribosome, the so-called small sub unit.

Both Dr. Steitz and Dr. Ramakrishnan did their X-ray work at the Brookhaven National Laboratory's National Synchrotron Light Source, where intense radiation lost from whirling beams of electrons can be used for probing the properties of matter. They published their results in 2000, the same year that Dr. Yonath published her own analysis of both parts of the ribosome.

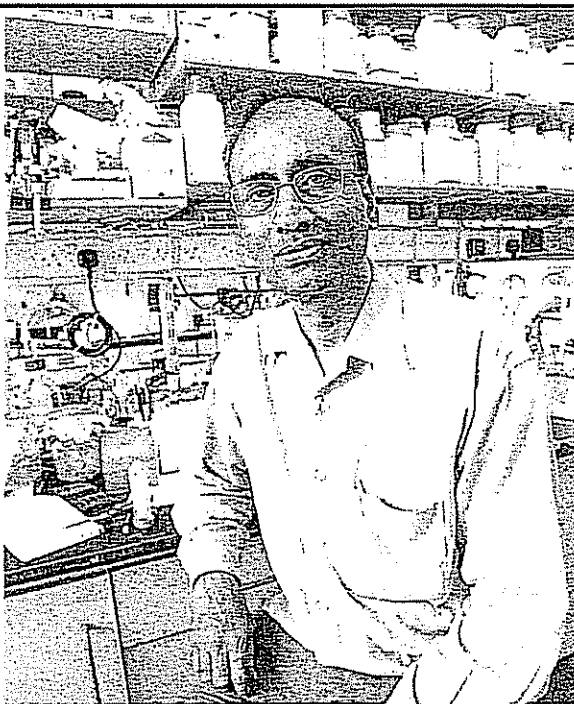
Dr. Steitz is the co-founder of the company Rib-X Pharmaceuticals of New Haven, formed to apply the ribosome research to develop and commercialize drugs for the treatment of multi-antibiotic resistant infections.

Besides the implications for biomedical research, another consequence of the ribosome work was to resolve an old "classic chicken and egg problem" about evolution, Dr. Berg of the National Institute of General Medical Sciences explained. If ribosomes are needed to make proteins but they are also made of proteins, which came first?

The answer, Dr. Berg said, is that the active core of the ribosome is made of RNA. The protein seems to have been added later, which means the ribosome is "an RNA-based machine that evolved the ability to make proteins."

If ribosomes depended on proteins to function, that would have been a paradox.

"This is a key point in evolution," Dr. Berg said, "when RNA learned to make proteins."



ALASTAIR GRANT/ASSOCIATED PRESS



URIEL SINAI/GETTY IMAGES

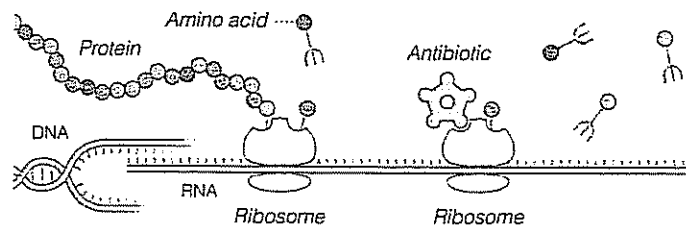


DOUGLAS HEALEY/ASSOCIATED PRESS

From top, Venkatraman Ramakrishnan, Ada E. Yonath and Thomas A. Steitz mapped the sites of atoms in the giant molecular complexes inside cells known as ribosomes.

Blocking Translation

The three recipients of this year's Nobel Prize in Chemistry showed what the complex machinery of DNA translation looks like at the atomic level.



PROTEIN ASSEMBLY DNA contains recipes for many different types of proteins, which perform most of the functions of a cell. RNA copies of these genetic recipes are read by ribosomes, which build proteins by linking different amino acids.

DISRUPTING THE PROCESS Some antibiotics kill bacteria by interfering with their ribosomes' ability to create proteins. Research by the recipients showed the structure of ribosomes in detail, aiding the development of new antibiotics.

THE NEW YORK TIMES

3 share Nobel in chemistry

THOMAS H. MAUGH II

Two Americans and an Israeli who mapped the precise structure of the ribosome — the cell's critical protein-making factory — won the 2009 Nobel Prize in chemistry Wednesday.

Their independent work, published in 2000, provides fundamental information about the workings of cells at the atomic level and is already being exploited by drug companies working to make more effective antibiotics.

The \$1.4-million prize will be shared equally by Thomas A. Steitz of Yale University; Venkatraman Ramakrishnan of the Medical Research Council Laboratory of Molecular Biology in Cambridge, England, an Indian-born U.S. citizen; and Ada E. Yonath of the Weizmann Institute of Science in Rehovot, Israel.

Yonath is the only one of this year's nine science winners who is not an American citizen, either native or naturalized. She is the first woman to win the chemistry Nobel since Dorothy Crowfoot Hodgkin of Britain received the 1964 prize. Yonath is also the first Israeli woman to win a Nobel.

The ribosome, which is made up of a large and small subunit, translates the cell's genetic information into the thousands of proteins that enable the cell to function. The proteins it produces carry out chemical reactions and provide the cell's structural foundation.

The three Nobelists used a technique called X-ray crystallography to determine the ribosome's structure. X-ray crystallography is a time-consuming, tedious science, requiring excruciating patience and care to produce crystals of cellular proteins and sophisticated math to analyze X-ray patterns

that arise when an X-ray beam is focused on such crystals.

This is difficult with even small proteins, and many researchers thought it would be impossible with the ribosome, which is made of many different proteins and also contains pieces of RNA. Getting such a large, amorphous structure to form precise crystals had never been attempted before.

"When these researchers began their work, determining the structure and mechanism of the ribosome seemed nearly impossible," said Jeremy M. Berg, director of the National Institute of General Medical Sciences, which funded all three investigators.

Yonath began trying to grow crystals in the early 1970s, working with a bacterium that can grow under harsh conditions such as near-boiling water. Her assumption was that this microbe's ribosomes would be more stable and more resistant to degradation during the process of inducing crystal formation.

After 20 years, it finally became clear that she could produce such crystals, and other researchers such as Steitz and Ramakrishnan joined the race to complete the work.

But there still were daunting obstacles to overcome. The X-ray images produced directly from a crystal are insufficient to reveal its structure. They lack crucial mathematical information that researchers call phase angles. This information is typically obtained by seeding the crystals with heavy metal atoms, such as mercury. But ribosomes are so large that obtaining the phase angles was exceedingly difficult.

Steitz's contribution was to determine how the ribosomes were oriented within the crystal. That, combined with the information from heavy metals, finally made it possible to de-

termine phase angles and, in 1998, Steitz published the first crude crystal structure of the ribosome's large subunit.

It was then necessary only to improve the crystals and obtain more data to increase the sharpness of the image, allowing researchers to locate every atom within the assemblage.

In 2000, Steitz published the refined structure of the large subunit and Yonath and Ramakrishnan each published that of the small subunit.

The work could prove invaluable in the search for new antibiotics to fight infections. At least half of all antibiotics work by blocking the activity of ribosomes in bacteria without affecting those in human cells. But bacteria have grown resistant to most of them. Using the new ribosome images, pharmaceutical companies have been able to determine how the antibiotics function and thus to design new molecules that circumvent resistance.

"Scientists around the world are using the winners' research to develop new antibiotics that can be used in the ongoing battle against antibiotic-resistant bacteria that cause so much illness, suffering and death," said Thomas H. Lane, president of the American Chemical Society.

Yonath, 70, was born in Jerusalem and trained at the Weizmann Institute of Science, where she has spent her entire career. "I'm really, really happy," she said of the award.

Steitz, 69, was born in Milwaukee and is a Howard Hughes Medical Institute researcher at Yale University. Solving the problem, he said, "was the most exhilarating moment I have had in science."

Ramakrishnan, 57, was born in Chidambaram, Tamil Nadu, India, and received his doctorate from Ohio University. He said he at first thought the

early morning call from the Nobel Foundation was a joke being played by one of his friends. "I complimented him on his

Swedish accent," he said.

thomas.maugh@latimes.com
Times staff writer Richard

Boudreaux in Jerusalem contributed to this report.



URIEL SINAI/Getty Images

ADA E. YONATH: The scientist at the Weizmann Institute of Science in Israel is the first Israeli woman to win a Nobel. Her research starting in the 1970s mapping a cell's protein-making component was taken up by her fellow Nobelists.



ALASTAIR GRANT/Associated Press

V. RAMAKRISHNAN: The Indian-born American citizen is a researcher at a lab in England.

3 Win Nobel Prize for Work Mapping Cells' Key Machinery

Associated Press

STOCKHOLM, Oct. 7 — Two Americans and an Israeli won a Nobel Prize in chemistry Wednesday for creating detailed blueprints of the protein-making machinery within cells, research that is being used to develop new antibiotics.

Venkatraman Ramakrishnan, Thomas Steitz and Ada Yonath will split the \$1.4 million award for their atom-by-atom description of ribosomes.

Yonath, 70, is the fourth woman to win the Nobel chemistry prize and the first since 1964.

Ribosomes are key to life. They use instructions from genes to make thousands of proteins that control what happens in the body. Many antibiotics kill bacteria by attacking their ribosomes, and the detailed descriptions by the new Nobel winners are being used to develop drugs.

The three scientists worked independently and published their results virtually simultaneously in 2000.

"I didn't feel it was a personal competition, but it was a bit of a

race," said Steitz, 69, a professor at Yale University. "We were all taking separate approaches."

Yonath works at the Weizmann Institute of Science in Rehovot, Israel. Ramakrishnan, 57, is at the MRC Laboratory of Molecular Biology in Cambridge, England, where he went after working in the United States. Steitz is a professor of molecular biophysics and biochemistry at Yale and is an investigator with the Howard Hughes Medical Institute.

The academy called Yonath a "strong-willed pioneer" for starting on the quest in the 1970s, when most people thought it would be impossible. She, and eventually her co-winners, used a technique called X-ray crystallography to try to pinpoint the positions of individual atoms in the ribosome. Basically, that technique involves showering the ribosome with X-rays and determining how the rays scatter.

Ramakrishnan described his work on ribosomes as an attempt to understand "this large molecular machine that takes information from genes and uses it to stitch together protein."

NANOBIOSCIENCE

France and Israel Join Forces in Nanobioscience

For the past two years, CNRS and the Weizmann Institute, a prestigious Israeli research institution, have joined forces to explore the rapidly-growing field of nanobioscience, at the interface between nanoscience and biology.

Set up in January 2008 by CNRS and the Weizmann Institute, the European Associated Laboratory Nano Bioscience (LEA NaBi) is the successful combination of both scientific and human elements. On the one hand, its creation is motivated by the shared need to move forward in this new field which applies the methods of nanoscience to biological systems and structures. And on the other hand, it acknowledges the longstanding bond that has developed between French and Israeli researchers.

Joseph Zyss, who, along with his Israeli counterpart Ron Naaman, is the technical and scientific co-director of the LEA, was the initiator of this project. "In 1990, I launched a series of biennial Franco-Israeli conferences in physical optics, the PRISNO series, which continue to this day. To a large extent, these conferences provided a framework for the development of the LEA. The project now offers an opportunity for greater understanding and appreciation between our two countries in the field of photonics and beyond."

Little negotiation was therefore necessary before the two institutions signed a preliminary agreement in 2007, which led to an initial four-year renewable joint research program. This agreement covers a dozen or so projects that are all related to nanobioscience with a photonics component. For example, teams are working on the design and production of biochips for biological analyses, as well as on the development of systems for the control of cell differentiation, which could both be of value to cancer research.

The LEA NaBi was officially inaugurated in March 2009 at the Weizmann Institute in Rehovot (south of Tel Aviv). But it is also active on three sites in France: the Institut d'Alembert in Cachan near Paris, the French "bridgehead" headed by Zyss; the laboratory of statistical physics (LPS)* and the PASTEUR chemistry laboratory,† both at the ENS in Paris; and the Institut Fresnel in Marseille.

Yet this geographical distance does not affect the cohesion of the teams involved: "We host Israeli researchers for several months, and vice versa," explains Zyss. "The projects we are work-

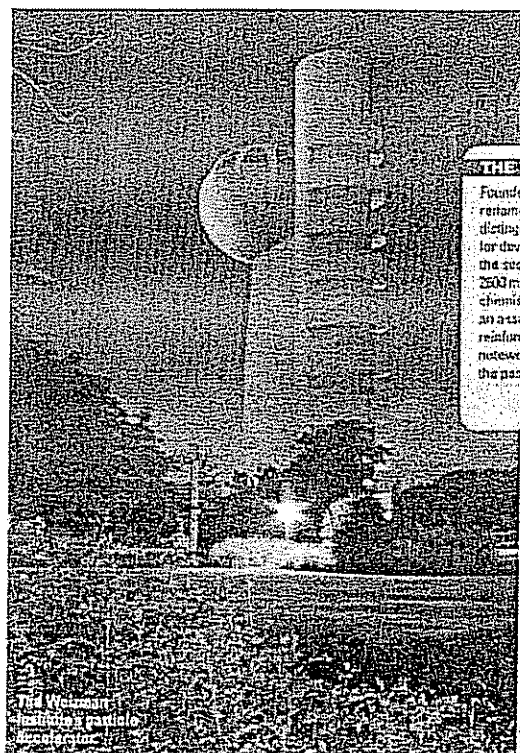
ing on provide a daily framework for the activities of the different teams."

A total of 40 people, divided equally between the two partners, now work for the LEA. Post-doctoral fellows form the backbone of the program. "We have seen a growing, spontaneous flow of requests from potential partners who want to be part of the LEA," stresses Zyss, who admits he is often approached by students eager to join such a prestigious laboratory. And prestige does play its part, at both an individual and institutional level.

Francesca Grassia, who contributed to setting up the LEA at the CNRS Office of European Affairs, recalls the importance of this partnership: "The Weizmann Institute is one of the best-performing research institutions in the world, both in terms of scientific results and technology transfer." Similarly, CNRS is perceived in Rehovot as a European partner of choice.

As for the LEA NaBi, its future depends on three major factors. The first is to obtain results that will enhance the reputation of nanobioscience and its applications. The second is the hope that the advances achieved by the laboratory will result in industrial exploitation. "In this respect, the Weizmann Institute and CNRS have all the expertise necessary," notes Grassia. Finally, perhaps one day the LEA NaBi could have its own site. It would then become the first CNRS International Joint Research Unit in Israel.

Stéphane Julien



THE WEIZMANN INSTITUTE

Founded in 1934 as the Daniel Sieff Research Institute, it was renamed Weizmann Institute in 1949 and has since been distinguished on several occasions. Its scientists were responsible for developing the RSA cryptography algorithm that is today used for the security of bank credit cards or for online transactions. One of its 2503 members, Ada Yonin, received the 2009 Nobel Prize for chemistry. The Institute's participation in the LEA NaBi allows Israel, an associate country in EU programs since the end of the 1990s, to reinforce its position in the European Research Area. There is one noteworthy precedent: the Pasteur-Weizmann Foundation has for the past 35 years involved scientists from both institutions.

1. Institut d'Alembert de recherche (CNRS/ ENS Cachan).
2. Laboratoire de physique statistique (CNRS/ ENS Paris/ Universités Paris-VI and -VII).
3. Processus d'activation sélectif par transfert d'énergie uni-electronique ou radiatif (CNRS/ ENS Paris/ Université Paris-VI).
4. CNRS / Université Aix-Marseille -I and -III / Centrale Marseille.

CONTACT INFORMATION

→ Joseph Zyss
ENS Cachan
joseph.zyss@logemans-cachan.fr
→ Francesca Grassia
DAE-CNRS, Paris
francesca.grassia@cnrs.fr

The Brain by Carl Zimmer

Smell is a powerful and evocative sense yet also a deeply enigmatic one. So scientists have invented an odor yardstick to figure out what goes on between your nose and your brain.

Your nose is a paradox. In some ways the human sense of smell is astonishingly precise. For example, natural gas companies add a smelly molecule called *n*-butyl mercaptan to natural gas, which is odorless by itself, so that people can sniff gas leaks. All it takes is one *n*-butyl mercaptan molecule for every 10 billion molecules of methane to do the trick. To put this precision in perspective, imagine you are standing in front of two Olympic-size swimming pools. One of them contains a grand total of three drops of *n*-butyl mercaptan, and the other has none. Your nose could tell the difference.

But don't get too smug, because in other ways your sense of smell is practically useless. To judge for yourself, find someone to help you run a simple experiment. Close your eyes while your partner raids your refrigerator and then holds different foods under your nose. Try to name each scent. If you're like most people, you'll bomb. In a number of studies, scientists have found that people tested on items in their own kitchens and garages give the wrong answer at least half the time. And as bad as we normally are at identifying smells, we can easily be fooled into doing worse. If orange food coloring is added to cherry-flavored soda, for example, people are more likely to say that it smells like oranges.

Noam Sobel of the Weizmann Institute of Science in Israel and his colleagues have been puzzling over this paradox for the past several years. What has been missing in the science of smell, they argue, is a meaningful way to measure it—an olfactory yardstick. Now they have built one.

That it has taken so long for someone to come up with a yardstick for smell is something of a scandal. Scientists who study vision, for example, know that light with a wavelength of 620 nanometers will appear a particular shade of orange. They know with perfect certainty that orange is closer in wavelength (and perceived color) to yellow than it is to green. And they have used such objective measures about light and vision to learn a great deal about the biology that allows us to see. Scientists who study smell have had no equivalently objective way to judge, for example, whether the smell of roses is closer to spearmint or vanilla.

Part of the reason for this lack of an odor yardstick may have been the common belief that the human sense of smell is crude. Dogs and other mammals have a better sense of smell than we do, but their prowess doesn't mean our noses are useless. In fact, as Sobel and his colleagues demonstrated in a 2007 experiment, humans can do a pretty good impression of a bloodhound.

Sobel and company went into an open field and set down 30 yards of twine scented with chocolate. Then they brought together 32 people and gave them a mission: Follow the trail using nothing but your nose. The scientists put blindfolds on their subjects so they could not see the twine. Earplugs blocked out sounds. Elbow pads, knee pads, and work gloves shielded them from tactile clues. Only their noses could provide them with information.

The subjects got down on all fours about 10 feet from the start of the scent trail. Then they started to sniff.

Remarkably, most of the volunteers were able to find the twine. Even more remarkably, 21 of them were able to follow its scent from start to finish. Whenever they veered off course, they sniffed their way back. Not only did they track the scent impressively well, but they also improved with practice. The scientists arranged for some of the subjects to run the course for 45 minutes a day for three days; they cut their times and improved their accuracy.

When Sobel's human bloodhounds put their noses to the ground, they drew in a gaseous cocktail of many different kinds of molecules—from the dirt, the grass, and anything else riding along in the air. Those molecules then latched onto olfactory receptors located on nerve endings in their nostrils. Only certain molecules, one theory holds, have the right shape to latch onto certain receptors. A given receptor can snag a number of different odor molecules, and a given odor molecule can latch onto several different receptors. Each nerve in a person's nose builds all its receptors using just a single gene.

The olfactory neurons are the only ones in the central nervous system that are directly exposed to the air. When a receptor grabs a molecule, it causes an electric signal to travel the length of the neuron from the nasal lining to the smell-processing regions of the brain. There, the neuron converges with thousands of other neurons delivering their own signals. The brain does not just passively accept all these signals. If we learn how to tell two odors apart through one

Our brains can learn to revalue the same odor for different conditions. The smell of bacon is alluring if you're hungry, but not after the fourth helping.

nostril, for example, we are able to tell them apart with the other nostril as well. The learning happens in the brain, not in the nose.

All this complex signal processing means that we can distinguish among thousands of different odor molecules. Sobel and his colleagues recently set out to pin down how that process works by determining the relationship between the structure of a molecule and the way it smells. The scientists began by building a database of 1,500 odor-producing molecules, cataloging 1,664 different traits—their size, the strength of the chemical bonds between their atoms, and so on.

Next, Sobel and his team looked for patterns in this dizzying cloud of data using a statistical technique known as principal component analysis, a method commonly employed to analyze large sets of data and tease out patterns. They searched for traits that consistently varied in lockstep with one another from molecule to molecule. A few key traits account for a lot of the variation in structure from one molecule to the next. For instance, the size of a molecule varies along with how tightly its atoms are packed.

Sobel used these patterns to give each molecule in his database a single, simple score, like notches on a yardstick.

This yardstick, Sobel soon determined, is not just a statistical abstraction. It has a deep connection to how we smell the world. The researchers selected molecules from different intervals along the yardstick and had people sniff them. The farther apart the molecules were on the yardstick, the easier it was for people to tell them apart by their odor.

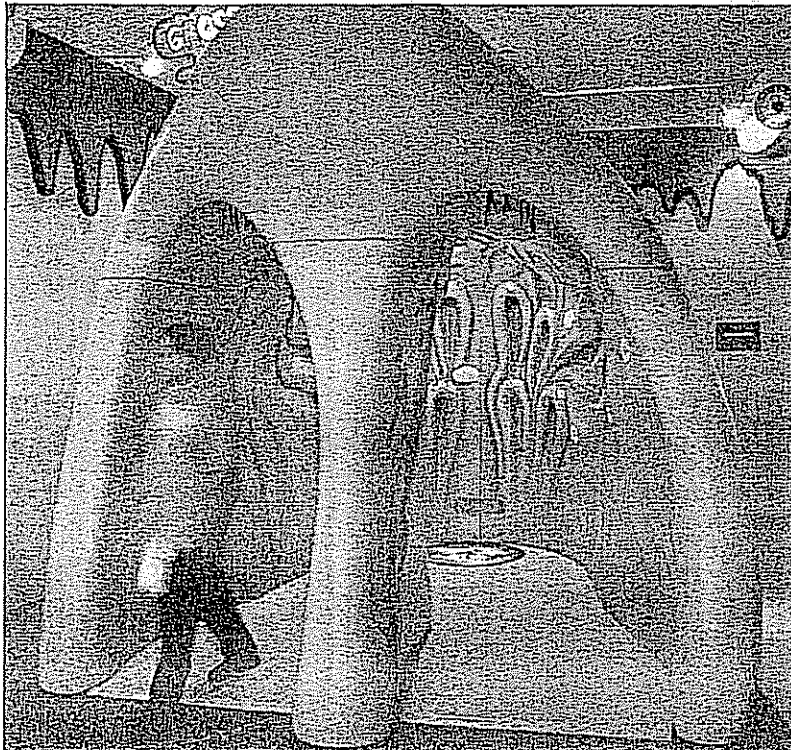
Sobel also got a striking result when he asked people to report how pleasant or unpleasant they judged various smells to be. Molecules ranked at one end of the yardstick stank to high heaven. At the other end, they were delightfully fragrant. The yardstick

ancestors felt pleasure when they sensed smells that signified desirable things (a mother's teat, a ripe piece of fruit) and moved toward them. They felt disgust or fear at odors that signified danger (rotting corpses or a predator's feces) and moved away.

Our sense of smell is not a purely automatic system, however. An odor, Sobel argues, is more than the physical properties of a molecule; it is also the emotions these properties summon up. This is where learning comes in. We can learn to fear certain smells that signal danger, just as we learn to make associations with dangerous sights or sounds. At a deeper level, our brains can revalue the same smell for different conditions. The smell of bacon may be alluring if you are hungry, but after a fourth helping, the same

smell can start to get sickening. Scientists can see this revaluing take place within the brain as emotion-regulating regions change their activity. As a result, we can use pleasure and disgust as a guide not just for finding the right kinds of food but also for eating the right amount. These links to emotion and learning also help explain why a single whiff can summon up powerful memories.

Using Sobel's yardstick, scientists may be able to start untangling the paradox of smell: why we are so good at distinguishing odors and so bad at naming them. Our brains appear to have evolved an elegant way to reduce the dizzying variety of molecules in our environment into a simple scale based on what matters most about scents—whether they smell good or bad. By giving different odor molecules a place on the yardstick, we can distinguish fine gradations among them. Although this method may be helpful and efficient, it doesn't give us much information that we can use in putting a name to different smells. Imagine that someone showed you pictures of different types of fruit and had you name each one. Now imagine that the pictures zoom in on a single patch of color on each piece of fruit. You might be easily able to tell the difference between two shades of red without being able to say which belonged to a strawberry and which to a raspberry.



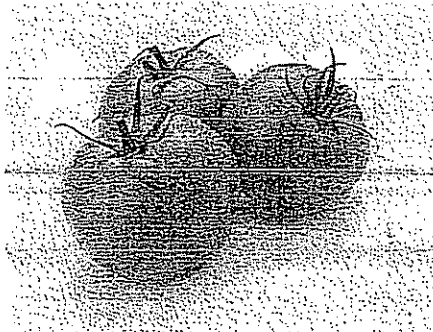
did such a good job of measuring the quality of odors that the scientists could use it to predict just how pleasant (or unpleasant) people would rate a new molecule.

To see whether this yardstick is universal, neurobiologist Nathalie Mandairon and her colleagues at the University of Lyon in France decided in 2008 to test Sobel's odor-ranking system on mice. The researchers picked a set of odors and observed how long the animals sniffed them. The closer an odor was to the pleasant end of Sobel's yardstick, the longer the mice spent smelling it. Sobel's odor yardstick seems to have uncovered a fundamental truth about the nature of smell. When the noses of our distant ancestors evolved into sophisticated molecular detectors, he suggests, they started to process key traits to come up with a simple measurement—an internal yardstick. Our

This analogy, Sobel argues, actually understates the difficulty we have in naming smells. He draws a distinction between odor molecules and "odor objects." There is a visual object we call "banana" that encompasses our experience of seeing a banana. There is also an odor object version of "banana," a combination of the inherent pleasantness of the molecules released by the fruit (as measured by Sobel's yardstick) and our subjective mental state when we encounter them. Emotions are notoriously hard to put into words, and the emotions wrapped up in odors make the problem of identification even harder.

Supreme Court judge Potter Stewart famously wrote in 1964 that pornography was hard to define but that he knew it when he saw it. In the same way, we may not be able to put a name to an odor, but we sure know when something stinks. □

Pink tomato gene



Dr. Asaph Aharoni of Israel's Weizmann Institute's Plant Sciences Department has revealed the gene that's responsible for producing pink tomatoes.

Dr. Aharoni's research focuses on plants' thin, protective outer layers, called cuticles, which are mainly composed of fatty, wax-like substances. In the familiar red tomato, this layer also contains large amounts of antioxidants called flavonoids that are the tomatoes' first line of defense.

Some of these flavonoids also give the tomato cuticles a bright yellow cast – the colour component that is missing in the translucent pink skins of the mutants.

Using a unique lab system, Dr. Aharoni

and his team were able to rapidly and efficiently identify hundreds of active plant substances called metabolites.

The research, carried out in Dr. Aharoni's lab by Dr. Avital Adato, Dr. Ilana Rogachev and research student Tali Mendel, showed that the differences between pink and red tomatoes go much deeper than skin colour. The scientists identified about 400 genes whose activity levels are quite a bit higher or lower in the mutant tomatoes. The largest changes, appearing in both the plant cuticle and the fruit covering, were in the production of substances in the flavonoid family. The pink tomato also has less lycopene. In addition, alterations in the fatty composition of the pink tomato's outer layer caused its cuticle to be both thinner and less flexible than a regular tomato's skin.

The researchers found that all of these changes can be traced to a mutation on a single gene known as SIMYB12. This gene acts as a "master switch" that regulates the activities of a whole network of other genes, controlling the amounts of yellow pigments as well as a host of other substances in the tomato.

From Weizmann Institute to your car engine

President Shimon Peres sees nanotechnology as "a new dimension destined to change the world". From its offices in Rehovot's Science Park, ApNano Materials has already started || Lior Elam



ApNano Materials founders Dr. Menachem Genut and Aharon Feuerstein

Nanotechnology:

The ability to use miniscule materials, measured in nanometers, for the benefit of mankind.

Yossi was finishing up fueling his car when the gas station attendant suggested he buy an oil additive for the engine. Yossi hesitated for a second, then agreed to purchase the red metal bottle. He didn't know it then, but in the following year his purchase would save him hundreds of shekels on gas expenses and increase the life span of his engine significantly. Like many other consumers, Yossi is not aware that behind this revolutionary product, stands a monumental scientific discovery by researchers from the Weizmann Institute. This discovery was applied by ApNano Materials in designing a revolutionary set of products, marketed under the brand name "NanoLub" - the world's first nanotechnology-based dry lubricant.

ApNano Materials, headed by Aharon Feuerstein and Dr. Menachem Genut, is one of the first companies in the world to realize the potential of nanotechnology. Nanotechnology is the applied use of miniscule materials, measured in nanometers (one billionth of a meter), for the benefit of mankind. The

research group, spearheaded by Prof. Reshef Tene and Dr. Genut, the first to synthesize the material, discovered a group of nanoparticles in the shape of tiny spheres and thin tubes, of inorganic composition (which don't contain linked carbon and hydrogen atoms), that have unique physical features.

The company's products are based on two types of nanometric particles: spherical and tube-shaped. The diameter of the spherical particles is 100 nanometers - one thousandth the thickness of a human hair, granting it qualities that are impossible in larger sizes. According to Dr. Genut, "The addition of a small amount of NanoLub to regular oil decreases the friction significantly, and lengthens the life of moving parts in heavy machinery by over 600%". In Israel the additive is sold at Sonol gas stations, while the additive for industrial oils is marketed by "Delkol".

"The use of nanoparticles does not stop at car oil," notes Dr. Genut. "We have developed a technique that allows bearings manufacturers to combine the new particles in the manufacturing process itself, allowing for particles with extremely low friction that actually oil themselves". The particles have other uses in low-maintenance environments such as flight, space and medicine, as well as highly sterile environments, such as factories for semi-conductors. Other uses include heavy duty systems and machinery such as power plant turbines, heavy machinery and more.

According to Aharon Feuerstein, chairman of the board, the company has developed another line of commercialized products called "Nano Armor" - a protective material four or five times stronger than steel and proven to be the strongest in the world. Nano Armor is used in personal products such as protective vests and helmets, as well as in motor vehicles and planes.

"The company is on a round of private fundraising until February, before offering shares of stock," adds Feuerstein. The company has thus far succeeded in raising a few million dollars from private investors. ▢

Gene linking stress to obesity, diabetes identified by Weizmann Institute scientists

By JUDY SIEGEL

Changes in the activity of a single gene in the brain can lead to metabolic changes that cause mice to develop symptoms associated with type 2 diabetes, as well as trigger anxious behavior.

These findings, discovered by Weizmann Institute of Science researchers, were published online this week in the *Proceedings of the National Academy of Sciences (PNAS)*.

The constant stress many are exposed to in our modern society may thus be taking a heavy toll: Anxiety disorders and depression, as well as metabolic disorders such as obesity, type 2 diabetes and arteriosclerosis,

have all been linked to stress.

These problems are reaching epidemic proportions. Type 2 diabetes alone is expected to affect some 360 million people around the world in 20 years.

The connection between stress, changes in appetite and anxiety-related behavior, was recently proven scientifically, but the exact reasons for this were not clear until Dr. Alon Chen of the Rehovot Institute's neurobiology department and colleagues made their gene discovery.

They found that all the body's systems are involved in the stress response, which evolved to deal with threats and danger. Behavioral changes tied to stress include heightened anxiety and concentration,

while other changes in the body include heat-generation, changes in the metabolism of various substances and even changes in food preferences.

The Weizmann team suspected that a protein known as Urocortin-3 (Ucn3) was involved in tying all of these together. Produced in certain brain cells – especially in times of stress – it is known to play a role in regulating the body's stress response.

These nerve cells have extensions that act as "highways" to speed Ucn3 on to two other sites in the brain: One, in the hypothalamus – the brain's center for hormonal regulation of basic bodily functions – oversees, among other things, substance exchange and feelings of hunger and sat-

ety; the other is involved in regulating behavior, including anxiety levels.

Nerve cells in both these areas have special receptors for Ucn3 on their surfaces, and the protein binds to these receptors to initiate the stress response.

The researchers developed a new, finely tuned method for influencing the activity of a single gene in one area in the brain, using it to increase the amounts of Ucn3 produced in just that location.

They found that heightened levels of the protein produced two different effects: The mice's anxiety-related behavior increased, and their bodies also underwent metabolic changes. With excess Ucn3, their bodies burned more sugar and fewer fatty acids,

and their metabolic rate sped up.

These mice began to show signs of the first stages of type 2 diabetes: A drop in muscle sensitivity to insulin delayed sugar uptake by the cells, resulting in raised sugar levels in the blood. The pancreas then produced extra insulin to make up for the perceived "deficit."

"We showed that the actions of single gene in just one part of the brain can have profound effects on the metabolism of the whole body," says Chen.

This mechanism, which appears to be a "smoking gun" tying stress levels to metabolic disease, might, in the future, point the way toward the treatment or prevention of a number of stress-related diseases.

Nobel for chemistry goes to Israeli, two Americans

By Dan Vergano
USA TODAY

Unraveling the machinery that generates proteins within cells, a discovery that offered new avenues to antibiotics, has earned two Americans and an Israeli the 2009 Nobel Prize in Chemistry.

Venkatraman Ramakrishnan, 57, of the United Kingdom's MRC Laboratory of Molecular Biology; Thomas Steitz, 69, of Yale; and Israel's Ada Yonath, 70, of the Weizmann Institute of Science will share the \$1.4 million prize equally. Working separately, the trio cracked the chemistry of the "ribosome" inside every cell and showed "how the DNA code is translated into life," Gunnar Öquist of the Royal Swedish Academy said at Wednesday's announcement.

"It seemed a bit like climbing Mount Everest. We knew it was doable, in theory. But we didn't know how to get there," Steitz said. "When we got it, it was the most exhilarating moment I've had in science."

"Everyone recognized this was on the short list for the prize," said Jeremy Berg, director of the federal National Institute of General Medical Sciences, part of the National Institutes of Health that funded all three winners for parts of their research. "We're terribly pleased but not terribly surprised."

Inside cells, thousands of ribosomes hook up with messenger

RNA molecules carrying bits of genetic code. The codes tell ribosomes to spit out proteins, the building blocks of blood, bone, brain and every other tissue. How these machines work had been a mystery without knowing the structure of the ribosome itself.

In 1980, Yonath first reported X-rays of crystallized ribosomes taken from microbes that thrive at high-temperature in the Dead Sea. The images began to reveal the shape of the ribosome. She later showed that freezing crystallized ribosomes also could lead to better X-rays of their structure.

Steitz and Ramakrishnan, a U.S. citizen, tackled higher-resolution X-rays of the small and large halves of the ribosomes, respectively. All three winners produced definitive images of the ribosome's structure in 2000.

"Proteins are workhorses of

the cell. Almost no other process is so fundamental," Berg said.

Steitz noted the ribosome work led to designs for antibiotics to combat infections such as drug-resistant staph. It also helped researchers understand the evolution of life, where at its core, the ribosome is built of RNA, not proteins, answering questions about how early life produced its own building blocks. An "RNA world" likely existed before microbes moved on to producing DNA and proteins billions of years ago, he suggested.

"Life is chemistry, and I think the award is well-deserved," said Thomas Lane of the American Chemical Society in Washington, D.C. Yonath is the first woman to win the chemistry Nobel since 1964, he noted, although half of U.S. chemistry degrees now go to women. "I think we'll see more."



Reuters

Steitz: Of Yale University in New Haven, Conn.



Reuters

Ramakrishnan: Of Cambridge University in the U.K.



AFP/Getty Images

Yonath: Of Israel's Weizmann Institute of Science.

Predictive medicine to greatly reduce treatment costs, US researcher says

• By JUDY SIEGEL

After decades in which the global outlays for medical treatment have skyrocketed, costs for diagnosis and treatment will drop significantly in five to 10 years, as electronic chips use a drop of blood to identify proteins and the risk of diseases they represent, a leading biomedical researcher predicted on Sunday.

Prof. Leroy Hood, a founder and the president of the Institute for Systems Biology in Seattle, told an overflow lecture at Jerusalem's Israel Academy of Sciences and the Humanities that the coming "revolution" in biomedical science will "democratize medicine."

He added that this new technology "will generate billions of data points on each individual, and everything will be much more inexpensive."

He is one of nine of the world's leading researchers in biomedicine – seven of them from abroad – who came to the Jerusalem academy for two days to mark its 50th anniversary.

The holder of 14 patents and the author of more than 650 peer-reviewed published journal articles, Hood is an advocate of "P4 medicine" – which he says will bring about a new

era of predictive, preventive, personalized and participatory medicine.

His research has brought about the discovery of an automated gene sequencer and synthesizer, a protein sequencer and synthesizer, and an inkjet microarray-technology that enables the sequencing of the human genome. Hood predicted that deciphering an individual genome will become cheap – about \$500 apiece, allowing medical treatment to be tailored to the individual patient.

Rather than reacting to symptoms of disease, when successful treatment might be too late, Hood said, patients will go to their physicians for an annual checkup, have their genetic codes tested and be told whether they are at high risk of getting a disease in the future and what can be done – by changing lifestyle or taking medications – to avoid it.

"We already have a chip that can identify 50 proteins in minutes. We want to do it to thousands," he said.

There has never been such a conference in Israel, said Israel Academy of Sciences vice president and Weizmann Institute of Science researcher Prof. Ruth Arnon.

The level of the biomedical scientists in attendance – including Israel's Nobel Prize laureate in Chemistry Prof. Ada Yonath who described her long work on the cells' protein factory, the ribosome – is extremely high, and the conference brought together not just leading Israeli scientists but also dozens of students at the beginning of their careers.

The other participants are: Prof. Arthur Beaudet, chairman of the department of molecular and human genetics at Baylor College of Medicine in Texas;



PROF. RUTH ARNON, vice president of the Israel Academy of Sciences and Humanities. (Judy Siegel)

Prof. Fotis Kafatos, chairman of immunogenomics at the Imperial College London; Prof. Mary-Claire King of the departments of medicine and genome sciences at the University of Washington School of Medicine in Seattle; Prof. Eric Lander, president of the Broad Institute of the Massachusetts Institute of Technology and professor of systems biology at Harvard Medical School; Prof. Matthias Mann, director of the Max Planck Institute of Biochemistry in the department of proteomics and signal transduction in Martinsried, Germany; Prof. Rino Rappuoli, global head of vaccines research at Novartis Vaccines and Diagnostics in Siena, Italy; Prof. Michel Revel of the Weizmann Institute of Science's department of molecular genetics in Rehovot and chairman of the Israel National Bioethics Council; Prof. David Scadden, co-director of the Harvard Stem Cell Institute and director of the Center for Regenerative Medicine at Massachusetts General Hospital; and Prof. Axel Ullrich of the department of molecular biology at Max Planck Institute of Biochemistry in Martinsried, Germany.

Atom & Cosmos



For more on the physics meeting, visit
www.sciencenews.org/aps_april2010

Physicists cook cosmic soup to 4 trillion degrees

Quark-gluon plasma shows sign of peculiar asymmetry

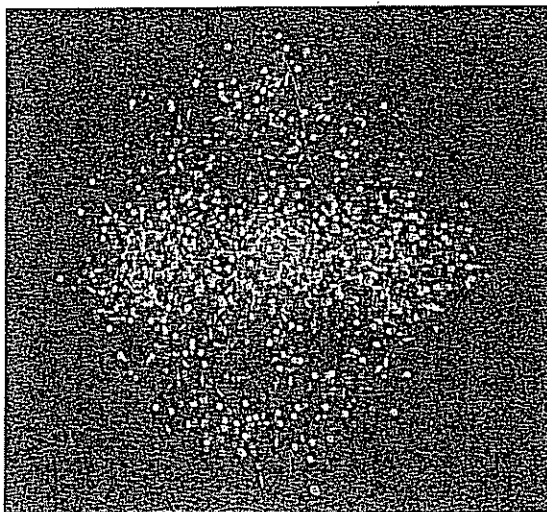
By Laura Sanders

Talk about hot and heavy. Scientists have taken the temperature of a minuscule glob of dense, hot matter formed in the grisly aftermath of collisions between gold atoms traveling near the speed of light. The material reaches an estimated 4 trillion degrees Celsius, about 250,000 times hotter than the sun's interior, and higher than any temperature ever reached in a laboratory, researchers reported at a news briefing on February 15.

The measurements, to be published in *Physical Review Letters*, provide a more detailed description of the superhot, superdense soup of matter called quark-gluon plasma, which may mimic the conditions of the infant universe. Other studies of the soup hint that discrete pockets of the matter break a special kind of symmetry.

In the new study, gold ions were smashed inside an underground track, 3.9 kilometers around, at Brookhaven National Laboratory's Relativistic Heavy Ion Collider on Long Island, N.Y. The collisions caused protons and neutrons to melt, freeing their constituent particles, quarks and gluons. The resulting material, called quark-gluon plasma, was tentatively reported at RHIC several years ago. By taking its temperature, RHIC researchers confirmed that the material consists of quarks and gluons. The new temperature reading also "tells us which point in the universe's history we are probing," said Steven Vigdor, a member of the research team at Brookhaven.

"We hope experiments of this kind give windows into new phases of matter," comments physicist Chris Quigg of the Fermi



A strange state of matter called quark-gluon plasma, produced by collisions of gold ions (simulation shown), reaches 4 trillion degrees Celsius, researchers report.

National Accelerator Laboratory in Batavia, Ill., who was not involved in the work. "There is something new to study."

The gold-gold collisions created a blob about a trillionth of a centimeter across that existed for only a little more than a trillionth of a trillionth of a second. So scientists couldn't stick a thermometer in it, said Barbara Jacak of Stony Brook University in New York, who worked on the temperature measurement. Instead, Jacak and colleagues detected photons—packets of light—as they moved away from the newly formed material, to see how hot the material was. Just as a hot iron rod turns from red to yellow to white as it heats up, light from the material changes properties depending on how hot it is. "The shine is brightest when the matter is hottest," Jacak said.

The average temperature, based on roughly a billion collisions, was measured at about 3 trillion degrees Celsius, Jacak said. By running theoretical models backward, the scientists deduced that the soup reached 4 trillion degrees soon after it was created.

The newly measured temperatures provide strong evidence that the substance is indeed a quark-gluon plasma,

as earlier experiments had indicated. This quark-gluon soup may share properties with the unbelievably hot, dense matter that pervaded the universe soon after the Big Bang, giving physicists a new way to explore properties of the early universe.

Although the substance is called a plasma, in some ways it behaves more like a liquid than a plasma or a gas (*SN*: 4/25/09, p. 26). "We are extremely anxious to find out how this works," Jacak says. "Why is it a liquid?"

The work establishes that the protons and neutrons have melted, but detailing the soup's precise ingredients poses "a fascinating question," Quigg says. "There are many phases. We don't know yet the degree to which these are separate."

In other experiments, the scientists found hints of asymmetry in the force that binds quarks in protons and neutrons. At extreme temperatures where matter changes forms, just the conditions present when RHIC's gold ions collide, asymmetrical "bubbles" might form, physicists theorize, breaking the symmetry in the strong nuclear force. The RHIC results hint that asymmetrical bubbles form for all but head-on collisions of gold ions, suggesting left-right symmetry breaking.

A similar asymmetry may explain why the universe is populated mostly with matter rather than equal amounts of matter and antimatter. If matter and antimatter were created in equal parts, as symmetry would dictate, then the two would annihilate each other, leaving nothing. Understanding how left-right symmetry is broken might give scientists new clues to how a matter-antimatter asymmetry was created in the early universe. 

BROOKHAVEN NATIONAL LABORATORY

Darwin's finch and the evo

Smell and speech are completely different, but odor may play a role in avian communication, according to Weizmann Institute of Science researchers. Darwin's finches – 14 related species of songbirds found on the Galapagos and Cocos Islands – will forever be enshrined in history for having planted the seeds of the theory of evolution. Today, exactly 150 years after Darwin's famous book, finches can still teach us about evolution. An international group of researchers, among them Prof. Doron Lancet and Dr. Tsviya Olender of the Rehovot institute's molecular genetics department, recently produced the full genome of the zebra finch and analyzed it. Their report, which appeared two weeks ago in *Nature*, is especially significant for what it reveals about the learning of language and speech. For the Weizmann scientists, however, the findings have provided an interesting twist on the

evolution of the sense of smell.

Song birds – like humans – are capable of complex communication through sound. The similarity between bird song and human language makes birds a useful scientific model for probing how this ability developed, what neuronal mechanisms are required and which genes encode them. Significantly, the scientific team found that a large percentage of genes expressed in the finch brain are devoted to vocal communication. They also found that the expression levels of a number of genes, specifically those belonging to the important class of micro-RNAs, change after the bird is exposed to song. This implies that such genes might be involved in a bird's ability to learn new tunes.

"The senses are sophisticated means of interacting with the environment. In our lab, we are primarily interested in smell," says Olender, who joined the project along with Lancet in order to map the genes

NEW WORLDS

• By JUDY SIEGEL-ITZKOVICH

encoding smell receptors in the finch. In doing so, they were entering the fray on a long-standing debate over whether the sense of smell is important for birds. Some positive evidence exists: Homing pigeons have been shown to use smell to help them navigate. In contrast, a computer-aided analysis of the chicken genome had shown that out of 500 genes encoding smell receptors, a mere 70 produce active proteins. Lancet and Olender have now conducted a similar analysis of the zebra finch genome. Their findings revealed that while the finch has the same total number of smell genes, it possesses three times as many that are active: Around 200 of the finch's genes can produce functional smell

Source: New Scientist (Main)
Edition:
Country: UK
Date: Saturday 5, December 2009
Page: 17
Area: 56 sq. cm
Circulation: ABC 160633 Weekly
BRAD info: page rate £6,000.00, scc rate £40.00
Phone: 01733 385 170
Keyword: Weizmann Institute of Science

Who knew stars came this big?

A SUPERNOVA that burst onto the cosmic scene in April 2007 was probably the death throes of the most massive star yet discovered.

So say Avishay Gal-Yam of the Weizmann Institute of Science in Rehovot, Israel, and his colleagues, who followed the afterglow of the explosion in a nearby dwarf galaxy over 18 months (*Nature*, DOI: 10.1038/nature08579).

Their observations point to the explosion of a hypergiant star with a mass 200 times that of the sun. That would blow apart the idea that stars bigger than about 150 solar masses do not exist in our mature universe.

Gal-Yam thinks the conditions in the host galaxy could be like those in the early universe, when theory says such giant stars were born and died in great numbers, seeding the universe with heavy elements. "These galaxies could be fossil labs to teach us about the first stars," he says.

A new odor — are we likely to find it pleasant or stinky?

Based on data from Sabra smells, Weizmann Institute's new 'electronic nose' gets it right

• BY JUDY SIEGEL

Most people think that scents are judged subjectively as being pleasant or unpleasant according to people's personal preference and culture. But a new "electronic nose" built by Weizmann Institute of Science researchers has shown that the perception of an odor's pleasantness is "innately hardwired" to its molecular structure; and that only in specific circumstances are personal or cultural differences shown to influence opinions on odors. These findings, published on Friday in the online journal PLoS (US Public Library of Science) Computational Biology, could be applied to the automated testing of toxins in the environment and the monitoring of bad smells, as well as to quick screening of scents for the perfume industry. In the future, this discovery may allow for the digital transmission of smell to scent-enable movies, games and music, providing a more immersive and captivating experience.

The team — comprising scientists at the Rehovot Institute led by Dr. Rafi Haddad

(then a graduate student of Prof. Noam Sobel of the neurobiology department and co-supervisor Prof. David Harel of the computer science and applied mathematics department), together with Abebe Medhane of the neurobiology department and Dr. Yehudah Roth of Holon's Wolfson Medical Center — managed to train their "eNose" to predict whether an odor would be perceived as pleasant or unpleasant, or anywhere in between.

They taught an electronic system to predict the pleasantness of novel odors, just like a human would perceive them. Over the last decade, electronic devices commonly known as electronic noses, or "eNoses," have been developed to be able to detect and recognize odors. The main component of an eNose is an array of chemical sensors. As an odor passes through the eNose, its molecular features stimulate the sensors in such a way as to produce a unique electrical pattern — an "odor fingerprint" — that characterizes that specific odor.

Like a sniffer dog, an eNose first needs to be trained with odor samples so as to build

a database of reference. The instrument can then recognize new samples of those odors by comparing the odor's fingerprint to those contained in its database. But unlike humans, if conventional eNoses are presented with a novel odor whose fingerprint has not already been recorded in their database, they are unable to classify or recognize it.

So the team decided to approach the problem from a different perspective. Instead of training an eNose to recognize a particular odor, they taught it to estimate the odor along a particular perceptual axis of "odorant pleasantness" and predict how humans would find it.

To achieve this, they first asked a group of native Israelis to rate the pleasantness of a selection of odors according to a 30-point scale ranging from "very pleasant" to "very unpleasant." From this dataset, they developed an "odor pleasantness" algorithm, which they then programmed into their eNose. They then got the eNose to predict the pleasantness of a completely new set of odors not contained in their

database against the ratings provided by a completely different group of native Israelis.

The scientists found that the eNose was able to generalize and rate the pleasantness of novel odors it had never smelled before — and these ratings were about 80 percent similar to those of individual raters who had not participated in the eNose training phase. In addition, if the odors were simply classified as either "pleasant" or "unpleasant," rather than being rated on a scale, the eNose achieved an accuracy of 99%.

To find out whether smell perception is culture-specific or not, they tested eNose predictions against a group of recent Ethiopian Jewish immigrants to Israel. The results showed that the eNose's ability to predict the pleasantness of novel odors against the native Ethiopians' ratings was just as good, even though it was "tuned" to the pleasantness of odors as perceived by native Israelis.

In other words, even though different odors have different meanings across cultures, the eNose performed equally well

across these populations. This suggests a fundamental cross-cultural similarity in the assessment of whether odors are pleasant.

"Being able to predict whether a person whom we never tested before would like a specific odorant, no matter their cultural background, provides evidence that odor pleasantness is a fundamental biological property, and that certain aspects of molecular structure are what determine whether an odor is pleasant or not," said Sobel.

"We believe that culture influences the perception of olfactory pleasantness mostly in particular contexts. To stress this point, many may wonder how the French can like the smell of their cheese, when most find the smell quite repulsive. We believe that it is not that the French think the smell is pleasant per se; they merely think it is a sign of good cheese," Sobel continued.

"However, if the smell was presented out of context in a jar, the French would probably rate the odor just as unpleasant as anyone else would."

Study finds smells etched in brain

*Bad odors found
to leave bigger mark;
findings could aid
trauma patients*

REUTERS

CHICAGO — The aroma of Grandmother's fresh-baked cookies etch themselves into the brain's emotional memory, but so does a whiff of rotten fish, Israeli scientists said in a finding that might help in treating trauma patients.

They said bad smells make the biggest first impression — which is likely an evolutionary defense mechanism — but early pleasant scents also make an imprint on the brain.

"We found that the first pairing or association between an object and a smell had a distinct signature in the brain," even in adults, Yaara Yeshurun of the Weizmann Institute

of Science in Israel, whose study appears in the journal Current Biology, said in a statement.

"This 'etching' of initial odor memories in the brain was equal for good and bad smells, yet was unique to odor."

To test smell-related memories, the researchers presented a group of volunteers with a set of objects and associated each with a smell and a sound.

Some of the smells and sounds were pleasant, such as a pear or a guitar, and others were unpleasant, such as a dead fish or the screech of a power drill.

A week later, they asked people to recall the objects and found people tended to remember the unpleasant associations best, whether they were smells or sounds.

Next, they did similar experiments while people's brains were being scanned using functional magnetic resonance imaging, or fMRI.

In these experiments, they noticed that a part of the hippocampus and amygdala lit up when smells were first associated with a new object, but not sounds.

Much more study is needed, but they said the findings could lead to better ways to help improve memories, or even offer better ways to help erase early, traumatic memories.

Study explains how smells conjure strong memories

CHICAGO — The aroma of grandmother's fresh-baked cookies etch themselves into the brain's emotional memory, but so does a whiff of rotten fish, Israeli scientists said in a finding that might help in treating trauma patients.

They said bad smells make the biggest first impression — which is likely an evolutionary defense mechanism — but early pleasant scents also make an imprint on the brain.

"We found that the first pairing or association between an object and a smell had a distinct signature in the brain," even in adults, Yaara Yeshurun of the Weizmann Institute of Science in Israel, whose study appears in the journal *Current Biology*, said in a statement.

"This 'etching' of initial odor memories in the brain was equal for good and bad smells, yet was unique to odor."

To test smell-related memories, the researchers presented a group of volunteers with a set of objects, and

then associated each with a smell and a sound.

Some of the smells and sounds were pleasant, such as a pear or a guitar, and others were unpleasant, such as a dead fish or the screech of a power drill.

A week later, they asked people to recall the objects and found people tended to remember the unpleasant associations best, whether they were smells or sounds.

Next, they did similar experiments while people's brains were being scanned using functional magnetic resonance imaging or fMRI.

In these experiments, they noticed that a part of the hippocampus and amygdala lit up when smells were first associated with a new object, but not sounds.

Much more study is needed, but they said the findings could lead to better ways to help improve memories, or even offer better ways to help erase early, traumatic memories.

Once smelled, never forgotten

WHY does just a whiff of certain smells instantly transport you back to childhood? It may be because the first smell you associate with an object is given privileged status in the brain.

Yaara Yeshurun and colleagues at the Weizmann Institute of Science in Rehovot, Israel, showed volunteers an object such as a chair or pencil that was unlikely to already be associated with a smell, at the same time as exposing them to an odour or sound. An hour-and-a-half later, they showed them the same object with a different odour or sound.

One week later, the researchers showed the volunteers the object again and asked them which odour or sound they associated with it, while scanning their brains. Volunteers were more likely to mention the first odour – and when they did, their brains showed a characteristic pattern of activity in the hippocampus. This pattern did not appear if volunteers plumped for the second odour, or if they had been exposed to sounds rather than smells (*Current Biology*, DOI: 10.1016/j.cub.2009.09.066).

Yeshurun concludes that the brain reserves a special pattern of activity for memories that represent the first time we have associated a smell with a particular thing – and that such pairings are most likely to be laid down in childhood.



STOCK/18187/ALAMY

SCIENCE

Bad smells linger longer in brain

The aroma of Grandmother's fresh-baked cookies etch themselves into the brain's emotional memory, but so does a whiff of rotten fish, Israeli scientists said in a finding that might help in treating trauma patients.

They said bad smells make the biggest first impression – which is likely an evolutionary defence mechanism – but early pleasant scents also make an imprint on the brain.

"We found that the first association between an object

and a smell had a distinct signature in the brain, even in adults," said Yaara Yeshurun of the Weizmann Institute of Science in Israel, whose study appears in the journal *Current Biology*. Some smells were pleasant, and others were unpleasant, such as a dead fish or the screech of a power drill.

A week later, they asked people to recall the objects and found people tended to remember the unpleasant associations best, whether they were smells or sounds.

Next, they did similar experiments while people's brains were being scanned using functional magnetic resonance imaging or fMRI. In those experiments, they noticed that a part of the hippocampus and amygdala lit up when smells were first associated with a new object, but not sounds.

Much more study is needed, but they said the findings could lead to better ways to help improve memories, or even offer better ways to help erase early, traumatic memories. Reuters

Headline	That smells like trauma treatment
Date	07 Nov 2009
MediaTitle	The Straits Times (World) (Sat)
Section	World
Journalist	N/A
Frequency	Daily
Circ / Read	389,248 / 1,167,744

That smells like trauma treatment

CHICAGO: The aroma of grandmother's fresh-baked cookies etches itself into the brain's emotional memory, but so does a whiff of rotten fish, Israeli scientists said in a finding that might help in treating trauma patients.

They said bad smells make the biggest first impression – which is likely an evolutionary defence mechanism – but early pleasant scents also make an imprint on the brain.

"We found that the first pairing or association between an ob-

ject and a smell had a distinct signature in the brain" even in adults, said Ms Yaara Yeshurun of Israel's Weizmann Institute of Science, whose study appears in the journal *Current Biology*.

"This 'etching' of initial odour memories in the brain was equal for good and bad smells, yet was unique to odour."

In their experiments, the scientists noticed that a part of the brain known as the hippocampus and amygdala lit up when smells were first associated with a new

object, but not sounds. The findings suggest that activity in the two brain regions together can render a memory "special".

Although any application of the findings would be far off, Ms Yeshurun said the results could suggest ways to strengthen particular memories.

"Perhaps more importantly, it may help us generate methods to better forget early and powerful memories, such as trauma," she told the *Science Daily*.

REUTERS



Observations - February 4, 2010

With a little help, water can freeze as it heats up

By John Matson



The Celsius scale is an elegant, simple system of measurement: water freezes at 0 degree Celsius and boils at 100 degrees C. (The actual definition of the scale is a bit more complex, involving the so-called triple point of

water, but that's the general idea.) But chefs at high altitudes know that the simplicity of Celsius doesn't always hold—the higher your kitchen, the lower the boiling point of water. Similarly, water's freezing point is negotiable, with "supercooled" water able to remain liquid down to around −40 degrees, and even colder at extreme pressures. Supercooling can occur if water is so pure and is kept in such uncontaminated conditions that the molecules have nothing to interact with and crystallize around.

It has long been known that electrically charged surfaces can affect supercooled water's ability to freeze, a fact unsurprising given that water is a polar molecule whose orientation and hence ability to crystallize can be controlled by electric fields. A study in the February 5 issue of *Science* explores the interaction between electric fields and supercooled water's freezing point, even producing the counterintuitive phenomenon of water freezing as its temperature increases. The researchers, from the Weizmann Institute of Science in Rehovot, Israel, experimented with supercooled water on pyroelectric surfaces, materials that develop transient electric charges during temperature changes, either positive or negative depending on whether the pyroelectric is heated or cooled.

By using opposite sides of the same pyroelectric lithium tantalate crystal, the Weizmann team produced two surfaces with opposite charges during cooling—one surface developed a positive charge as the temperature decreased, the other a negative charge.

On an uncharged lithium tantalate surface, the water remained a supercooled liquid down to -12.5 degrees C. But when the pyroelectric surface had a positive charge, the team found that water froze at -7 degrees C; the positive charge somehow promoted the ice-forming process. Conversely, when the surface was negatively charged, the water did not freeze until -18 degrees C.

Even after the negative charge had worn off, the water remained in supercooled liquid form. But when the pyroelectric was heated from -11 degrees to -8 degrees C, thereby generating a positive charge on the surface, the water coalesced into a solid—freezing even as its temperature increased.

Ice photo: © iStockphoto/Milous



An "impossible" stellar explosion may provide
an unexpected window onto the earliest days
of the cosmos, says Stuart Clark

The star that time forgot



At first, there didn't seem anything earth-shattering about the tiny point of light that pricked the southern Californian sky on a mild night in early April 2007. Only the robotic eyes of the Nearby Supernova Factory, a project designed to spy out distant stellar explosions, spotted it from the Palomar Observatory, high in the hills between Los Angeles and San Diego.

The project's computers automatically forwarded the images to a data server to await analysis. The same routine kicks in scores of times each year when a far-off star in its death throes explodes onto the night sky, before fading back to obscurity once more.

But this one did not fade away. It got brighter. And brighter. That's when human eyes became alert.

The supernova finally reached its peak brightness after 77 days. After 200 days – long after most supernovae have dwindled back into obscurity – it was still burning brightly. Only in October 2008, an unprecedented 555 days after it was first spotted, had it faded enough for the supernova hunters to call off their observations.

Digesting what they had seen took longer still. SN 2007bi, as dry protocol labelled the event, was one of the most extreme explosions ever recorded, of that there was no doubt. It was so intense that it didn't fit any model of how normal stars die. But then, it was rapidly becoming clear that, in life as in death, this had been no normal star.

If the interpretation of what popped up that April night is correct, this was a star that should not have existed, in a place where it should never have been. It was a mind-bogglingly massive star that was a throwback to a universe long since gone. It was a star that time forgot.

That picture began to emerge only after long months of monitoring the supernova's afterglow with the Samuel Oschin Telescope, a 61-year-old veteran atop Mount Palomar. This afterglow is powered by the decay of heavy radioactive elements generated in the runaway processes of nuclear fusion that occur during the initial explosion. The critical process is the decay of radioactive nickel, which quickly turns to cobalt, which in turn decays to iron, radiating gamma rays as it does so. The brightness and persistence of the afterglow reveal how much of these elements the supernova produced.

Plugging these observations into models of conventional supernovae brought a startling conclusion. To keep the supernova glowing that brightly, and for that long, the explosion

must have produced 10 times more radioactive nickel than a normal supernova can muster – a discrepancy so huge that it demanded an explanation.

A clue to what was going on came in a few largely forgotten papers buried in journals from 40 years ago. In the core of any massive star, the outward pressure of photons created in nuclear fusion reactions counters the weight of the material bearing down on it, preventing the star from collapsing in on itself. Sometimes, in massive stars many times the size of the sun, gravity can eventually overwhelm this photon pressure, initiating what is known as a core-collapse, or type II, supernova. That is one of two common types of supernova. The other, called type Ia, occurs when a dying white dwarf star accretes mass from a companion star and grows unstable, igniting in a final searing fireball (see diagram, page 31).

In the old papers, astronomers speculated on what might happen to cause a truly giant star – one bigger than about 200 suns – to go supernova. In this case, they calculated, the core of the star could eventually become so hot during nuclear fusion that photons would start to convert spontaneously into pairs of particles: an electron and its antimatter doppelgänger, a positron. This would rob the star of some of the photon pressure needed to support its outer layers, causing it to collapse in on itself in a gargantuan supernova that would vaporise the star. This final titanic burst of fusion would create vast quantities of heavy radioactive elements, far larger than a conventional supernova can produce. The astronomers called it a "pair-instability" supernova.

Implausible interloper

No supernova explosion answering to this description had ever been witnessed, and the idea remained a mere twinkling in the theorists' eyes. That is, it did until Avishay Gal-Yam, an astrophysicist at the Weizmann Institute of Science in Rehovot, Israel, and his collaborators started looking at SN 2007bi. The more they compared the data with various supernova models, the more they became convinced that the pair-instability model was the answer to the conundrum this explosion posed. "Only a pair-instability supernova can produce that much radioactive nickel," says Gal-Yam. With the model, they could even calculate how big the exploding star had been: a whopping 300 times the mass of the sun (*Nature*, vol 462, p 624).





Problem solved? Not a bit of it. The finding came with a massive sting in its tail: according to all our theories and all our observations, stars that big simply should not exist.

At least, they should not exist in the kind of universe we see around us today. In the decades since the pair-instability model was born, theory and some comprehensive sweeps of the night sky have combined to show that the composition of the modern cosmos prevents stars reaching such huge sizes. The presence of appreciable quantities of what astronomers call metals – elements heavier than hydrogen and helium – causes gas clouds to collapse speedily into “pocket-sized” stars. That is why most stars today are celestial minnows, containing less mass than our sun. The absolute upper limit on a modern star, theory and observations of our galaxy agree, lies at about 150 solar masses. A monster of 300 solar masses is an implausible interloper into this settled scene.

Things were different in early cosmic times, some 13 billion years ago in the pristine universe immediately after the big bang: Back then, solar giants ruled the roost. Only hydrogen, helium and trace amounts of lithium were floating around the cosmos, and much bigger quantities of these elements had to accumulate before they fell under the spell of gravity and were pulled together to form a star. As a result, the first stars in the universe were humongous, containing anything up to several hundred solar masses.

Fossil universes

Existing before proper galaxies had been able to form, these stars lived brief, wild lives of just a few million years as they furiously burned their vast stocks of hydrogen. Yet in their violent deaths, these stars were of huge significance. As theory has it, these explosions fused the first elements heavier than hydrogen, helium and lithium. They provided the raw materials for the cosmos we see today: its galaxies, its sun-like stars, its planets and, in one insignificant corner at least, its life.

No one has ever seen these cosmic giants directly. We would dearly love to, if only to confirm the grounds for our own existence. Unfortunately, we can't. Even as they were sowing the seeds of the future cosmos, these megastars were precipitating their own demise. By increasing the metal content of the cosmos as they died, they destroyed the very conditions that nurtured them in the first place. By the end of the first few hundred million years after the big bang, metal levels were so high that stars of their like could never form again. Direct evidence for the existence

of megastars lies far beyond the horizon of even our most powerful telescopes.

Or does it? If SN 2007bi is what it seems, we might have found a get-out clause: a loophole that allows us to spy if not the first megastars, then something very similar. Against the odds, the cosmic trailblazers may have lived on into the modern universe. But how?

The secret lies in where this supernova was situated: an otherwise unassuming dwarf galaxy some 1.6 billion light years away from Earth. Dwarf galaxies, as their name suggests, are runtish structures that never made it to full size. Whereas a fully formed galaxy such as our own Milky Way contains several hundred billion stars, a dwarf galaxy can have as few as just a couple of million.

Observations of the distant universe show that dwarf galaxies were once much more prevalent. “We know that the first galaxies to form were dwarfs,” says Nils Bergvall of the Uppsala Observatory in Sweden. The idea is that these were the basic blocks that built up to form the much larger galaxies of today.

We also know that dwarf galaxies, even those relatively nearby which we can see as they were in comparatively recent cosmic time, have just 5 to 10 per cent of the metals that our sun has – or markedly less than one-hundredth of their total mass. The earliest dwarf galaxies may have had even less.

We have been slow to grasp the implication: that the tiniest dwarf galaxies could be pristine chunks of the early universe, preserving its composition and conditions in a cosmos that has long since moved on. Their degree of preservation could be the result of their sheer dwarfishness: because gravity within them is weaker than within a normal galaxy, a supernova exploding within it will fling the metal-rich products outwards at such speed that they mostly escape altogether.

If the original conditions of the universe were preserved in these dwarf galaxies, there would be no reason why further waves of megastars should not continually form and die within them throughout cosmic time. If it is the absence of metals that determines stellar size, behemoth stars are not restricted to the furthest reaches of the universe: they could be found in any dwarf galaxy with a low enough metal content, including places well within reach of our telescopes. It is a line of reasoning that the identification of SN 2007bi now seems to support in spectacular fashion.

The discovery of a nearby population of megastars in what amounts to suspended animation would have huge implications for stellar science. We do not understand the processes of star formation and death as well as we would like to think. “It is surprisingly



difficult to get the models to agree with the observations," says Gal-Yam. He cites the example of gold, the abundance of which in the universe essentially defies explanation, although most astronomers assume it must somehow be made in supernovae. To find some answers, we might need to look no further than nearby dwarf galaxies.

But wait a moment. If these huge living fossils have always been lurking on our cosmic doorsteps, how come we have not seen them before now? Stars that big would surely be hard to overlook, either during their tempestuous lives or spectacular deaths. Yet apart from one peculiarly luminous supernova in 1999, we have never seen anything that looks like SN 2007bi.

Part of the explanation, says Alexei Filippenko of the University of California, Berkeley, is that we have been looking in the wrong places. "Telescope time is precious, and in a pathetic dwarf galaxy there are not that many stars, so not that many opportunities for one to go supernova," he says. Astronomers have understandably focused their attention on the big galaxies that are richly stocked with stars.

Tantalising glimpse

That is now changing as fast robotic sky searches, such as the Palomar Transient Factory based at the observatory that first spotted SN 2007bi, swing into action. Such projects make no judgement about where best to look; they just keep their electronic eyes open for anything that is changing in the sky. This new strategy is already bearing fruit. "We are now tracking a number of supernovae that could also turn out to be pair-instability

supernovae. But we want to be absolutely certain before we announce," says Filippenko.

Direct observations of any living megastars lurking out there are more tricky. Giant stars with their huge stocks of hydrogen and helium fuel would be so hot that most of their energy would be emitted as ultraviolet light, which is absorbed by Earth's atmosphere before it reaches ground-based telescopes. "Without seeing the ultraviolet, these stars will just hide away and look like ordinary high-mass stars," says Gal-Yam.

Because astronomers have traditionally believed that there is little of interest to see at ultraviolet wavelengths, there are no general-purpose ultraviolet space telescopes, either. The Hubble Space Telescope can see at these wavelengths, but the kind of painstaking programme to map relatively nearby dwarf galaxies would mean tying it up for thousands of hours of observation time. Gal-Yam has just submitted a proposal to do just that, but he is competing against about 40 other projects.

Hubble was serviced for the final time last year, and attention is now switching to its replacement, NASA's James Webb Space Telescope, which is scheduled for launch in 2014. But this telescope has no ultraviolet capability. "Once Hubble is gone, we are going to be totally blind," says Gal-Yam. "There is an urgency about doing this work."

At it stands, that April supernova could have been a tantalising and wholly unexpected glimpse into a universe we thought we would never see, that of the first stars, the cosmos makers. That would be an explosion to truly blow our minds. ■

Stuart Clark is the author of *Galaxy and Deep Space* (Quercus). Read his blog at www.stuartclark.com

"We would dearly love to see one of these cosmic giants directly, if only to confirm the grounds for our own existence"

VITAL SIGNS

Cellphone radiation has "non-thermal" effects beyond the mere heating of tissue.

shown to suppress melatonin production in rats. If suppression also occurs in humans, one of the body's defenses would be weakened.

Epidemiological studies have found an increased risk of leukemia in people living near high-voltage power lines. The IARC now classifies extremely low-frequency EMFs (such as those from power lines) as a possible human carcinogen. Denis L. Henshaw, a physicist at the University of Bristol in England, cites evidence that power-line EMFs disrupt melatonin production, thereby impairing the immune system's ability to prevent and repair genetic damage.

Power lines operate at lower frequencies (around 50 hertz) than cellphones. But cellphones produce regular pulses that fall in the extremely low-frequency range of 1 to 300 hertz. It is therefore possible, according to Henshaw, Kimdi and others, that cellphone EMFs could also have an effect on human cells and, potentially, on melatonin production.

While acknowledging that some researchers have found alterations in melatonin levels, former WHO coordinator Repacholi says, "It must be something else, because [power-line EMFs] hardly penetrate into the body. There is no mechanism by which the fields could cause melatonin change." Counters Henshaw, "There are thousands of papers documenting the effect of power-line EMFs. We don't know yet if this is true for cellphones, but for power-line EMFs there clearly are non-thermal effects."

GENE EXPRESSION

Research by Igor Belyaev, an associate professor in the Department of Genetics, Microbiology and Toxicology at Stockholm University, has shown that EMFs can affect gene expression—the mechanism by which genes are activated and "speak out"—in human and animal cells. Belyaev exposed human lymphocytes, a type of white blood cell involved in the body's immune response, to EMFs at 915 megahertz, a common cellphone frequency. The samples were taken from healthy people and those reporting EHS symptoms. In cells from both types

of subjects, Belyaev observed a stress response that altered gene expression. The stress response induced by EMFs at 915 megahertz disrupted the body's DNA-repair machinery, he concluded, thus making it harder to fix the kind of cellular damage that can lead to cancer. In other research, Belyaev has found that cellphone-frequency EMFs inhibit DNA repair in stem cells; DNA breaks in stem cells are critical to the onset of leukemia and some tumors, including gliomas.

Stress response does indeed cause changes in gene expression; however, says Repacholi, "lots of experiments can find effects, but that doesn't translate into the whole organism, because the whole organism compensates. The gap between a biological effect and an adverse health effect is a big one."

INTRACELLULAR SIGNALING

Rony Seger of the Weizmann Institute of Science in Rehovot, Israel, has found that EMFs in the 900-megahertz range also influence intracellular signaling pathways—how cells talk to each other. Working with rat cells, Seger and his colleagues found that cellphone radiation changes the activity of certain enzymes, prompting them to start producing free radicals. Free radicals are rogue atoms that can cause damage when they interact with DNA and other crucial cellular components.

Seger emphasizes that the effect "produces a small amount of free radicals, which in themselves are not harmful." But he also says that intracellular signaling could be part of a more general cancer-inducing mechanism that is not yet understood. "It is possible that this system could cause the activation of another system," he says, which could in turn create a cascade of intracellular events whose cumulative effect could be harmful. He cautions, though, "The amplification [of the free radicals] has to be much stronger in order to induce these adverse effects." Boice points out that free radicals are produced all the time as a by-product of our metabolism. "The body has processes that take care of them," he says. "You can't extrapolate from a petri dish to humans."

*Alarms and diversions
for the thinking person*

The reading list

"Is there anybody out there? In Alejandro Jenkins' case, the question refers not to whether life exists elsewhere in the universe, but whether it exists in other universes outside of our own.

"While that might be a mind-blowing concept for the layperson to ponder, it's all in a day's work for Jenkins, a postdoctoral associate in theoretical high-energy physics at Florida State University. In fact, his deep thoughts on the hypothetical 'multiverse' — think of it as a mega-universe full of numerous smaller universes, including our own — are now receiving worldwide attention, thanks to a cover article he co-wrote for the January 2010 issue of *Scientific American* magazine.

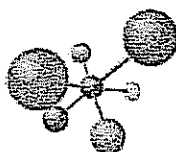
"In 'Looking for Life in the Multiverse,' Jenkins and co-writer Gilad Perez, a theorist at Weizmann Institute of Science in Israel, discuss a provocative hypothesis known as the anthropic principle, which states that the existence of intelligent life (capable of studying physical processes) imposes constraints on the possible form of the laws of physics.

"'Our lives here on Earth — in fact, everything we see and know about the universe around us — depends on a precise set of conditions that makes us possible,' Jenkins said. 'For example, if the fundamental forces that shape matter in our universe were altered even slightly, it's conceivable that atoms never would have formed, or that the element carbon, which is considered a basic building block of life as we know it, wouldn't exist.'"

— From "Looking for Life in the Multivers" at astrobio.net



Michal Sharon (Weizmann Institute of Science/Michal Sharon)



MySciNet

An Inclusive Community

Career Profiles

Making Science and Family Fit

Israeli structural biologist Michal Sharon has made some bold decisions in her young scientific career. After productively using

nuclear magnetic resonance (NMR) spectroscopy to study protein structure during a Ph.D., she switched to structural mass spectrometry for her postdoc in the United Kingdom. Upon taking a tenure-track position at the Weizmann Institute of Science in Rehovot 3 years ago, she set out to create the first structural mass spectrometry lab in Israel. And when she wrote the proposal that won a European Research Council starting grant, she let her scientific ambition run free, asking herself, "What will I want to investigate ... if money was not a concern?"

Sharon "would go home to make dinner and then if necessary and things were going well return to the lab after the children were in bed," writes her postdoctoral adviser Carol Robinson.

Sharon believes that many young women with families lack confidence in their abilities — including their ability to couple a full commitment to science with family life. They "don't know if they are capable of leading a group [or] if they will be able to combine family and career," she says. Sharon — who had two children before she finished her Ph.D. and has since added a third — admits that she herself has experienced self-doubt. But time, success, a supportive husband, and excellent role models have encouraged her to be ambitious in her science and at home. "I don't think that science should be done as the result of a sacrifice," she says.

A Ph.D. and children

Sharon obtained a B.Sc. degree in chemistry from the Hebrew University of Jerusalem in 1996. While doing a lab rotation in the lab of Jacob Anglister during the first year of her M.Sc. degree at the Weizmann Institute, "I discovered that I'm attracted by technology and biophysical methods and that I enjoyed collecting data and then putting the small pieces of information together [like] a puzzle," Sharon says.

Sharon joined Anglister's lab for her master's project and Ph.D., studying the three-dimensional structure of a region in the HIV-1 protein envelope that helps the virus enter human cells. Sharon used molecular biology methods to express and purify the virus peptide and NMR spectroscopy to analyze its structure as it is bound to neutralizing human antibodies. She wrote six papers describing the work. "The structure led us to propose a mechanism for the receptor selectivity of the HIV virus" with potential therapeutic applications, she says.

Sharon had a son at the beginning of the second year of her Ph.D. and a daughter 2.5 years later. "My Ph.D. was ... something like half a year longer" because of maternity leaves, she says, but "I don't feel [in the] end that it stopped me at any stage." She finished the degree in the summer of 2003.

Her key to balancing work and family during graduate school, she says, was good time management. She left work earlier than she did before she had children, but she made up for the lost time by reading papers and writing e-mails after the children were asleep, by staying longer some days, and by coming into the lab on weekends. She learned to value every minute of the work day. "I write down a plan [of] what I need to do in the following week, and then I divide it [into] what should be done in each day." It's "not the number of hours you are in the lab, but ... the work that is done," she says.

A family experience abroad

"In Israel, if you want to have your independent career, you have to do your postdoc abroad," she says. "I felt it was quite a big decision to ... take my family with me and to move to another country." Despite her obvious ability, she considered working in someone else's lab rather than pursuing a lab of her own.

Hadassa Degani, a female scientist who had been sitting on her Ph.D. committee, noticed "her hesitations whether to pursue an academic career," Degani writes in an e-mail. "At that stage she needed encouragement and support and reassurance of her high qualifications." Degani's input was important in her decision to carry on with a postdoc abroad, Sharon says. But most important was "a very supportive husband that really encouraged me all along ... [and] believes in me and my ability." Sharon's husband, who manages adult education programs in the government sector, quit his job in Israel so that the family could move overseas.

Sharon went to work at the University of Cambridge in the lab of Carol Robinson (now at the University of Oxford), who had pioneered new structural mass spectrometry methods that made it possible to study huge protein complexes. The family was assisted in the move by Cambridge's Israeli community. "We had many phone calls, and they gave us a lot of advice, so our landing was very soft," Sharon says.

In Robinson's lab, Sharon studied protein-protein interactions within proteasomes, large multiprotein complexes that clear cells of unwanted proteins by degrading them into small peptide fragments. "I was very fortunate during that period to have access to prototype instruments that were modified specifically for these needs," Sharon says. "It was very exciting because we could actually explore the capabilities and the limitations and applications" of the new approaches.

Sharon and her husband took turns dropping the children off at school. After school, the children went to a club. "I was working until 5:30 and then of course we had some time together and dinner together ... and when they went to sleep, I continued to do the things that I needed to do," Sharon says. Robinson writes in an e-mail that Sharon "would go home to make dinner and then if necessary and things were going well return to the lab after the children were in bed. This I recognised as something that I had done when my 3 children were small and believe it demonstrates a strong will to succeed."

Robinson, Sharon says, was "beyond being a ... perfect role model." She "was always very supportive, motivating, inspiring, and I learned a lot from her." Sharon also attended a professional development course organized by the University of Cambridge for female graduate students and postdocs and built a small support network. Once in the United Kingdom, Sharon soon matured, Degani says, "gaining full confidence in her intellectual and scientific abilities" and demonstrating her determination to be a scientist. "She embarked into a new field and was able to gain leadership in this field very fast."

By the time Sharon finished her postdoc, in 2006, she had published 15 more papers, seven as first author. She had secured a postdoctoral fellowship from the European Molecular Biology Organization, a Wingate Scholarship, and a Dorothy Hodgkin Fellowship from the Royal Society, which allowed her to develop an independent line of research in Robinson's lab. Sharon had her third child and took an 18-week maternity leave, after which her mother-in-law came from Israel to help with childcare. Sharon found a tenure-track position in Israel, and the family moved back there.

Science and family at home

Since 2007, Sharon has been a senior lecturer in the Department of Biological Chemistry at the Weizmann Institute. Today her lab counts four Ph.D. students, three postdocs, one technician, and a research associate. She shares two postdocs with another lab. She continues studying multiprotein complexes involved in the protein degradation pathway, focusing on how their assembly and architecture affect their function. "We combine a biological lab that includes molecular biology and biochemistry with the analytical chemistry using mass spectrometry," Sharon says.

Setting up the lab presented a double technical challenge. First, the protein complexes she studies are large and dynamic, have transient interactions, and are present in low numbers within cells, all of which makes them hard to isolate in sufficient quantity and purity, Sharon says. The second challenge was getting the structural mass spectrometry equipment running.

Leading a lab and raising children share many similarities, Sharon says. "Often, things I'm thinking about in relation to my work are similar to the things I think in relation to my kids," like finding the correct balance between allowing them independence and providing close mentoring. The most rewarding part of her job is discovering "one day that [students] have become independent and often they know things more than you. ... It's like having your child start walking."

"Of course, it [is] a challenge to balance a career and children," Sharon says. It's made easier by her supportive husband, a childcare provider, and a part-time house cleaner.

One issue many women scientists have to deal with is a constant feeling of guilt, Sharon says. "If you're not enough at work, you feel guilty about your work. If you're not enough with the children, you have guilt," too, she says. The most important thing, she says, is to maintain a sense of perspective. "Generally, we should be more patient and ... forgive ourselves and accept that there will be times" when the focus is on work and times where the balance swings toward family. Having a family helps her maintain that equanimity, she says. "If something doesn't go well in the lab, at the end of the day, you come back home [and] you have your children."

Elisabeth Pain is contributing editor for South Europe.

10.1126/science.caredit.a1000014

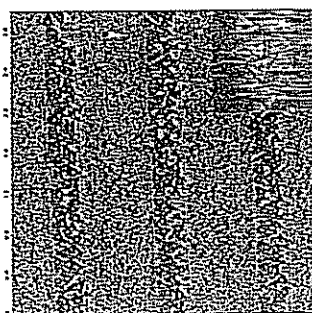
HIGH-PERFORMANCE COMPUTING | Brute Force

Petri Dish Processing

Nucleic acids are the building blocks of life, but can they be used as the building blocks of computers too? A look at the latest from the world of DNA computing and nanotechnology. *By Matthew Dublin*

While once the domain of fringe science fiction, the concept of using molecules to self-assemble and perform calculations like a computer chip has been the serious focus of the field of DNA computing for more than 10 years now. The work of DNA computing pioneer Leonard Adleman, a professor of computer science at the University of Southern California, led many in the field to believe that it might be possible for DNA to compete with silicon-based computing.

In the mid-1990s, Adleman's lab demonstrated the use of DNA to solve a version of the Hamiltonian Graph problem, which is similar to the traveling salesman problem. The results caused quite a stir. "When Adleman published his first paper in 1994, there was a bit of a gold rush and people jumped into the area, and very quickly a large number of papers appeared proposing various DNA-based solutions for hard [computational] problems," says Martyn Amos, senior lecturer in the department of computing and mathematics at Manchester Metropolitan University. "People thought if we can beat silicon, then we've found our killer app, and the field was driven by this search for the application of DNA-based computing that would establish its superiority over silicon."



CONCENTRATIONS OF TRIANGULAR DNA ORIGAMI

But according to Amos, who earned his PhD with a dissertation on DNA computing from the University of Warwick in 1997, the issue of practicality in using molecules to do heavy computation is hampered by the inherent messiness of biology. "Small errors are very quickly amplified when you're using techniques such as PCR and affinity purification, which are fine for biologists for the level of accuracy they require, but not for a computer scientist," Amos says. "Tiny errors, which are imperceptible to the molecular biologist, are absolutely crucial to a computer scientist."

There are several methods for building a DNA computer, including logic gates using DNazymes and oligonucleotides for input, DNA tiling, or PCR. DNA computers certainly use less power than silicon processors, are fast, and do not suffer from significant heat issues when compared

to standard chips. However, scalability with a DNA computer is by its very nature a messy proposition. So while early DNA computing was characterized by a monolithic approach, like finding a statue inside the block of marble, many in the field have moved beyond the hope that someday biologically based microprocessors would surpass silicon chips to utilizing the computational potential of DNA strands to perform more basic logic functions.

One such researcher is Ehud Shapiro, a professor of computer science and biology at the Weizmann Institute, who is focused on practical applications for DNA computing that aim to execute relatively basic logical functions very quickly. Shapiro published a demonstration of the world's first programmable, autonomous DNA computing device — composed of enzymes and DNA molecules — back in 2001. To put it in perspective, a trillion of Shapiro's computing devices could fit in a single drop of water. This first device was able to perform simple tasks such as checking a list of 0s and 1s to determine if there was an even number of 1s. Then in 2004, Shapiro and his colleagues developed a DNA-based computer, complete with input and output modules that were capable of detecting cancer in a test tube and releasing a molecule to destroy it. The proof in the nano pudding was clear: these devices were capable of effectively interacting with

a biological environment for medical and other purposes. "Our vision was that if we are to make a successful programmable, autonomous molecular computing device, they should be able to sense molecular symptoms of disease and analyze them on the input side and release a drug molecule on the output," Shapiro says. "So the vision for these kind of autonomous computing devices is that eventually they could be encapsulated in some appropriate packaging, delivered into a patient's body, and when traveling there they might be able to detect abnormalities that would require intervention."

Recently, Shapiro and his colleagues managed to develop a system that uses DNA strands capable of performing basic logic functions just like the countless number of components that make up any processing chip. They used DNA molecules to represent the various elements of a simple "if ... then" train of deduction: All men are mortal. Socrates is a man. Therefore, Socrates is mortal. The device can successfully and reliably answer questions such as "Who is mortal?" and "Is Socrates mortal?" and other more complicated queries with additional rules and facts.

Shapiro's team also created a compiler to translate between a conventional programming language and a DNA computing "code." The compiler then translates the facts, rules, and queries into molecular representations, which in turn instruct a robotic system to assemble the logical deductions and produce a result. The results were encoded via flashes of green light emanating from a glowing fluorescent molecule that was revealed by an enzyme attracted to the site of the correct answer.

Drugs enabled with logic functions, or "smart drugs," have always been Shapiro's focus for DNA computing rather than attempting to rival a silicon

processor. "It seems that [DNA computing] in general is gravitating towards the vision we proposed and slowly abandoning the vision of competing with silicon computers," he says. "I think [silicon computers] are doing pretty well and will continue to do so in the future, whereas there is an urgent need to have more intelligent drugs, and the potential of biomolecular computing is in this direction."

Fabrication, not computation

While Moore's Law has proven itself to be a reliable rule of thumb for the ever-increasing speed and complexity of processors, some researchers are looking to overturn the whole top-down assembly approach of making silicon wafers and transistors with increasingly smaller components. Currently, chipmakers have their sights set on methods to develop conventional lithographic and semiconductor fabrication techniques to make the components on chips smaller than 22 nanometers, the current target size of the industry. But some researchers have offered up proof-of-principle research that uses DNA molecules — not for computation, but as scaffolding or molecular-scale circuit boards upon which millions of carbon nanotubes or silicon nanowires can be deposited to form transistors for ultra-fast computation at the sub-22 nm level.

"Instead of conventional top-down assembly, where you keep having devices on the silicon wafer and you keep shrinking them smaller and smaller and smaller with each generation of technology, and as these features in the silicon wafer get smaller and smaller, it gets harder to do that," says Gregory Wallraff, a research scientist at IBM's Almaden Research Center in San Jose, Calif.

"And it's this problem with the continual miniaturization that's making people look at other ways of doing it. And one way is to assemble components that are already at the molecular scale ... so instead of shrinking things down, we'll start off with something small and assemble it the way we want."

IBM is working in conjunction with Caltech, where the techniques for creating so-called DNA origami were developed by Paul Rothemund in a process that makes individual DNA molecules self-assemble using a solution that mixes a long, single strand of viral DNA with a combination of various short synthetic oligonucleotide strands. The short segments can be used to fold the viral DNA into specific 2D shapes through base pair binding to create triangles, squares, or stars no wider than a DNA double helix. The team recently published research that used Rothemund's technique in conjunction with electron-beam lithography and oxidative etching to create binding sites on SiO₂ and diamond-like carbon, both practical materials for chip making.

"The essential first step was to figure out a way to position [Rothemund's] origami structures on the silicon wafers in a precise way, to locate them precisely on the silicon wafer," says Wallraff. "The next step is to assemble the components which are things like silicon nanowires, quantum dots, carbon nanotubes — those would be the components of the transistors. The second step is going to be as hard or harder." Beyond the challenge of getting these particles to assemble on the DNA templates, there is also the issue of defects caused by biology's inherent messiness.

So for now, the very flexibility and virtuosity that gives DNA the potential to aid in computing remain the biggest hurdles facing its practical application. ■

Editorial

The boycotters' flawed logic

Twenty-first century humankind has come to rely on computers, but how do we know computers are reliable?

In large part, we know because of the work of Amir Pnueli, a pioneering Israeli computer scientist and logician. Born in prestate Israel in 1941, Pnueli earned degrees from the Technion and Weizmann Institute. In 1973 he founded the computer science department at Tel Aviv University and, after a return to Weizmann, joined the faculty at NYU.

Pnueli won the A.M. Turing Award, often called the Nobel Prize of computer science, for his work on temporal logic and verification. Pnueli was able to help programmers evaluate the truthfulness of systems over time. His breakthrough enabled chip makers to verify the reliability of silicon chips across millions of calculations, and programmers to minimize the bugs in their software.

Dr. Pnueli died this week, succumbing to a brain hemorrhage at 68. His death and, more importantly, his life are worth noting in their own right. But we can't help also noting that the seminal contributions of a native-born Israeli researcher were once again in the news at a time when anti-Israel forces are pushing hard for boycotts of Israeli academic institutions.

The Norwegian University of Science and Technology hotly debated just such a boycott before administrators came to their senses last week and voted unanimously to reject the notion. Meanwhile promoters of Boycott, Divestment and Sanctions for Palestine keep at it. By seeking to isolate Israel, they think, or at least pretend, that they are bringing Israelis and Palestinians closer to the peace both sides deserve. Instead, like the framers of the odious Zionism equals racism resolution, they only succeed in making Israelis feel more isolated and less inclined to risk their hard-fought security or inflame internal political turmoil for uncertain diplomatic promises from sworn enemies.

While the Norwegians' rejection of the boycotters is welcome, the drumbeat of isolation works its own perverse logic: To even entertain a debate about whether a country deserves a place at the table of nations somehow suggests that it is a debate worth having. It holds Israeli history and society — its people, its accomplishments, its problems, its very reality — hostage to the simplistic notion that only Israel is responsible for an intractable status quo. It absolves Palestinians and their allies and enablers of any responsibility for their dismal and ineffective track record of state- and confidence-building.

Yes, war and conflict, politics and paralysis are part of the Israeli story. But so too are its disproportionate contributions to the advancement of humankind. Located in a neighborhood where academic inquiry and scientific progress are too often devalued and impeded by desperate, corrupt leaders and backward-looking clerics, Israel provides a vision of the Mideast's future, not its warring or destitute past.

QUANTUM COMPUTING: SUPERPOSITION OF 0 AND 1



Circuit elements made of individual atoms, electrons or even photons would be the smallest possible. At this dimension, the interactions among the elements are governed by quantum mechanics—the laws that explain atomic behavior. Quantum computers could be incredibly dense and fast, but actually fabricating them and managing the quantum effects that arise are daunting challenges.

Atoms and electrons have traits that can exist in different states and can form a quantum bit, or qubit. Several research approaches to handling qubits are being investigated. One approach, called spintronics, uses electrons, whose magnetic moments spin in one of two directions; think of a ball spinning in one direction or the other (representing 1 or 0). The two states can also coexist in a single electron, however, creating a unique quantum state known as a superposition of 0 and 1. With superposition states, a series of electrons could represent exponentially more information than a string of silicon transistors that have only ordinary bit states. U.C. Santa Barbara scientists

have created a number of different logic gates by tapping electrons in cavities that are etched into diamond.

In another approach being pursued by the University of Maryland and the National Institute of Standards and Technology, a string of

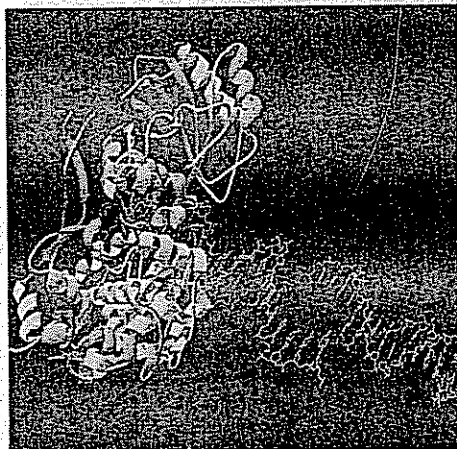


LEVITATED STRING of calcium ions in a vacuum chamber can perform quantum calculations.

ions is suspended between charged plates, and lasers flip each ion's magnetic orientation (their qubits). A second option is to detect the different kinds of photons an ion emits, depending on which orientation it takes.

In addition to enjoying superposition, quantum elements can become "entangled." Information states are linked across many qubits, allowing powerful ways to process information and to transfer it from location to location.

BIOLOGICAL COMPUTING: CHIPS THAT LIVE



COMPUTATION can occur when a DNA molecule (right, green) provides data to software DNA molecules (center, red) that a FokI enzyme (colored ribbon) can process.

Biological computing replaces transistors with structures usually found in living organisms. Of great interest are DNA and RNA molecules, which indeed store the "programming" that directs the lives of our cells. The tantalizing vision

is that whereas a chip the size of a pinky fingernail might contain a billion transistors, a processor of the same size could contain trillions of DNA strands. The strands would process different parts of a computing task at the same time and join together to represent the solution. A biological chip, in addition to its having orders of magnitude more elements, could provide massively parallel processing.

Early biological circuits process information by forming and breaking bonds among strands. Researchers are now developing "genetic computer programs" that would live and replicate inside a cell. The challenge is finding ways to program collections of biological elements to behave in desired ways. Such computers may end up in your bloodstream rather than on your desktop. Researchers at the Weizmann

Institute of Science in Rehovot, Israel, have crafted a simple processor from DNA (above), and they are now trying to make the components work inside a living cell and communicate with the environment around that cell.

MORE TO EXPLORE

A Future of Integrated Electronics: Moving Off the Roadmap. Edited by Daniel J. Radack and John C. Zolper. Special issue of *Proceedings of the IEEE*, Vol. 96, No. 2; February 2008.

Carbon Wonderland. Andre K. Geim and Philip Kim in *Scientific American*, Vol. 298, No. 4, pages 90–97; April 2008.

Molecular Implementation of Simple Logic Programs. Tom Ran et al. in *Nature Nanotechnology*, Vol. 4, pages 642–648; October 2009.

Scientists discover new protein partnership leading to pediatric tumor regression

REHOVOT, Israel—Why are some pediatric cancers able to spontaneously regress? Professor Michael Fainzilber and his team in the Weizmann Institute's Biological Chemistry Department seem to have unexpectedly found part of the answer. Further research toward a better understanding of the mechanism of action might hopefully lead, in the future, to the development of drugs that will be able to induce regression of certain tumors.

TrkA is a particular cell receptor well known for its "pro-life advocacies." When nerve growth factor proteins bind to TrkA receptors, it activates the receptors into promoting the growth and survival of neurons.

So when Fainzilber and his team carried out screening tests to identify other molecules involved in this signaling cascade, it took them by surprise to learn that TrkA may not be what it seems. They found that if TrkA teams up with another molecule called CCM2—the newly identified player in this signaling cascade—they become "partners in crime," with TrkA turning into a cell killer.

However, though paradoxical, this atypical behavior may actually be rooting

for life after all. This idea comes from findings concerning pediatric tumors of neural origin; specifically, medulloblastoma—the most common malignant brain tumor and the second most common malignancy among children less than 20 years of age, and neuroblastoma—the most common extracranial solid cancer in childhood.

Neuroblastoma displays unusual behavior, being one of the few human malignancies known to demonstrate spontaneous regression in some cases, but nobody knows how or why. Studies have shown that the tumors with positive prognosis usually express TrkA, while aggressive forms of the tumor do not. However, how TrkA induces tumor regression is yet unknown and the mechanism was an enigma.

What if CCM2 were the missing piece to the tumor regression puzzle? Together with a group of scientists in Germany who were conducting a large-scale gene expression study in tumors from neuroblastoma patients, they checked the expression levels of CCM2 and TrkA from the patient samples collected. The results were clear-cut: TrkA and CCM2 were always expressed together in certain tumors—those

that showed the highest incidences of regression and patient survival.

The scientists confirmed their results by blocking the expression of either TrkA or CCM2 in some cells, which resulted in cell survival. On the other hand, by introducing CCM2 to cells lacking it, cell death was induced if TrkA was also present, suggesting that this mechanism could lead to tumor regression.

This research, recently published in "Neuron," is one of the first to elucidate this paradoxical "pro-cell death" behavior of TrkA and the first to identify CCM2 as a crucial accessory in this particular pathway, as well as describing in detail just how these two molecules interact.

Professor Michael Fainzilber's research is supported by the M.D. Moross Institute for Cancer Research; the Dr. Miriam and Sheldon G. Adelson Medical Research Foundation; the Helen and Martin Kimmel Institute for Stem Cell Research; the Irving B. Harris Foundation; and Mr. and Mrs. Michael Salzman, Bethesda, MD. Prof. Fainzilber is the incumbent of the Chaya Professorial Chair for Molecular Neuroscience.

Scientists reveal how tendons shape developing bones

STAFF REPORT

Bones, muscles, and tendons work together to provide the perfect balance between stability and movement in the skeleton. Now, Weizmann Institute scientists have shown that this partnership begins in the embryo, when the bones are still taking shape. Their study, published in a recent issue of *Developmental Cell*, describes a previously unrecognized interaction between tendons and bones that drives the development of a strong skeletal system.

"Our skeleton, with its bones, joints, and muscle connections, serves us so well in our daily lives that we hardly pay attention to this extraordinary system," says Dr. Elazar Zelzer of the Weizmann Institute's Department of Molecular Genetics. "Although previous research has uncovered mechanisms that contribute to the development and growth of each component of this complex and wonderfully adaptable organ system, specific interactions between bones, muscles, and tendons that drive the assembly of the musculoskeletal system are not fully understood."

Zelzer, research student Einat Blitz, Sergey Viukov and colleagues, were interested in uncovering the molecular mechanisms that regulate the formation of bone ridges — bony protruberances that provide a stable anchoring point for the tendons that connect muscles with bones. Bone ridges are critical for the skeleton's ability to cope with the considerable mechanical stresses exerted by the muscles. The researchers used embryonic mouse skeletons to study a bone ridge called the deltoid tuberosity, located on the humerus bone in the arm.

They discovered, to their surprise, that rather than being shaped by processes within the skeleton, bone-ridge formation was directly regulated by tendons and muscles in a two-phase procedure. First, the embryonic tendons initiated bone-ridge formation by attaching to the skeleton. This interaction induced the tendon cells to express a specific protein called scleraxis, which in turn, led to the production of another protein, BMP4 — a molecule involved in the onset of bone formation. Blocking BMP4

production in tendon cells prevented deltoid tuberosity bone-ridge formation. In the second phase, the subsequent growth and ultimate size of the deltoid tuberosity was directly regulated by muscle activity.

The results demonstrate that tendons play an active role in initiating bone-ridge patterning. According to Zelzer, "These findings provide a new perspective on the regulation of skeletogenesis in the context of the musculoskeletal system, and they shed light on an important mechanism that underlies the assembly of this system."

Zelzer's research is supported by the Y. Leon Benozio Institute for Molecular Medicine; the Helen and Martin Kimmel Institute for Stem Cell Research; the Kirk Center for Childhood Cancer and Immunological Disorders; the David and Fela Shapell Family Center for Genetic Disorders Research; the estate of Rubin Feryska; the estate of George Liebert; and the estate of Lela London. Zelzer is the incumbent of the Martha S. Sagon Career Development Chair.

Genetic Test Helps Doctors Treat Psoriasis Before Painful, Irreversible Joint Damage

The first genetic test for Psoriatic Arthritis (PsA) is now available from PsoriasisDX, LLC, a subsidiary of molecular dermatology research and development innovator PharmaGenoma, Inc. PsA is a progressive irreversible joint disease associated with psoriasis. It is estimated that 20 percent to 40 percent of psoriasis patients will eventually develop PsA.

"The PsoriasisDX Genetic Test helps identify those at high risk for developing PsA before they experience arthritic symptoms, providing the opportunity to lessen joint damage through early medical intervention," says Andy Goren, CEO of PharmaGenoma, Inc.

According to University of California, San Francisco (UCSF) psoriasis expert Dr. John Koo, "Until now, doctors have screened patients after the onset of the inflammatory arthritis. FDA approved medications for the treatment of PsA are most effective at controlling inflammation and arresting joint destruction, but are ineffective at reversing joint damage."

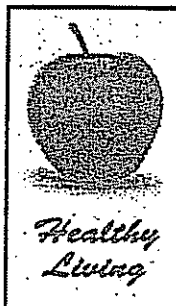
The PsoriasisDX Genetic Test kit (\$399) is available through qualified doctors. A genetic sample is collected using a cheek swab, and the sample is mailed for

analysis to the PsoriasisDX laboratory. Testing is performed at a CLIA-certified laboratory. Once the genetic analysis is complete, test results will be reported to the doctor.

"Dramatic advances in science mean that genetic tests hold the promise of identifying those at highest risk for developing psoriatic arthritis," says UCSF pharmacogenomics expert Wilson Liao, M.D.

In particular, an immune response gene variant called MICA-A9 is found in approximately 60 percent of patients who develop PsA. The MICA-A9 association was replicated by four peer-reviewed and published studies involving over 900 patients from multiple ethnic populations.

Positive tests for the MICA-A9 variant result in an approximately 60 percent chance of developing PsA, while negative tests for the MICA-A9 variant result in an approximately 70 percent chance of not developing PsA according to Nathan Vandergrift, Ph.D., assistant professor of medicine and biostatistics at Duke University, and Professor Doron Lancet, PhD, Head of the Crown Human Genome Center at the Department of Molecular Genetics, Weizmann Institute of Science.



To see or not to see

STAFF REPORT

How do the visual images we experience, which have no tangible existence, arise out of physical processes in the brain? New research at the Weizmann Institute of Science provides evidence, for the first time, that an "ignition" of intense neural activity underlies the experience of seeing.

In research recently published in the journal *Neuron*, Prof. Rafael Malach and research student Lior Fisch of the Weizmann Institute's Department of Neurobiology worked with a neurosurgeon, Dr. Itzhak Fried of Tel Aviv Sourasky Medical Center, a distinguished team of medical doctors from the Center, and Weizmann Institute students. They asked a group of epileptic patients who had had electrodes clinically implanted into their brains in preparation for surgery to volunteer for some perceptual awareness tasks. The subjects looked at a computer screen, which briefly presented a "target" image — a face, house, or man-made object. This image was followed by a "mask" — a meaningless picture for

distraction — at different time intervals after the target image had been presented. This allowed the experimenter to control the visibility of the images — the patients sometimes recognized the targets and sometimes failed to do so. By comparing the electrode recordings to the patients' reports of whether they had correctly recognized the image or not, the scientists were able to pinpoint what was happening — and when and where — in the brain as transitions in perceptual awareness took place.

Says Malach, "We found that there was a rapid burst of neural activity occurring in the higher-order visual centers of the brain — centers that are sensitive to entire images of objects, such as faces — whenever patients had correctly recognized the target image." The scientists also found that the transition from not seeing to seeing happens abruptly. According to Fisch, "When the mask was presented too soon after the target image, it 'killed' the visual input signals, resulting in the patients being unable to recognize the

object. The patients suddenly became consciously aware of the target image at a clear threshold, suggesting that the brain needs a specific amount of time to process the input signals in order for conscious perceptual awareness to be ignited."

This study is the first of its kind to uncover strong evidence linking ignition of bursts of neural activity to perceptual awareness in humans. More questions remain: Is this the sole mechanism involved in the transition to perceptual awareness? To what extent is it a local phenomenon? By answering such questions, scientists might begin bridging the mysterious gap between the mind and the brain.

Malach's research is supported by the Nella and Leon Benoziyo Center for Neurological Diseases; the Carl and Micaela Einhorn-Dominic Brain Research Institute; the S. and J. Lurie Memorial Foundation; the Benjamin and Seema Pulier Charitable Foundation, Inc; Vera Benedek, Israel; and Mary Helen Rowen, New York, NY. Prof. Malach is the incumbent of the Barbara and Morris Levinson Professorial Chair in Brain Research.

Cooling world forests

Trees' "energy budget" includes heat reserves.

The simple formula we've learned in recent years – forests remove the greenhouse gas CO₂ from the atmosphere, therefore, forests prevent global warming – may not be quite as simple as we thought. Forests can also directly absorb and retain heat and, in at least one type of forest, these effects may be strong enough to cancel out a good part of the benefit in lowered CO₂. This is a conclusion of a paper that was published last month in *Science*, by scientists in the Weizmann Institute's faculty of chemistry.

For the past 10 years, the Weizmann Institute has been operating a research station in the semi-arid Yatir Forest, a pine forest at the edge of the Negev Desert. This station is part of a worldwide project composed of more than 400 stations, called FLUXNET, which investigates the relationship between forests, the atmosphere and climate around the globe. The contribution of the Yatir station, said Prof. Dan Yakir of the environmental sciences and energy research department, is unique as it "is one of very few in the semi-arid zone, which covers over 17 percent of the Earth's land surface, and it has the longest record of the processes taking place in semi-arid forests."

Forests counteract the greenhouse effect by removing heat-trapping CO₂ from the atmosphere and storing it in living trees. Over years of measurement, Yakir has found that the semi-arid forest, even though it's not as luxuriant as temperate forests farther north, is a surprisingly good carbon sink – better than most European pine forests and about on par with the global average. This was unexpected news for a forest sitting at the edge of a desert, indicating that there is hope for the more temperate forests if things heat up under future global change scenarios.

But forests do more than just store CO₂, and Yakir, together with Dr. Eyal Rotenberg, decided to look at the larger picture – the "total energy budget" of a semi-arid forest. The first hint that other processes might be counteracting the cooling effect of CO₂ uptake came when they compared the forest's albedo – how much sunlight is reflected from its surface back into space – with that of the nearby open shrub land.

They found that the dark-colored forest canopy had a lower albedo, absorbing more of the sun's energy than the pale, reflective surface of surrounding areas. In a cloudless environment with high levels of solar radiation, albedo becomes an important factor in surface heating.

Next, the researchers looked at the mechanisms for "air conditioning" within the forest itself. To cool down, trees in wetter areas of the globe use water-cooled systems: they open pores in their leaves and simply let some of the water evaporate, drawing heat away in the process. But the semi-arid pine forest, with its limited water supply, is not built for evaporation. The scientists found that it uses an alternative, efficient air-cooling system instead. As semi-arid forests are not as dense as their temperate counterparts, the air in the open spaces between the trees comes into contact with a large surface area and heat can be easily transferred from the leaves to the air currents. This semi-arid air cooling system is quite efficient at cooling the treetops and this cooling, in turn, leads to a reduction in infrared (thermal) radiation out into space. In other words, while the semi-arid forest can cool itself well enough to survive and take up carbon, it both absorbs more solar radiation energy (through the albedo effect) and retains more of this energy (by suppressing the emission of infrared radiation).

"Although the numbers vary with location and conditions," said Yakir, "we now know it will take decades of forest growth before the 'cooling' CO₂ sequestration can overtake these opposing 'warming' processes."

Yakir and Rotenberg then asked: if planting semi-arid forests can, in

Jewish Independent (Vancouver, BC)

Date **19.02.2010**

Circ.

2,350

Page

fact, lead to warming over a good part of their lifecycles, what happens when the opposite process – desertification – takes place? By applying what they had learned to existing data on areas that have turned to desert, they found that desertification, instead of hastening global warming, as is commonly thought, has actually mitigated it, at least in the short term.

By reflecting sunlight and releasing infrared radiation, desertification of semi-arid lands over the past 35 years has slowed down global warming by as much as 20 percent, compared with the expected effect of the CO₂ rise over the same period. And in a world in which desertification is continuing at a rate of about six million hectares a year, that news might have a significant effect on estimating the rates and magnitude of climate change.

“Overall,” Yakir concluded, “forests remain hugely important climate stabilizers (not to mention the other ecological services they provide), but there are tradeoffs, such as those between carbon sequestration and surface radiation budgets, and we need to take these into consideration when predicting the future.” ■

– *Courtesy of the Weizmann Institute*

Who knew stars came this big?

A SUPERNOVA that burst onto the cosmic scene in April 2007 was probably the death throes of the most massive star yet discovered.

So say Avishay Gal-Yam of the Weizmann Institute of Science in Rehovot, Israel, and his colleagues, who followed the afterglow of the explosion in a nearby dwarf galaxy over 18 months (*Nature*, DOI: 10.1038/nature08579).

Their observations point to the explosion of a hypergiant star with a mass 200 times that of the sun. That would blow apart the idea that stars bigger than about 150 solar masses do not exist in our mature universe.

Gal-Yam thinks the conditions in the host galaxy could be like those in the early universe, when theory says such giant stars were born and died in great numbers, seeding the universe with heavy elements. "These galaxies could be fossil labs to teach us about the first stars," he says.

5 December 2009 | NewScientist | 17

	IMAJ	24/02/2010
גן המדע ברחובות בסכנו ויצמן		

Capsule

Treating trauma with smell therapy

The aroma of grandma's freshly baked cookies etches itself into the brain's emotional memory, but so does a whiff of rotten fish. This finding by Israeli scientists could help in treating trauma patients. Unpleasant smells have the strongest first impact – likely an evolutionary defense mechanism – but early pleasant scents also make an imprint on the brain. Published in *Current Biology*, Dr. Yeshurun of the Weizmann Institute of Science stated: "This 'etching' of initial odor memories in the brain was equal for good and bad smells, yet was unique to odor." To test smell-related memories, the researchers presented a group of volunteers with a set of objects and then associated each with a smell and a sound. Some of the smells and sounds were pleasant,

such as a pear or a guitar, and others were unpleasant, such as a dead fish or the screech of a power drill. A week later, they asked the volunteers to recall the objects and found that people tended to remember the unpleasant associations best, whether they were smells or sounds. Next, they did similar experiments while people's brains were being scanned using functional magnetic resonance imaging. They noticed that a part of the hippocampus and amygdala lit up when smells were first associated with a new object, but not sounds. Although much more study is needed, the findings could lead to better ways to help improve memories, or even offer better ways to help erase early traumatic memories.

Israel High-Tech & Investment Report, December 2009

Early scents etched in the brain

Common experience tells us that particular scents of childhood can leave quite an impression, for better or for worse. Now, researchers reporting the results of a brain imaging study show that first scents really do enjoy a "privileged" status in the brain.

"We found that the first pairing or association between an object and a smell had a distinct signature in the brain," even in adults, said Yaara Yeshurun of the Weizmann Institute of Science in Israel. "This 'etching' of initial odor memories in the brain was equal for good and bad smells, yet was unique to odor." Sounds did not have the same effect, the research showed.

In the study, the researchers presented adults with a visual object together with one, and later with a second, set of pleasant and unpleasant odors and sounds while their brains were imaged by functional magnetic resonance imaging (fMRI). A week later, the researchers presented the same objects inside the fMRI and tested participants' associations of those images with the scents and smells.

**A brain
imaging study
shows that
first scents
really do enjoy
a "privileged"
status in the
brain.**

The researchers found that people remembered early associations more clearly when they were unpleasant, regardless of whether they were smelled or heard. The images, however, revealed a unique activation in particular brain regions in the case of their first olfactory (but not auditory) associations. That signature held regardless of whether the odors or sounds were pleasant or unpleasant. The researchers even found that they could predict what a person would remember later based on the activity in their brains on day 1.

Yeshurun explained that it makes good sense to remember unpleasant memories as a kind of evolutionary "risk management." But the findings show that there is also something particularly special about early memories of smells. That wasn't really unexpected, Yeshurun said—it is after all a phenomenon that has long fascinated authors, poets, and scientists alike. Still, the results did hold some surprises.

"We expected a unique representation of initial or 'first' olfactory associations but did not expect that it would materialize even in cases where the

behavioral evidence did not indicate a stronger memory," Yeshurun said. "In our paradigm, initial and later olfactory associations were remembered equally well, but only first associations had the unique brain representation."

In terms of understanding the brain, the findings suggest that activity in two brain regions, known as the hippocampus and amygdala, together can render a memory "special." Although any application of the findings would be far off, Yeshurun said the results could suggest ways to strengthen particular memories. "Perhaps more importantly, it may help us generate methods to better forget early and powerful memories, such as trauma," she said.

—*Weizmann Institute of Science*

Weizmann Institute Reveals How Smells are Bound Up in our Memories

By Genvieve Shuler

REHOVOT, ISRAEL — From Proust's madeleines to the overbearing food critic in the movie *Ratatouille* who is transported back to his childhood at the aroma of stew, artists have long been aware that some odors can spontaneously evoke strong memories. Scientists at the Weizmann Institute of Science have now revealed the scientific basis of this connection. Their research appears in the latest issue of *Current Biology*.

Graduate student Yaara Yeshurun, together with Profs. Noam Sobel and Yadin Dudai of the Institute's Department of Neurobiology, thought that the key might not necessarily lie in childhood, but rather in the first time a smell is encountered in the context of a particular object or event. In other words, the initial association of a smell with an experience will somehow leave a unique and lasting impression in the brain.

To test this idea, the scientists devised an experiment: First, in a special smell laboratory, subjects viewed images of 60 objects, each presented simultaneously with either a pleasant or an unpleasant odor generated in a machine called an olfactometer. Next, the subjects were put in a functional magnetic resonance imaging (fMRI) scanner to measure their brain activity as they reviewed the images they'd seen and attempted

to remember which odor was associated with each. Then, the whole test was repeated — images, odors, and fMRI — with the same images, but different odors accompanying each. Finally, the subjects came back one week later, to be scanned in the fMRI again. They viewed the objects one more time and were asked to recall the odors they associated with them.

The scientists found that after one week, even if the subject recalled both odors equally, the first association revealed a distinctive pattern of brain activity. The effect was seen whether the smell was pleasant or unpleasant. This unique representation showed up in the hippocampus, a brain structure involved in memory, and in the amygdala, a brain structure involved in emotion. The pattern was so profound, it enabled the scientists to predict which associations would be remembered just by looking at the brain activity within these regions following the initial exposure. The scientists could look at the fMRI data on the first day of the experiment and predict which associations would come up a week later. To see if other sensory experiences might share this tendency, the scientists repeated the entire experiment using sounds rather than smells; they found that sounds did not arouse a similar distinctive first-time pattern of activity. In other words, these results were specific

to the sense of smell. "For some reason, the first association with smell gets etched into memory," says Prof. Sobel, "and this phenomenon allowed us to predict what would be remembered one week later based on brain activity alone."

Adds Ms. Yeshurun: "As far as we know, this phenomenon is unique to smell. Childhood olfactory memories may be special not because childhood is special, but simply because those years may be the first time we associate something with an odor."

Prof. Noam Sobel's research is supported by the Nella and Leon Benoziyo Center for Neurosciences; the J&R Foundation; the Eisenberg-Keefer Fund for New Scientists; and Regina Wächter, New York, NY.

The Weizmann Institute of Science in Rehovot, Israel, is one of the world's top-ranking multidisciplinary research institutions. Noted for its wide-ranging exploration of the natural and exact sciences, the Institute is home to 2,600 scientists, students, technicians, and supporting staff. Institute research efforts include the search for new ways of fighting disease and hunger, examining leading questions in mathematics and computer science, probing the physics of matter and the universe, creating novel materials, and developing new strategies for protecting the environment.

DAY DRUMBEATS

WATER MAGIC

Forget what you've been told about water freezing at 32 degrees Fahrenheit.

Researcher Igor Lubomirsky and his colleagues at the Weizmann Institute of Science in Israel have been doing some whacky stuff: like freezing solid water while it's heating up.

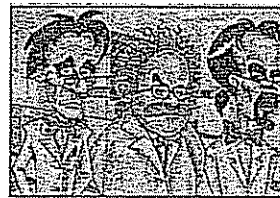
The scientists have discovered a new way to control the freezing point of water by using something called quasi-amorphous pyroelectric thin films. These surfaces change their electrical charge depending on their temperature.

When pyroelectric surfaces are positively charged, water is easier to freeze, and when they have a negative charge, it's harder to freeze.

Cool stuff. Check it out at LiveScience.com.

Source: Asian Age {Main}
 Edition:
 Country: UK
 Date: Monday 15, February 2010
 Page: 8
 Area: 58 sq. cm
 Circulation: 20000 Daily
 BRAD info: page rate £3,050.00, scc rate £0.00
 Phone: 020 3006 9000
 Keyword: Weizmann Institute of Science

Scientists freeze water with heat



IN WHAT is a bizarre trick, scientists have come up with a way that can make water freeze solid as it's heating up. Popular belief contends that water freezes at 32 degrees Fahrenheit (0 degrees Celsius). Now, according to a report in *Live Science*, researcher Igor Lubomirsky at the Weizmann Institute of Science in Rehovot, Israel, and his colleagues have discovered another way to control the freezing point of water — via what are called quasi-amorphous pyroelectric thin films.

These surfaces change their electrical charge depending on their temperature. When pyroelectric surfaces are positively charged, water becomes easier to freeze, and when they have a negative charge, it becomes harder to freeze.

The researchers saw that supercooled water could freeze as it's being heated, as long as the temperature changes the surface charge as well.

—ANI

Date 12.11.2009

Circ. 100750

Weizmann Institute has banner year with much to celebrate

Denise Rootenberg
Correspondent

TORONTO — Nov. 1, 2009 was the date for multiple celebrations as the illustrious Weizmann Institute of Science in Israel commemorated its 60th year, Weizmann Science Canada its 45th anniversary and Weizmann Women & Science its 20th.

A few days before, Hannah Angel-Kaman turned one, an event Toronto residents Howard and Roslyn Kaman despaired of ever attaining as they struggled with fertility problems for nine years before learning of a technique discovered as a byproduct of research undertaken by Weizmann professor Nava Dekel.

As well, Weizmann Women & Science supporters were elated that their 2008 guest speaker, Prof. Ada Yonath of Weizmann's structural biology department, was a joint winner of the 2009 Nobel Prize in Chemistry. Prof. Yonath, who persevered through 25,000 attempts to create ribosome crystals to study cellular protein manufacture, was the first Israeli woman and the first female since 1964 to receive the honour.

Ron Naaman, a professor in the department of chemical physics at Weizmann and former post-doctoral fellow at Stanford University and lecturer at Harvard, was the guest speaker. He explained his research so simply and compellingly that the audience was spellbound. His team combines biology and electronics by placing molecules on transistors to build minute, cost-effective devices called nano-sensors.

The terrorists who plotted to blow up airplanes in mid-air in 2006 planned to combine acetone, hydrogen peroxide (a component of hair bleach) and an acid to form triacetone triperoxide, or TATP, a colourless explosive undetectable by sniffer dogs. Weizmann has developed a tiny sensor that can be placed in airplane washrooms, much like a smoke detector, and determine whether they contain TATP or other liquids.

Currently, asthma is difficult to diagnose in babies and young children as patient collaboration is required. In the future, testing exhaled air with nano-sensors could overcome this problem, as well as being used to detect bacteria and sugar in breath. An additional commercial application is quality control whereby wavelengths emanated by the devices can penetrate packaged food and drugs.

Embodying the bright future of Weizmann and its 'Looking Forward' slogan, award-winning student Shawn Bramson of Montreal spoke passionately about the past summer spent at the institute and its desert field school as "the coolest and best" of his life.

Weizmann's stellar achievements for the benefit of humanity continue to provide a vital tool to combat the increasing hostility shown towards Israel.

Then there was the icing on the cake.

In a press release last week, *The Scientist* magazine announced its top 10 best places to work in academia outside of the US. The Weizmann Institute placed second to the Max Planck Institute of Molecular Cell Biology and Genetics in Dresden, Germany.

Canada also had reason to be proud as Dalhousie University placed fifth and the University of Toronto placed 10th.

Study finds smells etched in brain

*Bad odors found
to leave bigger mark;
findings could aid
trauma patients*

REUTERS

CHICAGO — The aroma of Grandmother's fresh-baked cookies etch themselves into the brain's emotional memory, but so does a whiff of rotten fish, Israeli scientists said in a finding that might help in treating trauma patients.

They said bad smells make the biggest first impression — which is likely an evolutionary defense mechanism — but early pleasant scents also make an imprint on the brain.

"We found that the first pairing or association between an object and a smell had a distinct signature in the brain," even in adults, Yaara Yeshurun of the Weizmann Institute

of Science in Israel, whose study appears in the journal Current Biology, said in a statement.

"This 'etching' of initial odor memories in the brain was equal for good and bad smells, yet was unique to odor."

To test smell-related memories, the researchers presented a group of volunteers with a set of objects and associated each with a smell and a sound.

Some of the smells and sounds were pleasant, such as a pear or a guitar, and others were unpleasant, such as a dead fish or the screech of a power drill.

A week later, they asked people to recall the objects and found people tended to remember the unpleasant associations best, whether they were smells or sounds.

Next, they did similar experiments while people's brains were being scanned using functional magnetic resonance imaging, or fMRI.

In these experiments, they noticed that a part of the hippocampus and amygdala lit up when smells were first associated with a new object, but not sounds.

Much more study is needed, but they said the findings could lead to better ways to help improve memories, or even offer better ways to help erase early, traumatic memories.

Scientist uses research to detect explosives

By CAROLYN BLACKMAN
Staff Reporter

Thanks to Ron Naaman, your next flight to Israel will be a little more secure.

That's because Naaman, a professor in the department of chemical physics at the Weizmann Institute of Science, has developed ways to help airport security in the Jewish state detect liquids that can be used as explosives.

He says his work centres on the "intersection of biology and electronics."

"All living things are composed of chains or structures of molecules, and what we see in their interactions, we use to build electronic devices,

specifically nano-sensors," he told last week's Weizmann Canada national annual meeting.

Naaman, who did post-doctoral research at Stanford and Harvard universities before joining Weizmann, has applied his work to such things as diagnosing asthma by measuring the content of exhaled breath and to detecting contaminated contents in pharmaceutical capsules and sealed food.

But the Israeli government has used it to detect homemade explosives in airports.

"[People can easily] buy two solutions in a pharmacy that [when put together] become a powerful explosive that cannot be detected by animals," Naaman said. "That is why we cannot take liquids on a plane."

Since 9/11, it's become a major issue to determine how to detect these explosives, he said, and Naaman and his colleagues have developed a way to differentiate between dangerous and safe compounds. "It is important to have sensitivity and selection, because we do not want to close up the airports for nothing."

In his welcoming remarks, Jay Alan Smith, chairman of the board of Weizmann Canada, said that to mark the 45th year of the Canadian society and the 60th year of the Weizmann Institute, Weizmann Canada has rebranded and updated its image in a project supported by the Silver Tree Foundation.

Scientist uses research to detect explosives

By CAROLYN BLACKMAN
Staff Reporter

Thanks to Ron Naaman, your next flight to Israel will be a little more secure:

That's because Naaman, a professor in the department of chemical physics at the Weizmann Institute of Science, has developed ways to help airport security in the Jewish state detect liquids that can be used as explosives.

He says his work centres on the "intersection of biology and electronics."

"All living things are composed of chains or structures of molecules, and what we see in their interactions, we use to build electronic devices,

specifically nano-sensors," he told last week's Weizmann Canada national annual meeting.

Naaman, who did post-doctoral research at Stanford and Harvard universities before joining Weizmann, has applied his work to such things as diagnosing asthma by measuring the content of exhaled breath and to detecting contaminated contents in pharmaceutical capsules and sealed food.

But the Israeli government has used it to detect homemade explosives in airports.

"[People can easily] buy two solutions in a pharmacy that [when put together] become a powerful explosive that cannot be detected by animals," Naaman said. "That is why we

cannot take liquids on a plane."

Since 9/11, it's become a major issue to determine how to detect these explosives, he said, and Naaman and his colleagues have developed a way to differentiate between dangerous and safe compounds. "It is important to have sensitivity and selection, because we do not want to close up the airports for nothing."

In his welcoming remarks, Jay Alan Smith, chairman of the board of Weizmann Canada, said that to mark the 45th year of the Canadian society and the 60th year of the Weizmann Institute, Weizmann Canada has rebranded and updated its image in a project supported by the Silver Tree Foundation.

Israeli scientist develops asthma sensor

Compiled by CJN Staff

An innovative marriage of electronics and biology is making possible the development of sensors for such diverse applications as detecting asthma and explosives.

Ron Naaman, a professor of chemical physics at the Weizmann Institute of Science in Israel, recently told a Montreal audience recently that nano-technology has vastly broadened understanding of molecules and how they interact with transistors.

Molecules, using different kinds in combination, can be "trained" to recognize substances in their environment by running a current through them.

The sensor that has been developed in Naaman's lab picks up on the increased nitrous oxide that is produced by the body and released into the blood to expand the vessels when a person has an infection.

The asthma sensor will be useful in detecting the disease in babies who cannot undergo tests like older children, he said.

The sensor is no bigger than a small coin, Naaman added, and simply must be placed in front of the infant.

Another sensor he is working on with his team sniffs out TATP, an explosive that is made from easily obtained acetone and hydrogen peroxide, and is

favoured by terrorists because they can be mixed, for example, in the toilet of an airplane.

"TATP cannot be detected by dogs, and currently there is no commercial detector," Naaman said.

His sensor has been refined so that it can distinguish TATP from acetone alone, which is found in many people's luggage in the form of nail-polish remover.

Other sensors being worked on may be able to detect bacteria, such as listeriosis, in food and to see through soft materials like clothes, which could have a security use.

"We want to build the 'ultimate sensor' that can detect thousands of molecules and distinguish between them," Naaman said, which could lead to applications as diverse as health, air and water quality, security and food and drug safety.

Naaman spoke to Weizmann Canada's new business and professional division, as well as took part in a talk-show style discussion for the public, hosted by Global TV anchor and reporter Paola Samuel.

The other guests were Govindanunny Thekkadath, senior technology adviser at the Canadian Air Transport Security Authority, Dr. Ron Olivenstein, director of the Montreal Chest Institute's asthma clinic, and Danielle Medina, president of Foods with a Conscience.



Israeli scientist Ron Naaman



Scientists from Israel's top biomedical research institutions and Scripps Florida met recently in Jupiter. Front row, left to right, John L. Cleveland of Scripps Florida and Israeli scientists Yosef Yarden, Ronit Satchi-Fainaro, Bat Sheva Kerem and Miri Ziv of Israel Cancer Association in Israel. Back row, left to right, Israeli researchers Shai Izraeli and Doron Ginsberg. Submitted photo

08/02/2010	אספון 08/02/2010
מכון ויצמן	מכון ויצמן

business class nanotechnology

ApNano's Nano Armor is four or five times stronger than steel and proven to be the strongest in the world.

◁ There is no doubt that Israel is at the center of innovative technological developments, and Israeli innovations are ubiquitous in popular products, from cellular phones to computers to the internet. However, Israel's technological innovations have not yet spurred the local industry to take firm root. ApNano Materials develops and manufactures revolutionary nanotechnology products here in Israel, and considering President Peres' statement that nanotechnology is "destined to change the world," it seems that ApNano Materials is on its way to becoming a leading, multi-billion dollar international company, developing a variety of internationally distributed products. ▷

Calling card

ApNano Materials

Established: 2002

Founders and Directors: Mr. Aharon Feuerstein and Dr. Menachem Genut

Status: private company.

Share holders: Venture Capital Newton Technology Ventures; Yeda Research and Development Co. - the commercial branch of Weizmann Institute, AYYT - the commercial branch of the Holon Academic Technologic Institute, the founders and private European investors.

Products: NanoLub - the world's first commercial lubricant based on nanotechnology.

NanoArmor - a line of anti-ballistic products that shield against explosions, ricochet, and special light absorbing coatings.

Website: www.apnano.com

Israeli, Scripps Florida scientists share drive to cure cancer

By DAVID A. SCHWARTZ
STAFF WRITER

Five scientists from Israel's top biomedical research and treatment institutions visited Scripps Florida in Jupiter last week to participate in a symposium as part of a collaboration to develop new cancer drugs.

"What we share with the Scripps Institute is the drive to cure cancer," said Yosef Yarden, spokesman for the Israeli scientists at a press conference during the symposium last Wednesday and a scientist at the Weizmann Institute in Rehovot.

The scientists hope to ultimately engage in joint research projects funded by the National Institutes of Health, said John L. Cleveland, chairman of Scripps Florida's department of cancer biology.

Cleveland called the symposium "a big infomercial of what we have here and we can apply to different research centers."

Scientists at Scripps Florida's Department of Cancer Biology have special interest in breast, lung, ovarian and prostate can-

cer and in multiple myeloma, leukemia, lymphoma and melanoma, according to the Scripps Florida website.

Researchers at Scripps and the Israeli institutions want to discover new strategies for treating relapsing cancers or tumors that don't respond to conventional therapy, Cleveland said.

Yarden said leukemia and cancers of the lung, kidney, prostate and breast are of particular interest to the Israeli researchers. He spoke briefly about the work of the five scientists.

Ronit Satchi-Fainaro, of Tel Aviv University, is developing "nano particles" that cut off the blood supply to tumors, Yarden said.

Dr. Shai Izraeli, a clinician and researcher at Tel Aviv University's Sackler School of Medicine and Sheba Medical Center, was studying leukemia in children with Down's syndrome when he discovered a new process to treat leukemia in children and adults.

Doron Ginsberg, of Bar-Ilan University, is studying

the process of programmed cell death and ways to harness the process.

Bat Sheva Kerem, a geneticist at Hebrew University of Jerusalem, is looking at chromosomes typically found in cancers. "Her treatment might lead to defined diagnosis and treatment of cancer," Yarden said.

Yarden said he is working on combining two antibodies to create "therapeutic antibodies" that help a person overcome resistance to certain cancer therapies.

The Israeli scientists came to Scripps through the efforts of the nonprofit Israel Cancer Association USA in West Palm Beach. The organization raises funds for fellowships in cancer research at 38 universities, hospitals and institutions in Israel.

Cleveland said he thinks the collaborative relationship is the first at Scripps.

Symposiums every other year will alternate between Florida and Israel, Cleveland said. The next symposium will be in Israel in 2012.

Scientists identify 'smoking gun' of stress-related diseases

Changes in the activity of a single gene in the brain can lead to metabolic changes that cause mice to develop symptoms associated with type 2 diabetes, as well as trigger anxious behavior.

These findings, discovered by Weizmann Institute of Science researchers, were published online this week in the *Proceedings of the National Academy of Sciences*.

The constant stress many are exposed to in our modern society may thus be taking a heavy toll: Anxiety disorders and depression, as well as metabolic disorders such as obesity, type 2 diabetes and arteriosclerosis, have all been linked to stress.

These problems are reaching epidemic proportions. Type 2 diabetes alone is expected to affect some 360 million people around the world in 20 years.

The connection between stress, changes in appetite and anxiety-related behavior was recently proven scientifically, but the exact reasons for this were not clear until Dr. Alon Chen of the Rehovot institute's neurobiology department and colleagues made their gene discovery.

They found that all the body's systems are involved in the stress response, which

evolved to deal with threats and danger. Behavioral changes tied to stress include heightened anxiety and concentration, while other changes in the body include heat-generation, changes in the metabolism of various substances and even changes in food preferences.

The Weizmann team suspected that a protein known as Urocortin-3 (Ucn3) was involved in tying all of these together. Produced in certain brain cells – especially in times of stress – it is known to play a role in regulating the body's stress response.

These nerve cells have extensions that act as "highways" to speed Ucn3 on to two other sites in the brain: One, in the hypothalamus – the brain's center for hormonal regulation of basic bodily functions – oversees, among other things, substance exchange and feelings of hunger and satiety; the other is involved in regulating behavior, including anxiety levels.

Nerve cells in both these areas have special receptors for Ucn3 on their surfaces, and the protein binds to these receptors to initiate the stress response.

The researchers developed a new, finely tuned method for influencing the activity

of a single gene in one area in the brain, using it to increase the amounts of Ucn3 produced in just that location.

They found that heightened levels of the protein produced two different effects: The mice's anxiety-related behavior increased, and their bodies also underwent metabolic changes. With excess Ucn3, their bodies burned more sugar and fewer fatty acids, and their metabolic rate sped up.

These mice began to show signs of the first stages of type 2 diabetes: A drop in muscle sensitivity to insulin delayed sugar uptake by the cells, resulting in raised sugar levels in the blood. The pancreas then produced extra insulin to make up for the perceived "deficit."

"We showed that the actions of a single gene in just one part of the brain can have profound effects on the metabolism of the whole body," says Chen.

This mechanism, which appears to be a "smoking gun" tying stress levels to metabolic disease, might, in the future, point the way toward the treatment or prevention of a number of stress-related diseases.

– Judy Siegel

Weizmann scientists developed an electronic 'nose' that can predict the pleasantness of novel odors
These findings have implications for automated environmental toxicity monitoring and transmitting scent digitally

19.04.2010 - Weizmann Institute scientists have 'trained' an electronic system to be able to predict the pleasantness of novel odors, just like a human would perceive them – turning the popular notion that smell is completely personal and culture-specific on its head. In research published in PLoS Computational Biology, the scientists argue that the perception of an odor's pleasantness is innately hard-wired to its molecular structure, and it is only within specific contexts that personal or cultural differences are made apparent.

These findings have important implications for automated environmental toxicity and malodor monitoring, fast odor screening in the perfume industry, and provide a critical building block for the Holy Grail of sense technology – transmitting scent digitally.

Over the last decade, electronic devices, commonly known as electronic noses or 'eNoses,' have been developed to be able to detect and recognize odors. The main component of an eNose is an array of chemical sensors. As an odor passes through the eNose, its molecular features stimulate the sensors in such a way as to produce a unique electrical pattern – an 'odor fingerprint' – that characterizes that specific odor. Like a sniffer dog, an eNose first needs to be trained with odor samples so as to build a database of reference. Then the instrument can recognize new samples of those odors by comparing the odor's fingerprint to those contained in its database.

But unlike humans, if eNoses are presented with a novel odor whose fingerprint has not already been recorded in their database, they are unable to classify or recognize it.

So a team of Weizmann scientists, led by Dr. Rafi Haddad, then a graduate student of Prof. Noam Sobel of the Neurobiology Department and co-supervisor Prof. David Harel of the Computer Science and Applied Mathematics Department, together with their colleague Abebe Medhanie of the Neurobiology Department, and Dr. Yehudah Roth of the Edith Wolfson Medical Center, Holon, decided to approach this issue from a different perspective. Rather than train an eNose to recognize a particular odor, they trained it to estimate the odor along a particular perceptual axis. The axis they chose was odorant pleasantness. In other words, they trained their eNose to predict whether an odor would be perceived as pleasant or unpleasant, or anywhere in between.

To achieve this, the scientists first asked a group of native Israelis to rate the pleasantness of a selection of odors according to a 30-point scale ranging from 'very pleasant' to 'very unpleasant.' From this dataset, they developed an 'odor pleasantness' algorithm, which they then programmed into the eNose. The scientists then got the eNose to predict the pleasantness of a completely new set of odors not contained in their database against the ratings provided by a completely different group of native Israelis. The scientists found that the eNose was able to generalize and rate the pleasantness of novel odors it never smelled before, and these ratings were about 80% similar to those of naive human raters who had not participated in the eNose training phase. Moreover, if the odors were simply categorized as either 'pleasant' or 'unpleasant,' as opposed to being rated on a scale, it achieved an accuracy of 99%.

But these findings still don't determine whether olfactory perception is culture-specific or not. With this in mind, the scientists decided to test eNose predictions against a group of recent immigrants to Israel from Ethiopia. The results showed that the eNose's ability to predict the pleasantness of novel odors against the native Ethiopians' ratings was just as good, even though it was 'tuned' to the pleasantness of odors as perceived by native Israelis. In other words, even though different odors have different meanings across cultures, the eNose performed equally well across these populations. This suggests a fundamental cross-cultural similarity in odorant pleasantness.

Sobel: 'Being able to predict whether a person who we never tested before would like a specific odorant, no matter their cultural background, provides evidence that odor pleasantness is a fundamental biological property, and that certain aspects of molecular structure are what determine whether an odor is pleasant or not.' So how are cultural differences accounted for? 'We believe that culture influences the perception of olfactory pleasantness mostly in particular contexts. To stress this point, many may wonder how the French can like the smell of their cheese, when most find the smell quite repulsive. We believe that it is not that the French think the smell is pleasant per se, they merely think it is a sign of good cheese. However, if the smell was presented out of context in a jar, then the French would probably rate the odor just as unpleasant as anyone else would.'

The scientists' findings that odor perception is hard-wired to molecular structure and their design of an eNose that is able to classify new odors could provide new methods for odor screening and environmental monitoring, and may, in the future, allow for the digital transmission of smell to scent-enable movies, games and music to provide a more immersive and captivating experience.

Israel's top cancer researchers in Jupiter

BY JEFF OSTROWSKI
Palm Beach Post

JUPITER — Five of Israel's top cancer researchers are visiting Scripps Florida this week, a first step in a joint effort that might bring more grant money to Scripps Florida and perhaps even speed the discovery of cures for cancer.

Scientists from Israel and from Scripps Florida on Wednesday participated in a cancer symposium in Jupiter. The event gave Scripps a chance to show off a campus that cost state and county taxpayers \$579 million.

"This is like a big commercial about what we have here," said John Cleveland of Scripps' Department of

Cancer Biology.

The Israeli researchers seemed suitably impressed. One key attraction: Scripps' \$10 million robot, which offers "ultra high-throughput screening."

That sort of technology isn't available at Israel's academic institutes, said Yosef Yarden, a researcher at The Weizmann Institute.

"It is the first time I've seen such a facility under an academic roof," Yarden said.

Scripps Florida wants to share its equipment with the Israeli researchers, and it hopes to collaborate on the Israelis' research and apply jointly for grants from the National Institutes of Health. The NIH is the major backer of can-

cer research in the United States.

"The team approach to science is being pushed at the national level," Cleveland said.

Wednesday's event was organized by Israel Cancer Association USA, the West Palm Beach-based arm of Israel's equivalent of the American Cancer Society.

It was the first formal gathering of cancer researchers from Scripps and Israel, but it probably won't be the last. The Scripps scientists already plan a trip to Israel in 2012.

"This will be a productive collaboration," Cleveland said. "We're going to push this and make it happen."

ments as well as a host of other substances in the tomato.

How tendons shape bones

Bones, muscles, and tendons work together to provide the perfect balance between stability and movement in the skeleton.

Now, Weizmann Institute scientists have shown that this partnership begins in the embryo, when the bones are still taking shape.

Their study, published in a recent issue of *Developmental Cell*, describes a previously unrecognized interaction between tendons and bones that drives the development of a strong skeletal system.

"Our skeleton, with its bones, joints, and muscle connections, serves us so well in our daily lives. Please see *SCIENCE* on Page 18

that we hardly pay attention to this extraordinary system," says Dr. Elazar Zelzer of the Weizmann Institute's dept. of molecular genetics.

"Although previous research has uncovered mechanisms that contribute to the development and growth of each component of this complex and wonderfully-adaptable organ system, specific interactions between bones, muscles, and tendons that drive the assembly of the musculoskeletal system are not fully understood."

Zelzer, research student Einat Blitz, Sergey Vjukov and colleagues, were interested in uncovering the molecular mechanisms that regulate the formation of bone ridges—bony protuberances that provide a stable anchoring point for the tendons that connect muscles with bones.

Bone ridges are critical for the skeleton's ability to cope with the considerable mechanical stresses exerted by the muscles.

The researchers used embryonic mouse skeletons to study a bone ridge called the deltoid tuberosity, on the humerus bone in the arm.

They discovered — to their surprise — that rather than being shaped by processes within the skeleton, bone-ridge formation was directly regulated by tendons and muscles in a two-phase procedure.

First, the embryonic tendons initiated bone-ridge formation by attaching to the skeleton.

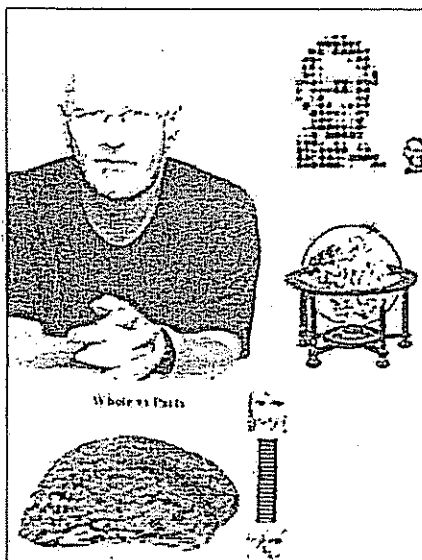
This interaction induced the tendon cells to express a specific protein called scleraxis, which in turn, led to the production of another protein, BMP4 — a molecule involved in the onset of bone formation.

Blocking BMP4 production in tendon cells prevented deltoid tuberosity bone-ridge formation.

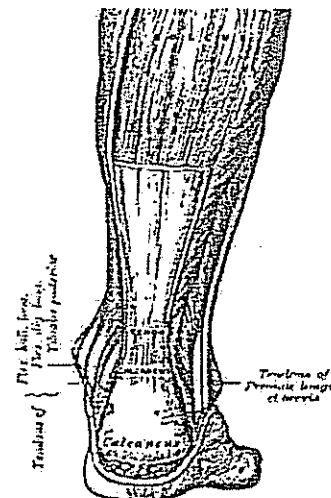
In the second phase, the subsequent growth and ultimate size of the deltoid tuberosity was directly regulated by muscle activity.

The results demonstrate that tendons play an active role in initiating bone-ridge patterning.

Zelzer says, "These findings provide a new perspective on the regulation of skeletogenesis in the context of the musculoskeletal system."



Prof. Rafael Malach



THE YATIR FOREST is on the southern slopes of Mount Hebron.



Desertification may have retarded global warming by as much as 20%, Weizmann researchers find

• By EHUD ZION WALDOKS

Researchers at the Weizmann Institute of Science in Rehovot recently made a surprising discovery about the abilities of forests to combat global warming.

In an article published on Friday in the journal *Science*, Prof. Dan Yakir and Dr. Eyal Rotenberg of the Environmental Sciences and Energy Research Department discuss their analysis of findings from the Yatir Forest research station.

By looking at the other side of the equation, the two researchers discovered that desertification was not necessarily all bad – in fact, it may have retarded global warming by as much as 20%. The desert reflects sunlight and releases infrared radiation, which has a cooling effect. And in a world in which desertification is continuing at a rate of about six million hectares a year, that news might have a significant effect on how we estimate the rates and magnitude of climate change.

The Yatir Forest station sits on the edge of the Negev Desert, a semi-arid zone. While forests are commonly believed to be excellent “carbon sinks,” sucking up the carbon dioxide in the atmosphere, which is thought to contribute to global warming, the two scientists have discovered other, potentially significant, opposing effects. While forests do constitute good carbon sinks, semi-arid forests also absorb and

trap more of the sun's rays than surrounding shrub land, they found, thus contributing to surface heating.

Semi-arid forests also transfer heat from the trees into the surrounding air to stay cool, causing more surface warming as well, the two found.

The Weizmann Institute has been operating the research station for 10 years, as part of a worldwide project comprised of more than 400 stations and called FLUXNET, which investigates the relationship between forests, the atmosphere and climate around the globe.

The Yatir station is unique because it “is one of very few in the semi-arid zone, which covers over 17 percent of the earth's land surface, and it has the longest record of the processes taking place in semi-arid forests,” according to Yakir.

“Although the numbers vary with location and conditions,” Yakir said in a statement, “we now know it will take decades of forest growth before the ‘cooling’ CO₂ sequestration can overtake these opposing ‘warming’ processes.”

“Overall, forests remain hugely important climate stabilizers (not to mention the other ecological services they provide), but there are trade-offs, such as those between carbon sequestration and surface radiation budgets, and we need to take these into consideration when predicting the future,” Yakir said.

Three Win Nobel Prize for Ribosome Research

By DENNIS OVERBYE

Three scientists who showed how the information encoded on strands of DNA is translated into the thousands of proteins that make up living matter will share the 2009 Nobel Prize for Chemistry, the Swedish Academy of Sciences said Wednesday.

The trio are Venkatraman Ramakrishnan of the M.R.C. Laboratory of Molecular Biology in Cambridge, England; Thomas A. Steitz of Yale University; and Ada E. Yonath of the Weizmann Institute of Science in Rehovot, Israel. Each will get a third of the prize, worth 10 million Swedish kronors total, or \$1.4 million, in a Dec. 10 ceremony in Stockholm.

Working independently and using, among other things, the X-rays generated by powerful particle accelerators and prodigious computer calculations, the three winners and their colleagues succeeded in mapping the locations of the hundreds of thousands of atoms in the giant molecular complexes inside cells known as ribosomes. In a news release, the Swedish academy said the three were being honored "for having showed what the ribosome looks like and how it functions at the atomic level."

The work, scientists said, has had important medical implications. Some antibiotics work by gumming up the ribosomes of bacteria, allowing those bacteria to be stopped at no danger to their host. The ribosome research, the academy said, is being used to develop new antibiotics.

Dr. Ramakrishnan was born in Chidambaram, India, in 1952 and obtained his Ph.D. at Ohio University. He holds United States citizenship. Dr. Steitz was born in Milwaukee in 1940 and got his Ph.D. from Harvard.

Dr. Yonath was born in Jerusalem in 1939, earned her Ph.D. at the Weizmann Institute of Science and has worked in Israel her whole life. She said on Wednesday that she was both surprised and not surprised at being

awarded a Nobel Prize.

Speaking by telephone, Dr. Yonath said people had long been telling her that her project was a potential winner. But at the same time, she said, there were "many, many people with fantastic work standing in line."

She said she was working and watching over her 13-year-old granddaughter when she received the news. One of the first people who called to congratulate her was the president of Israel, Shimon Peres, who shared a Nobel Peace Prize with the late leaders Yitzhak Rabin and Yasir Arafat in 1994.

Dr. Yonath is the fourth woman to win the chemistry prize and the first since 1964, said Thomas Lane, president of the American Chemical Society. Mr. Lane said it reflected "a tremendous change in the demographics of the field." More than 50 percent of chemistry degrees are now earned by women, he said.

In a telephone interview, Dr. Ramakrishnan said that when he was first told of the prize he thought it was a joke. "It was a bit overwhelming," he said.

Asked what he would do with the money, he laughed and said he did not even own a car, but that he might buy a new cello for his son who is a cellist in New York.

If the sequence of letters in the DNA forms the blueprint for life, ribosomes are the factory floor.

It starts in the nucleus of a cell with the master hereditary molecule DNA, which spells out the recipe for life and in particular the proteins that do all the work in the body using a four-letter alphabet of chemical bases, or nucleotides, designated by A, G, C and T.

When a gene, a stretch of DNA that contains the instructions for making a protein, is copied to make a similar stretch of single-stranded RNA, something like a mirror image of DNA, that bit of RNA floats from the nucleus over to a ribosome (there are many ribosomes, but they all have the

same basic structure), where another RNA molecule reads the first one and assembles amino acids in the proper order to construct a protein.

That much biologists knew by the 1960s, but they could not go any farther without understanding the detailed structure of the ribosome, a forbidding task since it contains hundreds of thousands of atoms.

Enter Dr. Yonath. "She's the one who is really the trailblazer," said Jeremy M. Berg, director of the National Institute of General Medical Sciences.

In the late 1970s, Dr. Yonath set out to solve this problem by growing crystals of the ribosome material from a desert bacteria known as *Geobacillus stearothermophilus* and then irradiating it with X-rays. Passing through the layers in a crystal, X-rays are diffracted into a pattern of dots and blobs that can be read by a computer to reconstruct the internal structure of the ribosome, a technique known as X-ray crystallography that had helped decipher the double helix of DNA itself.

But getting several hundred thousand atoms to sit for such a portrait was no easy task. It took 25,000 tries before the first ribosome crystals were created in 1980 and 20 years before the crystals were good enough to produce the X-ray patterns: millions of black dots pregnant with meaning about the arrangement of atoms in the so-called large sub unit, which makes up one of two parts of the ribosome.

Dr. Yonath's success, meanwhile, had drawn others into the field, including Dr. Steitz, who solved a key problem on how to interpret the dots on the diagram of the large sub unit, aided by electron microscope images of the ribosome obtained by Joachim Frank, then at the Wadsworth Center in Albany and now at Columbia. Meanwhile, Dr. Ramakrishnan, who got his start in ribosomes working as a postdoctoral fellow at Yale with Dr. Steitz's colleague Peter Moore, decoded the structure of the oth-

78 years
1939-2017

JSTANDARD.COM

JewishStandard

Pioneering spirit

Israel
rejoices in
its Nobel
laureate

NEWS ANALYSIS

Has 'Goldstone' killed
Mideast peace efforts? 18

WORLD

Trust still an issue
for Bibi, Obama 20

Cover story

One giant leap for womankind — and Israel

MIRYAM Z. WAHRMAN
Science correspondent

"This year, five women have conferred the greatest benefit on mankind. Congratulations to these Nobel Prize winners who, we believe, exemplify the pioneering spirit in all of us — regardless of gender."

—Full page New York Times advertisement for Levi's, Oct. 18, 2009.

Ada Yonath, age 70, made history on Oct. 7, becoming the first Israeli woman to win a Nobel Prize. She grew up in an impoverished Sephardic family in Jerusalem, went on to receive her doctorate from the Weizmann Institute of Science, completed postdoctoral fellowships at Carnegie Mellon University and MIT, and returned to Weizmann to undertake her ground-breaking biochemistry work. The Nobel Prize in chemistry was awarded to Yonath, together with Thomas Steitz of Yale University and Venkatraman Ramakrishnan, of the MRC Laboratory for Molecular Biology, Cambridge, U.K. "for studies of the structure and function of the ribosome."

Ribosomes are needed by all living things — from the lowliest bacteria to the most complex plants and animals. They are the microscopic structures found in all cells that translate information encoded in the DNA into the proteins that determine the way each cell functions. The three scientists, Yonath, Steitz, and Ramakrishnan, worked for decades to decipher the intricacies of ribosome structure and how they work.

Reaction at the Weizmann Institute

Arnold and Esther Leibowitz went to Israel shortly after Yom Kippur for a golf tournament in Caesaria, not realizing that they would also be there to experience a historic moment in Israeli science. Leibowitz, a gastroenterologist from Woodcliff Lake, has been involved with the Weizmann Institute since his first visit to the Rehovot campus about five years ago. He now serves on the national board as well as the New Jersey regional board of the American Committee for Weizmann Institute of Science.

"We got the email [regarding Yonath's Nobel Prize] and it was a chance of a lifetime to see the emotion at the Institute," said Leibowitz. He rushed over to the Weizmann campus in Rehovot. "It was Sukkos, and all the students were on vacation. Although many professors were on vacation as well, some scientists don't ever take a holiday." As he toured the campus he noted that

Dr. Miryam Z. Wahrman is professor of biology at William Paterson University of New Jersey and serves on the New Jersey regional board of the American Committee for the Weizmann Institute of Science. As an undergraduate student at Hunter College, she did research on the ribosomes of thermophilic bacteria.

16 JEWISH STANDARD OCTOBER 23, 2009



Ada Yonath at work in her lab at the Weizmann Institute of Science.

"every place we went, they were thrilled about Professor Yonath."

Leibowitz reported that TV cameras were filming reporters from Israeli and American news agencies interviewing Yonath. "She was occupied with interviews, but her assistant took us around her laboratory," he said. "It's a very modest looking lab, jammed with centrifuges, vials, and test tubes." Now Yonath's lab is equipped with what she needs to pursue her studies, but that wasn't always the case. "Initially she had to come to the U.S.," Leibowitz said, "because they didn't have ultracentrifuges [at Weizmann]."

The Leibowitzes lunched with Weizmann student Adi Natan, who is about to complete his doctoral work in physics and has had numerous postdoctoral offers from prestigious research centers in the United States. "He

wants to do postdoctoral work and then come back to Weizmann, but it is very difficult to get back in, very competitive," said Leibowitz. "I don't think you can realize the work that's being produced by the Weizmann Institute. There are at least four or five other [Weizmann] scientists just waiting to get the Nobel. That's the caliber of their research."

Leibowitz said that Weizmann's president, Daniel Zajfman, was in San Francisco when the award was announced, "so he missed all the hoopla." But his wife Joelle Zajfman met with the Leibowitzes and told them that the Nobel Prize "is something we've waited for; it was something we needed." In honor of Yonath's Nobel, Daniel Zajfman will speak at the inaugural gala of the New Jersey Region of ACWIS on Nov. 19 at the Liberty Science Center in Jersey City.

Weizmann gala to be held next month

The American Committee for the Weizmann Institute of Science New Jersey Region 2009 Inaugural gala will be held on Nov. 19 at 6 p.m. in the Liberty Science Center in Jersey City. Josh S. Westen, Sen. Frank Lautenberg, and Gov. Tom Kean Sr. are among the evening's honorees. Weizmann President Daniel Zajfman and Daniel Polisár of the Shalem Center will be speakers.

A giant leap for womankind

Levi Strauss and Company ran a full page advertisement in the Sunday, Oct. 18, New York Times, celebrating the historic achievement of the five women who garnered 2009 Nobel Prizes: Yonath for chemistry, Elizabeth H. Blackburn and Carol W. Greider (together with Jack W. Szostak) for physiology or medicine, Herta and Paul Amirson for literature, and Elinor Ostrom (together with Oliver E. Williamson) for economics. The ad was a mostly blank page, with this inscription: "This year, five women have conferred the greatest benefit on mankind. Congratulations to these Nobel Prize winners who, we believe, exemplify the pioneering spirit in all of us — regardless of gender. Levi's. Go Forth."

"This is the year of the woman," said Ruth Plager. "There are so many women getting Nobels this year, it's fantastic, utterly fantastic." Plager, who lives in Short Hills, runs a high-tech consulting firm, Zenith Bio LLC, for the biopharmaceutical industry. Yonath's Nobel resonated particularly strongly with her, as she spent a year at Weizmann in the 1960s, as a research technician.

Plager recalled that in the 1960s, "women had to get married to feel good about being a woman. It made no sense. A woman would go to work only if the husband didn't make enough money. This was the way it was, and not to be challenged."

"At that time the biggest thing I noticed at Weizmann were all these women scientists with children. They cared about different things: their work, as well as their appearance and their families. It was a real eye-opener. I thought, well, I am definitely not staying home when I got married."

Plager (who later married and divorced) pursued a highly successful career in the pharmaceutical and biotechnology industries, traditionally male-dominated areas. "Product management in the late '70s was a male franchise, like banking," said Plager. She was one of only three females hired by her company. "They would look at you with great suspicion, and when you did well they would be surprised."

She speculated about why Israel had been decades ahead of the rest of the world in terms of women in science. "In Israel it was a necessity," she said. "They couldn't afford to leave the female brains behind. But it was wonderful for the women." In addition, she pointed out, "all the women had to go into the military. That made a difference too."

While working in the San Francisco Bay area in the 1980s, Plager reconnected with Weizmann Institute and joined the Bay Region's branch of ACWIS. Now she serves on the New Jersey board. Plager noted that there are a number of highly successful female scientists at Weizmann who have made significant contributions to science and health.

"One of the biggest money-makers for the Institute is Copaxone, a multiple sclerosis drug," said Plager. "and it was developed by Ruth Arnon. It has annual sales of 1.5 to 2 billion dollars. I knew Ruth Arnon when I was there in the '60s. She was a very heimish, friendly woman," she added.

Plager speculated about future applications of the ribosome studies from her professional perspective as a

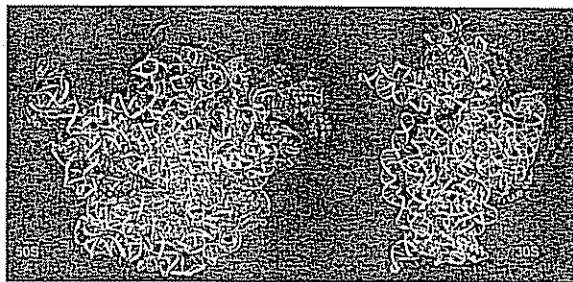
The science

A major approach to learning about the way cells work is to study the chemicals of the cell. The shape and workings of molecules, that is, the complex chemicals, can be studied with a technique called X-ray crystallography. That approach involves first transforming the chemical of interest into crystals — a form in which there is a regular, stable pattern of atoms. Table salt and sugar are crystalline forms of simple chemicals, and are easy to prepare. But more complex chemicals and structures can be challenging to crystallize. Once crystals are made, their structure is revealed by bombarding them with X-rays. The X-rays are deflected by individual atoms, and the pattern of the deflected rays, collected on X-ray film, or by other methods, is studied in order to infer the atomic architecture of the molecules.

In 1953 when the structure of DNA was solved, it was in part due to the work of another Jewish woman scientist, Rosalind Franklin, who in the 1940s and '50s, used X-ray crystallography to study DNA crystals and concluded that DNA was a twisted helical molecule. Unfortunately, she did not live long enough to be awarded a Nobel Prize for her ground-breaking work on that monumental problem; she died of cancer at the age of 38. James Watson, Francis Crick, and Maurice Wilkins received the Nobel Prize in medicine or physiology for DNA structure in 1962.

X-ray crystallography of ribosomes has helped to reveal how they work to produce proteins, which build and control everything that living organisms do. But ribosomes are made up of extremely complex combinations of various chemicals, including a variety of proteins and RNA (a chemical cousin of DNA). Scientists who first attempted to study ribosomes could not crystallize them. "Ribosomes deteriorate fairly quickly," explained Ada Yonath in an interview with Adam Smith of the Nobel Foundation. As a young scientist working in the 1970s, she was frustrated by failed attempts to form crystals for analysis. "At one point I had to describe what I was doing.... [I]t was like climbing Mount Everest, only to find out there was another mountain behind it."

Ironically, her breakthrough in research came when she had a bicycle accident and suffered a severe concussion. "I had some free time and had to recover. I read a lot," said Yonath. Through her reading she learned that polar bears from the North Pole had ribosomes that were special; the bears needed a way to preserve their ribosomes over the severe winter and had evolved a way to pack them on membranes to protect them. "Maybe this can be used to solve the structure of the ribosome," she thought. That was when she came up with the idea of studying ribosomes from very hardy species. "I used ribosomes from very, very robust bacteria," said Yonath.



X-ray structures of the two ribosomal subunits from bacteria.

The most robust bacteria are those that live at extreme conditions, such as bacteria that live in very hot or in very salty conditions. Yonath ended up studying thermophilic bacteria from hot springs, as well as bacterial species native to Israel that live in the Dead Sea. The hardy cells turned out to have resilient ribosomes, which enabled her to form the useful crystals. Over the last three decades, Yonath's work, along with that of Thomas Steitz, Venkatraman Ramakrishnan, and their co-workers, has aimed to refine the procedure, and in the process learn how ribosomes work in greater detail.

Further breakthroughs credited to these scientists have shown that antibiotic drugs that bind to ribosomes can block their function and kill cells. Since bacterial cells have ribosomes that are different from animal cells, it is possible to develop drugs that can target disease-causing bacteria and help people recover from serious illnesses. "The ribosome is very important," Yonath explained. "It is a target for many antibiotics.... We want to increase the possibility of the antibiotic to distinguish between the patient, who has to recover, and the pathogen, that has to die."

Dr. Edward Friedland, an orthopedic surgeon from Wyckoff, commented on Yonath's scientific breakthroughs. "What she has gotten recognition for is a wonderful advance in many regards. It may allow us to find ways to break down resistance of many bacteria to antibiotics," he said. One of the major problems in medical practice today is the development of antibiotic resistant strains of bacteria that spread from patient to patient in hospitals and other medical facilities. "If we could get into the mechanisms of the ribosomes, we could get over the resistance," said Friedland, who serves on the New Jersey regional board of the American Committee for the Weizmann Institute of Science. Friedland visited Weizmann Institute last November and "was impressed with its scope and the number of different aspects of science that they're involved in."

"They are exploring multiple facets of science on a basic level," he noted. "Methicillin Resistant Staph Aureus — you can't fight them. Thousands die because of resistant bacteria. Her research is outstanding and opens the door to future research."

Miriam Wahrman

consultant to industry. "I would think you could do more than just antibiotics," she said. "Such a basic discovery platform allows you to interpret so much. It has such an exponential effect. We don't know what the effect will be."

Yonath, who is a mother and grandmother, is the fourth woman ever to win the chemistry Nobel prize, the third Israeli to win that award (Aaron Ciechanover and Avram Hershko of Technion-Israel Institute of Technology won in 2004), and the ninth Israeli Nobel laureate.

Yonath is the 29th Jewish chemistry Nobel laureate. Of more than 750 total Nobel prizes awarded since 1901, at least 163 went to Jews.

For information on Nobel prizes see, www.nobelprize.org.

Information on Jewish Nobel laureates can be found at www.jewishvirtuallibrary.org.

Information on Weizmann Institute and ACWIS can be found at www.weizmann.ac.il and www.weizmann-usa.org.



KNESSET SPEAKER Reuven Rivlin (left), Knesset Education Committee chairman Zevulun Orlev (partially hidden), Nobel laureate Prof. Ada Yonath and Knesset Science and Technology Committee chairman Meir Sheerit examine a hanukkah made from silver and test tubes, at the Knesset yesterday. (Judy Siegel)

Yonath honored in Knesset as Sheerit calls for more money for science and education

• By JUDY SIEGEL

As leading scientists and politicians bemoaned that funding for scientific research and education lagged far behind needs, Knesset Science and Technology Committee chairman Meir Sheerit called for raising taxes on the very rich and funneling the additional revenue toward such purposes.

He was speaking at a special joint session of his committee with that of the Knesset Education Committee on Monday to honor Weizmann Institute of Science Prof. Ada Yonath, who less than two months ago won the 2009 Nobel Prize in Chemistry.

Sheerit described in detail ribosomes, the target of Yonath's research that manufactures proteins in all living cells; he noted there are 50,000 of them in each cell. The Nobel laureate spent decades studying her then-esoteric subject, which turned out to be a practical key to understanding how bacteria become resistant to antibiotics and how to develop new anti-bacterial drugs.

Yonath said she was overwhelmed by the new public awareness of ribosomes, among both adults and children; when her prize was first announced, the vast majority of people hadn't a clue what a ribosome is.

"I think it has helped promote the understanding of the public, the government and the Knesset of the need to promote scientific research," said

Yonath. "I get letters even from second- and third-graders."

She called for higher allocations for scientific research so that young scientists can make a living without being tempted by overseas offers and contributing to Israel's brain drain. "And the country must help youngsters, especially girls, who have what it takes to become excellent scientists. Women generally still advance slower and earn lower salaries than their male counterparts," she said.

Yonath added that she strongly opposed a proposal that will be discussed soon to tax research scholarships; Education Minister Gideon Sa'ar said he would fight it.

Knesset Speaker Reuven Rivlin, who also called for an increase in money for research, presented Yonath with a unique gift representing both Jewish tradition and science — a hanukkah designed by Hada Kruck and Anat Stein from silver and test tubes in which the oil floats on water and a colorful drawing of the candelabrum.

Sa'ar said he was determined to increase education and science funding in the 2011 state budget and to push to change national priorities, cutting back on defense spending to benefit these targets, which offer security for the future no less than weapons.

Yonath was warmly praised by all present, including Science and Technology Minister Prof. Daniel Herschkovitz,

Knesset Education Committee chairman Zevulun Orlev, Israel Science Academy president Prof. Menachem Ya'ari, academy vice president Prof. Ruth Arnon, and Israel Prize laureate, education promoter and retired textile tycoon Dov Lautman.

Ya'ari said that due to lack of funding, Yonath has had to go "door to door" among decision makers to get funding for Israel's participation in the regional project SESAME (Synchrotron-light for Experimental Science and Applications in the Middle East), based in Jordan and established in 2008. The project brings together unusual partners such as Iran, Bahrain, Egypt, Cyprus, Pakistan, the Palestinian Authority, Jordan and Israel.

The project includes the construction of the Middle East's first major cooperative international research center, 30 km. from Amman, employing a broad spectral range of light from infrared to X-rays that could be used for the study of structural molecular biology, molecular environmental science, surface and interface science, microelectromechanical devices, X-ray imaging, archeological microanalysis, materials characterization and clinical medical applications.

Ya'ari said that Yonath herself could advance her ongoing ribosome research using such a facility close to Israel instead of traveling to a synchrotron in France.

Give the nerd
a chanceAdar Primor
Opinion, Page B5

HAARETZ

English Edition

Friday, December 4, 2009 | Kfar Sava 17,5770, Vol 50, No 27525

Israeli Nobility

Hair be damned, laureate-to-be Yonath ready for Stockholm awards ceremony

By Ofri Ilani

The plane tickets to Sweden have not arrived yet but Prof. Ada Yonath is ready for the trip to receive her Nobel Prize in Chemistry. She has been briefed on the events scheduled for the days preceding Thursday's awards ceremony.

"Waiting for me in Stockholm will be a personal assistant - Katrina from the Ministry for Foreign Affairs - as well as the secretary of the Swedish Academy. They'll help us with our things and take us to our hotel. From the moment I arrive I'll always be together with the other two laureates," Yonath said earlier this week.

There is some history between Yonath, Venkatraman Ramakrishnan and Thomas Steitz, the two scientists with whom she shares the Nobel Prize in Chemistry for 2009.

Over the years scientists connected to Yonath's research team have accused Steitz, an American, of taking credit for Yonath's work on ribosomes. In any event, according to Yonath, the wrinkles were smoothed out even before the prize was announced.

"The relationship between me and them is of normal scientists," she said. "There were periods with a little tension,

See YONATH, Page A7



Cyril Bruneau

Prof. Yonath in her lab. Headed to Sweden to collect her Nobel.

YONATH

Continued from page A1

that's totally normal among scientists engaged in the same field. It's like between two neighbors. But we get along. I've met one of them twice already in the United States and in Europe after the announcement, and the smiles went from ear to ear."

In the meantime, Yonath is busy fending off journalists' questions with her prickly Israeli humor, especially when they ask about her haircut.

"I'm always having to get rid of reporters. People are obsessed with my haircut, everyone wants to do something with my hair before the ceremony. Very senior figures tell me their hairstylist wants to do my hair, for free. It's surprising. People from television are interested almost exclusively in aspects of my hair and my hairdresser. It's really important to them. They ask me, 'Aren't you happy that ribosomes, and not only 'Big Brother,' are being shown on TV?' But I say, the fear is that you are bringing ribosomes down to the level of 'Big Brother.'"

Despite her bemusement concerning the interest in her unruly mop, Yonath is pleased with the attention. "I'm truly glad I've managed to get the public interested in questions about basic research" that are not gener-

ally a major public draw.

"I've been invited to retiree associations, to enrichment programs for children. Most of the time I barely manage even to respond to ask about dates. I had 3,000 e-mails sent in the first days [after the prize announcement] that disappeared, and I'm waiting for them to be restored. It warms my heart that on Friday instead of talking about the government or about murders, they talked about ribosomes."

A few days after the prize was announced, in early October, Yonath caused a scandal by saying, in an interview with Army Radio, "I don't understand why we are keeping the terrorists captive and don't release everyone we are holding in the first place, regardless of a deal for [abducted Israeli soldier] Gilad Shalit's release."

The statement, which positioned Yonath in Israel's left wing, was denounced by scientists as well as politicians. Yonath has been silent on controversial issues since then, but has indicated that she is likely to end that silence after the Stockholm ceremony.

"I am not absenting myself from issues relating to Israel and society, and they continue to interest me, but until the party I prefer only to rejoice, to the extent that it's possible given the situation here."

NEW WORDS

• By JUDY SIEGEL-ITZKOVICH

SNIFFING OUT MEMORIES

Certain aromas — like that of the madeleine pastries recalled by French author Marcel Proust — are bound up in memories. Now researchers at the Weizmann Institute of Science in Rehovot have managed to figure out how the mechanism works and published their findings in the journal *Current Biology*.

Graduate student Yaara Yeshurun, together with Profs. Noam Sobel and Yadin Dudai of the institute's neurobiology department, thought the key might not necessarily lie in childhood, but rather in the first time a smell is encountered in the context of a particular event. That is, the initial association will somehow leave a unique and lasting impression.

To test this idea, the scientists devised an experiment: First, in a special smell laboratory, subjects viewed images of 60 objects, each presented simultaneously with either a pleasant or an unpleasant odor generated in an olfactometer. Next, the subjects were put in a functional-MRI (fMRI) scanner to measure their brain activity as they reviewed the images they'd seen and attempted to remember which odor was associated with each. Then, the whole test was repeated — images, odors and fMRI — with the same images, but different odors accompanying each. Finally, the subjects came back one week later, to be scanned again while viewing the objects one more time and being asked to recall the odors associated with them.

The scientists found that after one week, even if the subject recalled both odors equally, the first association revealed a distinctive pattern of brain activity. The effect was apparent whether the smell was pleasant or unpleasant. This unique representation showed up in the hippocampus, a brain structure involved in memory, and in the amygdala, involved in emotion. The pattern was so profound that it enabled the scientists to predict which associations would be remembered just by looking at the brain activity following the initial exposure. The scientists could look at the data on the first day of the experiment and predict which associations would come up seven days later.

To see if other sensory experiences might share this tendency, the scientists repeated the entire experiment using sounds rather than smells; they found that sounds did not arouse a similar distinctive first-time pattern. Childhood olfactory memories may be special not because childhood is special, but simply because those years may be the first time we associate something with an odor.

EILAT RESEARCH SHIP SETS SAIL

An sophisticated \$1.3 million research ship has been launched at the Interuniversity Institute for Marine Sciences in Eilat. Purchase and outfitting of the ship was financed by the Planning and Budgeting Committee of the Council for Higher Education, the Science and Technology Ministry, the Hebrew University of Jerusalem, the Weizmann Institute of Science in Rehovot and private donors.

HU Prof. Aaron Kaplan, who heads the Interuniversity Institute, said that "over the years the institute rented various vessels for teaching and research, but never was able to find one totally suitable. Now we have been able to realize a dream of many years. The fact that we now have a suitable ship will greatly advance marine research in Israel."

Kaplan noted that marine research has acquired increased attention in recent years due to new scientific approaches and the increased use of marine biological models for medical research. This, in turn, has brought more money into the field. "The new ship will make it possible to advance research on the unique organisms found in the Gulf of Eilat and in the ocean itself," said Kaplan. "The technology on the ship will make it possible to further the monitoring of the gulf, and the development of means to cope with possible crises such as an oil spill," he said.

City

front

Rehovot hits 120

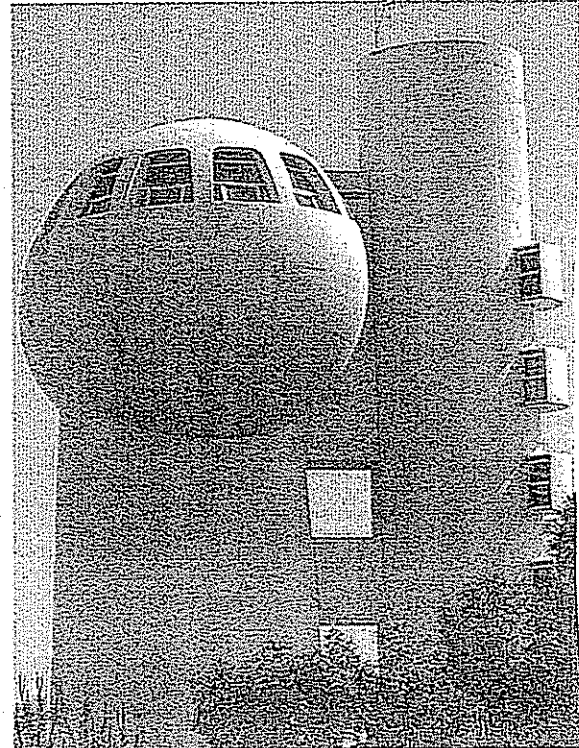
• Compiled by Barry Davis

Central Region

Last Sunday, Rehovot Mayor Rahamim Malul announced the start of the town's forthcoming 120th anniversary celebrations at a press conference held at Donedikov House. The events officially open this Sunday in the presence of President Shimon Peres, and there will be a street party on Rehov Ya'acov. The anniversary events will end in May 2011.

At the press conference, Mayor Malul said that a budget of some NIS 2.5 million had been set aside for the anniversary celebrations, and an additional NIS 750,000 for this year's Independence Day events in the city.

Meanwhile, the anniversary program's artistic director, Jacky Behar, said that the celebrations would focus on three themes – the city's scientific and academic work, local history and nostalgia, and the inhabitants and unique milieu of Rehovot.



THE WEIZMANN Institute of Science in Rehovot. The city will mark its scientific achievements as part of its 120th anniversary celebrations.

Yonath gives Israel, women and science a boost at Stockholm Nobel ceremony

As crystallographer becomes ninth Israeli to receive prize, past recipient slams inadequate state investment in research

• BY JUDY SIEGEL

In a formal but simple ceremony at the Stockholm Concert Hall on Thursday, 70-year-old Weizmann Institute of Science Prof. Ada Yonath – a pioneer in the study of the key protein-producing ribosomes in all cells – became the first Israeli woman, and the ninth Israeli, to win a Nobel Prize – and only the fourth woman to become a chemistry laureate.

Yonath, accompanied to Sweden by her only daughter, granddaughter and sister, shared the 10 million Swedish kroner (\$1.5 million) award with Britain's Indian-born Venkatraman Ramakrishnan and American Thomas A. Steitz, who continued Yonath's work.

The field involving the ribosome, which translates genetic code in the production of protein, has contributed much to understanding resistance of bacteria to antibiotics and is expected to help in the development of new and more effective anti-bacterial drugs.

Yonath will later during her week in Stockholm deliver a science lecture on ribosomes to represent herself and the other two chemistry laureates, as will others among the remaining 10 Nobel laureates in medicine or physiology, chemistry or physics and literature.

Each of the winners received a gold medal and a document from Swedish King Carl XVI Gustaf as the royal family and relatives and friends of the laureates were present. Orchestral music was played, and an opera singer sang arias from Tosca and Don Giovanni.

After the hour-long event, the royals, winners and guests proceeded to City Hall for a ball and festive dinner, where Yonath was due to sit close to the king.

The concert hall ceremony was devoid of all national symbols, including flags and anthems, as the annual occasion



PROF. ADA YONATH

is meant to celebrate science.

Simultaneously, scores of Yonath's colleagues attended a video screening of the ceremony at the Weizmann Institute in Rehovot, some of them wiping tears of joy from their eyes.

Before the ceremony, Yonath – one of five women to receive a Nobel this year and one of just 40 to do so in 108 years – said she hoped her award would encourage Israeli children – both girls and boys – to develop an interest in sciences in general and specifically chemistry.

"There is a great feeling here," Yonath said. "There is a lot of pleasure in it. I have my entire family here, and this is a wonderful opportunity to spend time with them. I can't complain."

She spent some of her time with the other laureates rehearsing in the concert hall and learning to curtsy or bow to the king. She also attended a reception in her honor at the home of Benny Dagan, Israel's ambassador in Stockholm, where everyone wanted to shake her hand.

The Nobel Prize was established by Swedish inventor and industrialist Alfred Nobel, who produced dynamite. The prize highlights and lends prestige to scientists who have spent decades committing to this time-consuming work.

Technion Prof. Avram Herskko, who shared the Nobel Prize in Chemistry four years

ago with his longtime student Prof. Aharon Ciechanover, said he worried that due to inadequate state investment in research, "there will be no more" Israeli Nobels, as the prizes received now and recently were based on work done 20, 30 or more years ago.

Yonath, a crystallographer born to a poor family in the Geula quarter of Jerusalem, was interested in science at an early age and recalled conducting experiments on their apartment balcony.

"Once, when I tried to calculate the height of the balcony, I broke my arm. Another time, I wanted to see if water moves faster than kerosene. When my father came out to smoke, a fire broke out."

At the age of 10, after she lost her father – a rabbi – to illness, her mother raised her and her sister in Jerusalem by running a failing grocery store and then as a government clerk in Tel Aviv.

Yonath graduated from the Hebrew University of Jerusalem with a bachelor's degree in chemistry and then a master's degree in biochemistry, followed by a doctorate in x-ray crystallography at the Weizmann Institute.

For years she had to fight skepticism and even ridicule by colleagues and peers, describing the way she was sometimes treated as if she were "the village fool" studying a theoretical subject that "would get nowhere."

Within a week of hearing she would receive the Nobel, she aroused some controversy by calling for the unconditional release of all Hamas prisoners, saying that "holding Palestinians captive encourages and perpetuates their motivation to harm Israel and its citizens.... Once we don't have any prisoners to release they will have no reason to kidnap soldiers."



YONATH'S NOBEL ACHIEVEMENT

Professor Ada Yonath of the Weizmann Institute of Science receives the Nobel Prize in Chemistry from King Carl XVI Gustaf of Sweden during the awards ceremony yesterday in Stockholm. Yonath is the ninth Israeli to be awarded a Nobel prize. Prime Minister Binyamin Netanyahu congratulated Yonath last night for 'the honor that your accomplishments have brought to Israel, its citizens and the Israeli scientific community.' Story, Page 4 (AP)

Rewiring Plants Could Supersize Crops

By [Brandon Keim](#) ☒ April 19, 2010 | 4:42 pm | Categories: [Agriculture](#), [Biology](#)



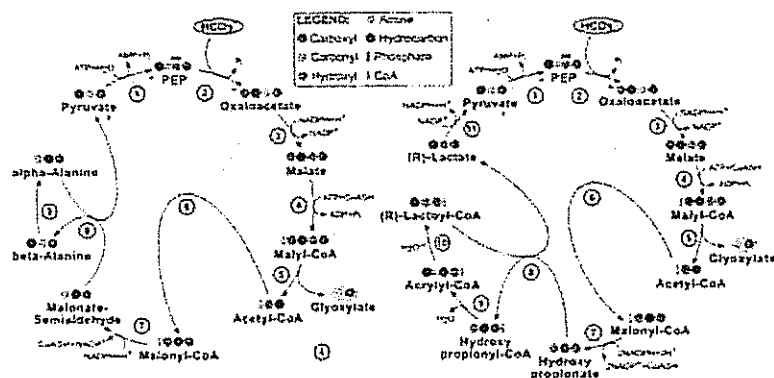
With a bit of biomathematical wizardry, researchers have found a new way for plants to breathe.

The newly discovered chemical reactions would allow plants to process carbon dioxide more efficiently. Crops could grow to enormous size.

“We wondered if we could take parts designed by nature, and rewire them together in a mix-and-match approach to get something that’s more efficient for human needs,” said synthetic biologist Ron Milo of the Weizmann Institute, co-author of the study published April 19 in the *Proceedings of the National Academy of Sciences*.

So-called carbon fixation is essential for the growth of plants, which combine carbon dioxide with water to produce organic compounds in their bodies. But while modern crops have been intensively bred, the essential process of carbon fixation has remained unaltered.

The chemical process used by almost all plants to fix carbon is called the Calvin-Benson cycle. Researchers have tried without success to tweak the cycle’s key enzyme, Rubisco. Evolution appears to have optimized the cycle — but according to Milo’s team, the cycle itself isn’t necessarily optimal.



The researchers designed algorithms that would calculate the combinations of all 5,000 metabolic enzymes identified by science, and return those that required the least energy to fix the most carbon. They found a family of enzyme-driven chemical reactions — malonyl-CoA-oxaloacetate-glyoxylate pathways, or MOG for short — that should be two to three times more efficient than the Calvin-Benson cycle.

For now, MOG pathways exist only in a server farm. The enzymes involved are found in various species of bacteria, not plants. The researchers hope to engineer bacteria with the pathways, and then tissue samples of plants.

Evolution might have stumbled on this solution, but Mother Nature also had to worry about pests, nutrients, water and other factors that modern farmers have under control.

“When you’re working in modern agriculture, what you’re trying to optimize is different from what nature is trying to optimize,” said Milo. “We’re trying to get the most food.”

Images: 1) [Kevin Lallier/Flickr](#). 2) [Two MOG pathways/PNAS](#).

See Also:

Weizmann Institute pursues sun-powered separation of H₂O

By JUDY SIEGEL-ITZKOVICH

The perfect replacement for petroleum and other polluting fuels would be using sunlight to split water into hydrogen and oxygen. Hydrogen clearly has a long-term potential as a clean, sustainable fuel.

But so far, man-made systems require additional chemical agents. Now, a unique approach developed by Professor David Milstein and colleagues at the Weizmann Institute of Science, organic chemistry department takes important steps in overcoming this challenge.

During this work, the team demonstrated a new mode of bond generation between oxygen atoms, and even defined the mechanism by which it takes place. In fact, it is the generation of oxygen gas by the formation of a bond between two oxygen atoms originating from water molecules that proves to be the bottleneck in the water-splitting process.

Their results were published in *Science*. Nature has evolved a very efficient process — photosynthesis, which is the source of all oxygen on Earth. Although there has been significant progress in understanding photosynthesis, just how this system functions remains unclear; worldwide efforts have been devoted to the development of artificial photosynthetic systems based on metal complexes that serve as catalysts but with little success. The Rehovot institute's approach is divided into a sequence of reactions, which leads to the release of hydrogen and oxygen in consecutive thermal- and light-driven steps, mediated by a special metal complex that Milstein's team designed in previous studies.

Moreover, the one they designed from the element ruthenium is a

"smart" complex in which the metal center and the organic part attached to it cooperate in cleaving the water molecule. The team found that upon mixing this complex with water, the bonds between the hydrogen and oxygen atoms break, with one hydrogen atom binding to its organic part, while the remaining hydrogen and oxygen atoms (OH group) bind to its metal center. This modified version of the complex provides the basis for the next stage of the process: the "heat stage."

When the water solution is heated to 100°C, hydrogen is released from the complex and another OH group is added to the metal center. "But the most interesting part is the third light stage," Professor Milstein said. "When we exposed this third complex to light at room temperature, not only was oxygen produced, but the metal complex reverted to its original state, which could be recycled."

Professor Milstein and his team have also succeeded in identifying an unprecedented mechanism for such a process. Additional experiments have indicated that during the third stage, light provides the energy required to cause the two OH groups to join and form hydrogen peroxide (H₂O₂), which quickly breaks into oxygen and water.

Moreover, the team has provided evidence showing that the bond between the two oxygen atoms is generated within a single molecule — not between oxygen atoms residing on separate molecules, as commonly believed — and comes from a single metal center. Discovery of an efficient artificial catalyst for the sunlight-driven splitting of water is a major goal of renewable clean energy research.

© The Jerusalem Post

Insecticides - Utilisation de l'aillicine
comme insectifuge et insecticide dans les cultures agricoles
Sous la direction du Professeur David Mirelman, une équipe de chercheurs de l'Institut Weizmann (située à Rehovot), propose une alternative aux insecticides et aux anti-insectes basés sur le principe actif de l'ail l'aillicine. Ce composé peut être utilisé pour protéger les fruits des mouches, des fourmis et d'autres insectes nuisibles. Il peut être rapidement généré en écrasant des gousses d'ail. Malheureusement, le composé ainsi obtenu est chimiquement peu stable. Pour cette raison, bon nombre de méthodes connues pour la synthèse de l'aillicine ne sont pas satisfaisantes. Toutefois, ces chercheurs ont récemment mis au point une procédure extrêmement efficace pour sa production et son stockage en grandes quantités. Cette aillicine en solution aqueuse a ensuite été utilisée avec succès pour protéger les fruits comme les kakis, les pêches, les goyaves des insectes et en particulier des mouches. Elle est également efficace pour repousser les fourmis et les insectes pouvant causer des dommages aux feuilles des arbres fruitiers.

Source: Newmarket Journal {Main}
Edition:
Country: UK
Date: Thursday 1, April 2010
Page: 4
Area: 43 sq. cm
Circulation: ABC 9174 Weekly
BRAD info: page rate £2,466.36, scc rate £7.98
Phone: 01638 668 441
Keyword: Weizmann Institute of Science

25 years ago

Journal, April 3, 1985

NEWMARKET Upper School sixth-former Martin Welch has been chosen to spend a month at a top Israeli science school as part of a special research team. He is one of only 12 British boys to be chosen. Martin, 17, who lives in Toyse Lane, Burwell, will join around a thousand youngsters at the Weizmann Institute of Science in Rehovot, Israel. He will be carrying out medical research for a month at the institute before returning to England to take up a place at Oxford University where he plans to study biochemistry. Martin is a friend of another high achiever at Newmarket Upper School - Jonathan Ridgeon, Britain's rising athletics star. The cost of the trip is largely being met by the institute but he still has to find a further £400 before he leaves for Israel in the summer.

25 years ago

Journal, April 3, 1985

NEWMARKET Upper School sixth-former Martin Welch has been chosen to spend a month at a top Israeli science school as part of a special research team. He is one of only 12 British boys to be chosen. Martin, 17, who lives in Toyse Lane, Burwell, will join around a thousand youngsters at the Weizmann Institute of Science in Rehovot, Israel. He will be carrying out medical research for a month at the institute before returning to England to take up a place at Oxford University where he plans to study biochemistry. Martin is a friend of another high achiever at Newmarket Upper School - Jonathan Ridgeon, Britain's rising athletics star. The cost of the trip is largely being met by the institute but he still has to find a further £400 before he leaves for Israel in the summer.

Israeli device tests food for bacteria

FoodScan 3000 from Israel is the only hand-held device that tests food samples for bacteria and provides on-site, immediate analysis — in just three seconds.

How can you be sure that bacteria are not festering in your food?

Dangerous pathogens like *Salmonella*, *E. coli*, *Listeria* and chemical contaminants are responsible for more than 76 million food-borne illnesses a year in the US, according to the Center for Disease Control.

Bacteria, viruses and toxins thrive on food that is undercooked, inadequately refrigerated or prepared in places where hygiene standards are lax.

One Israeli company, however, hopes to make your food safe from the farm to your fork.

Herzliya-based MS Tech has developed advanced smart sensor technology that can detect the presence of contaminants and related chemicals in just three seconds, in the field.

The company's innovative FoodScan 3000 is — according to the company — the only hand-held device now on the market that tests samples for bacteria and provides on-site, immediate analysis.

In the past, samples had to be sent to a lab for analysis — a time-consuming and costly process.

Another benefit is that unlike other testing systems, FoodScan 3000 is green; it does not use radioactive material or ionizing sources.

Food safety is an issue of grow-

ing concern worldwide. In the US recent recalls of suspect ground beef, peanut butter and lettuce, are increasing the pressure for expanded food safety inspection. The demand to keep food safe has spawned the food safety and production inspection business, a sector estimated at \$2.5 billion annually.

"Our technology can detect the presence or absence of bacteria and contaminants in food before anyone can see or smell them," Doron Shalom, CEO of MS Tech says.

Based on an array of High Frequency Quartz Crystal Microbalance (HGQ-CM) sensors and coatings, the technology from MS Tech provides highly sensitivity and selectivity in detecting target molecules and can tell you whether or not your food is contaminated in three seconds.

Weighing in at just 800 grams and the size of about two iPhones, FoodScan 3000 is integrated with HF-QCM sensors that are embedded with smart detection algorithms. The surface of each sensor has a chemical coating that is sensitive to different families of target molecules.

Doron gives the credit for this advanced sensor technology to his scientific team at MS Tech, headed by Dr. Lev Dayan, chief scientist and co-founder of the company.

Dayan, a leading expert in crystal physics, has more than 40 years' experience designing and developing electro-chemical sensors. Prof. Abraham Shanzer of the Dept. of Organic Chemistry at the Weizmann Institute of Science has also been a major contributor to the multi-disciplinary team. And the company boasts a high level board of scientific advisors.

A big benefit is early detection of spoiled food. "Sometimes food leaves the factory top quality, but because it is not stored well, handled properly, or kept at the right temperature, it will begin to spoil," Doron explains.

"When a food or beverage has a bad smell, it can do major damage to the reputation of a brand — not to mention the high cost of product recalls," he adds.

The company's long-range vision is that one day consumers will be able to scan their own food for contaminants.

MS Tech is also in negotiations with manufacturers of food processing equipment to integrate its plug-and-play sensors into their production lines and inspection processes.

Privately-held MS Tech is a candidate for a number of technology innovation awards from leading industry analysts. The company expects to begin first deployments with selective companies in the US and Europe this year, and claims that countries in Asia, with high food safety standards, are also keen to use the company's technology.

The company doesn't just plan to stop at foodstuffs. It is now in the process of setting up a major R&D center to be located in either the south or the center of the country.

What it needs now are partners and financing. "We are currently looking for strategic partners and raising capital to establish our R&D center and manufacturing facilities," concludes Doron.

**Jewish Times of South Jersey,
 Sharon Kanon**

Environnement

- Pr Dan Yakir & Dr Eyal Rotenberg du département des Sciences de l'Energie et de l'Environnement de l'Institut Weizmann à Rehovot ont analysé pendant 10 ans l'évolution de la forêt Yatir, en bordure du Néguev, zone semi-aride. Leur travail fait partie du projet mondial "Fluxnet" comprenant 400 stations dont le but est de déterminer les interrelations entre les forêts, l'atmosphère et le climat. Ils sont arrivés à la conclusion étonnante que la désertification aurait retardé le réchauffement climatique de 20%. En effet le désert réfléchit la lumière solaire, en libérant des radiations infrarouges qui ont un effet refroidissant. Dans un monde où la désertification progresse à l'allure de 6 millions ha/an, ces résultats peuvent influencer sur les prévisions de changement climatique. Les forêts sont réputées piéger le CO₂ de l'atmosphère et réchauffer celle-ci. De plus, en zone semi aride, les forêts réfléchissent la chaleur solaire et contribuent au réchauffement. Les forêts semi-arides couvrent 17% de la surface du globe.



- Le président de la région d'Eilat espère que l'Arava sera la "Silicon valley" de l'énergie renouvelable. Jon Cohen, président d'Arava Power Company a rejoint Siemens Israël pour installer une centrale solaire de 100 Mw, utilisant des champs solaires de moyenne importance dans les 6 Kibboutz Ketoura, Yotvata, Lotan, Grofit, Eliphaz et Neve Harif. En effet le plan du gouvernement est d'atteindre 5% d'énergie renouvelable dans 4 ans. Selon Jon Cohen ce plan n'est pas assez ambitieux et on devrait pouvoir installer 1000 Mw.

- Après la catastrophe de Haïti, le Dr Avi Shapira a informé la Knesset du scénario probable d'un séisme de magnitude de 7,5, se produisant à Beit Shea'n : 16 000 morts, 6000 blessés graves, 377 000 personnes déplacées, 10 000 bâtiments détruits et 20 000 endommagés.



Giant virus shows its prowess

Andy Coghlan

THE world's largest known virus just got bigger, and analysis of its genome supports the controversial idea that giant viruses shaped the cells of all animals and plants.

Armed with almost 1000 genes, the mimivirus is a monster compared with classic viruses such as HIV or the flu virus, which seldom have more than 10 genes. Jean-Michel Claverie of the Structural and Genomic Information Laboratory in Marseilles, France, has performed the first analysis of its genetic machinery, identifying which of the mimivirus's genes are switched on during each stage of infection.

He found that the virus has 75 more genes than previously thought. Crucially, Claverie's study reveals that the mimivirus uses its own genes and proteins to orchestrate its replication (*Genome Research*, DOI: 10.1101/gr.102582.109).

Classic viruses insert their

DNA into the nuclear DNA of the cells they infect and let their host do the hard work of replication for them (see diagram). In contrast, the mimivirus constructs a massive "factory" within the cell, where millions of new viruses, or virions, are produced. These eventually burst out from the dead host cell to spread and infect other cells. The only other viruses that replicate outside the nucleus are poxviruses, but even they rely on the nucleus to replicate some of their DNA.

In order to create the virus factory, the mimivirus appears to steal some of the host cell's resources. Claverie found that the virus has a gene that codes for a protein which carries ATP – the molecule that stores energy in a form that cells can use. It is also equipped to scavenge amino acids – the building blocks of proteins – from its host, thanks to genes that make proteins which transport amino acids.

Claverie found that these

genes are activated when the mimivirus first invades a cell. He believes they are used to set up the virion factory, which then allows the mimivirus to replicate without help from the host cell's own nucleus. In fact, the factory is so large it was originally mistaken for a nucleus.

Claverie says the mimivirus's independence supports the theory that giant viruses gave rise to the nuclei that package up DNA in all plant and animal cells. Philip Bell of Macquarie University in Sydney, Australia, who first put forward the theory, agrees. "This paper shows the ability of viruses to completely take over cells," he says. "This is one of the key aspects of my theory."

Abraham Minsky of the Weizmann Institute in Rehovot, Israel, says the results support his own team's recent study showing that the mimivirus lives in a cell's cytoplasm entirely independently of the host nucleus.

But David Moreira of the University of Paris-South, France, remains unconvinced. He argues that the mimivirus owes its enormous size to its ability to "pickpocket" genes from the eukaryotic cells it infects. "This paper does not alter my view," he says. ■

Obituary DOI:10.1145/1629175.1629187

Leah Hoffmann

Amir Pnueli: Ahead of His Time

Remembering a legacy of practical and theoretical innovation.

IT IS WITH great sadness that we note the death of Amir Pnueli, a pioneer in the fields of formal specification, verification, and analysis. Pnueli suffered a brain hemorrhage on November 2, 2009; his sudden death shocked the international computing community.

A shy and unassuming man, Pnueli was born in Nahalal, Israel, in 1941, and spent the bulk of his career at Tel Aviv University (where he founded the department of computer science), the Weizmann Institute of Science, and New York University. His modest demeanor belied groundbreaking technical achievements. In 1977, Pnueli's paper, "The Temporal Logic of Programs," marked a crucial turning point in the verification of concurrent and reactive systems. Temporal logic was developed by philosophers in the late 1950s to reason about the use of time in natural language. By introducing it to the field of formal methods, Pnueli gave researchers a set of tools that enabled them to specify and reason about the ongoing behavior of programs.

"That paper opened up a new world, both for him and for the field," says Moshe Y. Vardi, professor of computational engineering at Rice University. At the time, program verification was widely considered to be a hopeless challenge. But Pnueli's paper quietly established a framework for advanced techniques and gave new life to the domain. Throughout the rest of his career, Pnueli continued to refine his ideas and contribute to the development of other verification methods. He also coined the term "reactive system" to describe systems that maintain an ongoing interaction with their environment, and together with David Harel, a colleague at the Weizmann Institute, argued for its significance; the term has since become deeply ingrained in the literature. Working with a variety

of collaborators—including current and former students—Pnueli made additional contributions to a number of related topics, from model checking to the synthesis of reactive modules. "He had boundless curiosity," says Harel.

Pnueli was deeply interested in developing techniques that could be used in industrial applications and not only research settings. He cofounded several companies, designing and supervising systems that included message switching, operating systems, and compilers. Statecharts, a visual language for the specification and design of reactive systems that he created with Harel, has subsequently been applied to areas as diverse as avionics and electronic hardware systems.

Pnueli's graciousness and humility endeared him to colleagues and students alike. He listened attentively to all who sought him out, and had a knack for finding the best in what they said. "People loved working with him because he made them feel smart," says Lenore Zuck, a former graduate student who is currently an associate professor at the University of Illinois at Chicago. At work, Pnueli was laid-back and informal, alternating between research and conversation and indulging in long digressions about politics, food, and the latest title from Am Oved, an Israeli publishing house. "It never felt tiring to work with him," says Zuck.

His graciousness and humility endeared Pnueli to colleagues and students alike.

Beneath his casual comportment lay deep insight and intuition, and collaborations, says Harel, often happened inadvertently. "We once started something while standing in line for lunch at the cafeteria," says Harel. "Another time, it was at a conference coffee break." In fact, their work on reactive systems began on a plane flight. While discussing Statecharts, the visual language he had recently created, Harel suggested it was useful for particular kinds of systems—systems that interact frequently with one another and don't do heavy computation. "And Amir said, 'Yes, I thought the same thing. Maybe we should call them *reactive systems*,'" recalls Harel. "I said, 'Bingo.' And then we spent the next hour talking about what we mean."

Pnueli's accomplishments were widely celebrated. In 1996, he received ACM's A.M. Turing Award for his work in temporal logic and contributions to program and system verification. These accomplishments were also honored in 2000 by the Israel Prize for Exact Sciences, the state's highest honor. More recently, Pnueli received the 2007 ACM Software System Award, with Harel and others, for their work on Statemate, a software engineering tool that evolved from the Statecharts language and supports visual, graphical specifications that represent the intended functions and behavior of a system.

At Pnueli's funeral, Harel challenged himself to identify one of his colleague's vices. The verdict: procrastination. "He was often late," recalled Harel. In Pnueli's defense, he continued, the issue was always eventually taken care of, and "in great depth, in detail, and combined with the great grace of his personality and his deep wisdom." □

Leah Hoffmann is a Brooklyn-based technology writer.

Amir Pnueli, 68, Pioneer of Temporal Logic

By KENNETH CHANG

Amir Pnueli, who turned a philosopher's explorations of time, logic and free will into a critical technique for verifying the reliability of computers, died on Nov. 2 in Manhattan. He was 68.

The cause of death was a brain hemorrhage, according to New York University, where Dr. Pnueli (pronounced p'new-EL-ee) was a professor of computer science.

In their first few decades, computers were essentially glorified calculators. Numbers were fed in, and after some calculating the answers came out. By the 1970s, programmers knew how to verify that the programs were performing such calculations correctly.

But as computers became more powerful and software more sophisticated — juggling multiple tasks and responding to changing data — verification grew harder. Programmers had to take into account the behavior of the system over time as it responded to new data or instructions while calculating.

In researching the problem, Dr. Pnueli, then at Tel Aviv University, came across the work of the philosopher Arthur Prior, who had developed "tense logic" to evaluate statements whose truthfulness changes over time.

Take the statement "I am tired," for example. While its meaning does not change, it is sometimes true and sometimes less so, and a person acts differently depending on the extent of tiredness — going to bed versus going on a hike.

In much the same way, a computer's actions must often adjust to circumstances. If the hard disk

is busy reading data for another process, then a command to write data to the hard disk must wait.

"What Pnueli realized is this logic is actually a perfect fit for computer science," said Moshe Y. Vardi, a professor of computational engineering at Rice University.

Dr. Pnueli's findings on using Prior's concepts (now more commonly known as temporal logic) in computer systems appeared in a landmark 1977 paper, "The Temporal Logic of Programs."

In 1996, Dr. Pnueli received the A. M. Turing Award from the Association for Computing Machinery, an honor often called computer science's equivalent of the Nobel Prize. The award citation said his 1977 paper "triggered a fundamental paradigm shift in reasoning about the dynamic behavior of systems."

Chip makers now use software employing temporal logic to verify that the millions of transistors are calculating as designed, and programmers use temporal logic to minimize the number of bugs in their software.

"All these things are the result of Amir Pnueli's work over 30 years ago," Dr. Vardi said.

Amir Pnueli was born on April 22, 1941, at Nahalal, in what is now Israel. He earned a bachelor's degree in mathematics from the Technion-Israel Institute of Technology and a doctorate in applied mathematics from the Weizmann Institute of Science, writing a thesis on the calculation of ocean tides. He switched to computer science as a postdoctoral fellow at Stanford and then moved to positions at the Watson

Research Center of I.B.M. in Yorktown Heights, N.Y., and at Weizmann.

He founded the computer science department at Tel Aviv University in 1973 and served as its first chairman. In 1981 he returned to Weizmann as a professor of computer science. He joined the computer science department at N.Y.U. in 1999.

Dr. Pnueli also founded two software companies, Mini-Systems in 1971 and AdCad in 1984.

His awards include the Israel Prize, the highest honor given by the State of Israel, and membership as a foreign associate in the National Academy of Sciences.

Dr. Pnueli is survived by his wife, Ariela; two daughters, Shira Pnueli-Levi of Nes Ziona, Israel, and Noga Pnueli of Brooklyn; a son, Ishay, of Hod Hasharon, Israel; and four grandchildren.



Amir Pnueli

