

THE SCIENCE AND TECHNOLOGY SPHERE

Scientific and technological developments have an essential contribution for a new and better tomorrow. Novel science and technology can affect society in unimaginable ways and forms that are worth exploring and researching. Will understanding the brain make us use it more effectively? How well does medicine know the patients it treats? How do we form opinions? And what does the future of technology hold for us?

Brain Research - The Wondrous Voyage into Ourselves

Science is grappling with the great enigma of the human brain and how it operates. Europe is focused on the "Human Brain Project," the Obama administration intends to invest billions in brain research, and Israeli scientists are also throwing themselves into the task. How much progress have we made in understanding the brain and what still remains to be discovered?

"The most intriguing enigma of mankind... from the brain and from the brain alone come all our feelings, all our sorrow and all our happiness. Solving the puzzle is not for curiosity only, it's an essential mission of mankind," says **Prof. Eilon Vaadia**¹. That is one of the main reasons why governments, foundations and private firms are in a race to reveal the mystery. For instance, the EU has granted 1 billion Euros towards the Human Brain Project (HBP) for mapping the brain over the next 10 years.

Prof. Henry Markram², coordinator of the HBP, believes that this will be achieved by the collaboration between neuroscientists and computer scientists using small amounts of data and many elaborate algorithms in order to make predictions and model the whole brain. As he puts it "we don't need one Einstein, we need 1000 Einsteins". The biggest benefit of this conquest, says Markram citing President Peres' letter, is "not becoming strangers to ourselves."

Prof. Idan Segev³, a collaborator of the HBP, is convinced that in order to understand the brain we must build a model representing the exact reconstruction of the brain and create a virtual brain in a supercomputer. "The next challenge is to simulate a whole neuronal tissue, and

understand how to fix it, through the model, when it malfunctions in neurodegenerative diseases such as Parkinson's and epilepsy."

Prof. Richard Frackowiak⁴ stated that in the near future the most common disease is going to be dementia. Even after extensive research, we don't know anything about the degeneration of the brain. He believes that "we do a lot of art of neurology and not enough of science," but is hopeful that the development of HBP will allow more science. "You may ask yourself, where can we find the data that will allow us to map the brain and make a model? The answer is that thousands of patients have had CT and MRI scans done. This huge amount of data, if anonymous, could be used in the HBP and allow more accurate diagnosis of degenerative diseases."

Dr. Inna Slutsky⁵ wishes to use the HBP in order to understand the principles of synapses and regulation of the plasticity of the brain, and the mechanism that turns a healthy brain to a sick brain.

Prof. Yadin Dudai⁶ is excited about the new options to be opened by the HBP. The immense amounts of data that we now have in this field is impossible to understand on our own: "For the first time in biology, we are relegating part of the understanding of the data to a computer."

The Medicine of Tomorrow: With an Eye to the Individual

Decoding the human genome and deepening our understanding of the human body enable us to not only identify the causes of a long list of illnesses but also understand that different people require treatment that is customized for and focused on the individual. In the future, will we have medicines and treatments that are individually tailored to our specific needs?

Prof. Rafael Beyar⁷ presented the topic of the session and regarded the following as essential and unforgettable in personalized medicine: "There is no separation between body and mind." He continues and focuses on two similar ideas. The first being that the patient is in the center, and the second being on the use of genomics in a way that we ensure that medicine is personalized and not the opposite.

Dr. Leroy Hood⁸ is a strong believer in the paradigm change in medicine, using systems medicine as a new approach to curing disease. The integration of big data with system biology and patient activated social networks leads

to a medicine which is Predictive, Preventive, Personalized, and Participatory, (4P) medicine that is Pro-action; focused on the individual and on wellness. The impact of the 4P is extensive, lowering costs of healthcare to the point where it will be exported to third world countries and wellness will be the new focus instead of health or treatment of diseases.

Prof. Dina Ben Yehuda⁹ presents Chronic Myelogenous Leukemia (CML) as one of the first diseases to which the treatment became individualized. The finding of Peter Nowell and David Hungerford of the translocation between chromosome 9 and chromosome 22 in every CML cancer cell led to the discovery of the Bcr-abl gene by David Baltimore in 1990. 53 years after finding the chromosome abnormalities, CML which was once a lethal disease, is now curable.

Prof. Henry Atlan¹⁰ reminds us of the tremendous progress made in understanding molecular and physiological pathologies and abnormalities, but still not all patients are cured. These cures have been dependent on statistics and clinical trials. Today we know that there is a wide range of reactions of, which is where personalized medicine enters. But, reliance on the DNA alone disregards the environment. "Not only the structure of the gene but also its activity" is regulated by many different chemical reactions and therefore with rare exceptions, DNA analysis will not tell people their future diseases. Atlan concluded: "Truly personalized medicine, if it will be achieved one day... will be achieved after, after, after tomorrow."

Prof. Howard Cedar¹¹ emphasizes that prevention of diseases requires a different level of understanding than treating a disease. A good scientist doesn't only look at a problem and fixes it, he tries to understand what caused the problem, and if it could be prevented by making alterations. The better one understands the way a machine works, the more you can prevent problems. A higher level of medicine is not one where we can do more to treat the disease, but one where the emphasis is on wellness of the patients.

It's all in Your Head: How Do We Really Form Opinions?

Different scientific fields interconnect to give us a greater understanding of the process by which we perceive the world around us and form an opinion about it. What does modern research teach us about this process and what is yet to be discovered? Does this greater understanding increase the temptation to interfere with the processes of human perception in order to influence human behavior?

Prof. Maya Bar Hillel¹² introduced the panel as not based on how people affect other people and their opinions, but rather the processes taking place completely in one's mind.

Prof. Richard Axel¹³ studies how the sensory world, which is rich and full of "analog" signals, is represented in the brain, which functions by binary output of neurons. "One of the temptations of having a brain is to try and understand it." Taking the sense of smell as a case study, the actual smelling is carried out by olfactory receptors, encoded by more than 1,000 different genes out of 20,000 genes in mammals, which emphasizes the evolutionary importance of this sense to survival. A given odor will activate 50 receptors, and 10²³ different odors can be discriminated. Brain imaging techniques illustrate a random projection for every odor, which differs between individuals. The map of the odors in the cognitive cortex seems to be at random, making different patterns in each individual. "These sensory cortexes are blank slates when neural information is collected and entrained by learning experiences." These two pathways allow each person to have a different perception of certain smells. Therefore, one must conclude that deciphering smells is not an innate feature, but rather a new start for every new odor.

Prof. Noam Sobel¹⁴ discussed the sense of smell as one that is critical to our opinion formation. Mammals use it for many intricate and complex assignments, including "social chemosignaling," to gain information of creatures of the same kind. Dramatic effects in rodents such as menstrual synchrony take place when several females live together for a long period of time and depend on factors mediated by the sense of smell; and there's a growing notion of similar patterns in humans. The pheromones involved were shown to be transferred by sweat, but other media can be used to pass chemosignaling factors, including blood, urine, tears and even the possible unconscious response of people to handshaking – bringing the hand close to the nose after a while, so as to smell and form an opinion of the person they have just met.

Dr. Hillel Aviezer¹⁵ investigates illusory valence in highly intense facial expression. Although psychological models predict sharp distinctions between positive and negative facial expressions, all previous experiments were using exaggerated and clearly differentiated posed expressions, which is not usually the case in real life. To probe this issue, Aviezer and his group use facial images taken from the internet and explore people's deciphering of emotions in isolated bodies and faces separately. The results indicate that effective body context can change perceived facial valence, especially when dramatic emotions are involved.

Aviezer concludes: "Next time you use the expression "read my lips" think again - it should be: Read my hips!"

Prof. Daniel Kahneman¹⁶ defined the act of knowing as the absence of doubt or the proposition of something that is true. We believe in things when told by people we trust, and our mind is composed of two functionally distinct systems: First, the automatic, fast, even unconscious system that makes most of our everyday decisions. However, when this system is troubled and faces difficulties, the second system kicks in, and it's much more attentive and slower. Both systems work with a different notion of coherence: the first works when ideas fit, both emotionally and associatively. If ideas contradict or mismatch, then the second system is called to solve the incoherence or ambiguity. By this logic, essence of knowing things is that there is no other way to interpret the world, and belief in conclusions seems to make us believe in the original arguments. Thus although we may regard ourselves as rational and self-conscious creatures, in fact our opinions are at the mercy of our senses and outside forces.

New Media – Is It Still Renewing?

The technology panel, hosted by **Dr. Yossi Vardi**¹⁷ dealt with the future of social platforms, and the panelists sought to analyze the possible new directions to which these networks will turn in years to come.

Tim Armstrong¹⁸ stated that megatrends will affect our lives and emphasized the growing importance of video and content in the way we use the internet. If video traffic today accounts for half of internet traffic, Armstrong believes it will span as much as 90% in the future. "The power of new social media is the power of distribution."

Weili Dai¹⁹ agreed that future network technologies will work together seamlessly, and will start video content and fast connection deploying LTE instead of 3G, along with high security standards. Dai also referred to the local and global levels of network and software companies, stating "globalization of internet is key. But we need to focus on optimization for localization." In the One on One session with **Udi Segal**²⁰ she stressed the idea of global connectedness and cooperation with the common idea that "technology drives everything."

Digital technology has a huge impact on the advertisement market. **Maurice Lévy**²¹ stated that "there's a huge change in the way we're communicating with people, the way our messages are produced." The paradigm is that

on the one hand, a billion subscribers are connected and exchange thoughts and ideas, and on the other hand the communication is based on one-on-one interactions. Google, Facebook and AOL have the advantage of Intelligence Quotient (IQ) and Technology Quotient (TQ) and TQ rich resources, that is the intelligence and technology knowledge required, but they don't necessarily beat the smaller companies in Emotional Quotient (EQ) – the emotional aspect of understanding the consumer and meeting his needs, mediated by creative people.

René Obermann²² envisions a lifestyle that is becoming more and more mobile. Not only an increasing use of mobile phone, but even connecting digital glasses and clothes, all integrated into one network. This will result in an incredible uprising surge of traffic that will pose serious challenges to future network operations to avoid data traffic jams. He thinks the paradigm should be changed to be more user-friendly even for the generation that did not grow up with the Internet.

Marc Benioff²³ shared his excitement over the technological flurry we're experiencing: "We're fortunate to be alive right now to be able to witness this incredible renaissance." He identified seven properties of successful companies and organizations: involvement of social networks; mobility; big data and analytics- dealing with high data traffic; the ability to build communities fast; accessibility; cloud- so that you don't have to install and maintain your own infrastructure, and lastly: trust, and the ability to create a company that communicates between employees and customers.

Robert LoCascio²⁴ expressed his belief that Israel should stop focusing on its survival and advance beyond "the start-up nation" title to create global international big companies. He gave his own company as an example, which stock price jumped by \$10 largely thanks to investing in Israel and developing infrastructure and manpower here. On this note, Benioff stated that "the most creative and entrepreneurial people in the world are in Israel."

Richard Gelfond²⁵ was optimistic regarding the future of cinema entertainment amidst the threat of small mobile screens and home movies. "People are social animals. I don't think they want to be chained to their couches and tablets... They want to go out and interact with other people." The wide screen and powerful cinema experience are indispensable for movies based on special effects. The barriers to make movies will be lowered by the digital era, and initial attempts to film full-time movies using iPhones can be found already today.

Concerning the future of social networks, Armstrong claimed that mass social networks will diminish soon, and their nature will gradually return to supporting a reasonable amount of acquaintances. In Levi's opinion, however, the digital social networks still didn't fulfill their potential.

John Chambers²⁶ said in the One on One session with **Udi Segal**²⁷, "If you don't change, you get left behind" – which is true for countries as much as it is for companies. Global cooperativeness instead of government is the future of the world economy. Chambers believes that Israel should work hard to create more jobs to shrink the gap of haves and have-nots. Each company can give back and help in its own way.

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- 1 Prof. Eilon Vaadia (Israel) is the Director of the Edmond and Lily Safra Center for Brain Sciences and The Jack H. Skirball Chair & Research Fund in Brain Research at the Hebrew University of Jerusalem.
 - 2 Prof. Henry Markram (Switzerland) is a Professor of Neuroscience at the Swiss Federal Institute for Technology (EPFL). He is the Founder of the Brain Mind Institute, Founder and Director of the Blue Brain Project, and the Coordinator of the Human Brain Project, one of two ten-year one billion Euro Flagship Projects recently approved by the European Commission.
 - 3 Prof. Idan Segev (Israel) is the David & Inez Myers Professor in Computational Neuroscience and the Director of the Department of Neurobiology at the Hebrew University of Jerusalem.
 - 4 Prof. Richard Frackowiak (Switzerland) is the Director of the Department of Clinical Neuroscience and Head of Service of Neurology at the CHUV University Hospital in Lausanne.
 - 5 Dr. Inna Slutsky (Israel) is a Senior Lecturer at the Faculty of Medicine and the Sagol School of Neuroscience at Tel Aviv University.
 - 6 Prof. Yadin Dudai (Israel) is the Sara and Michael Sela Chair in Neurobiology at the Weizmann Institute of Science in Rehovot (Israel) and the Albert and Blanche Willner Family Global Distinguished Visiting Professor of Neural Science at New York University (NYU).
 - 7 Prof. Rafael Beyar (Israel) is the CEO and Director General of the Rambam Health Care Campus in Haifa. Previously, he served as the Dean of the Rappaport Faculty of Medicine at the Technion as well as Professor of Biomedical Engineering and Medicine.
 - 8 Dr. Leroy Hood (USA) is the President and Founder of the Institute for Systems Biology and one of the world's leading scientists in molecular biotechnology and genomics. Hood is a key player in the Human Genome Project and also played a pioneering role in deciphering the secrets of antibody diversity.
 - 9 Prof. Dina Ben Yehuda (Israel) is the Norman Green Professor of Hematology at the Faculty of Medicine of the Hebrew University in Jerusalem and Head of the Department of Hematology at the Hadassah University Hospital.
 - 10 Prof. Henri Atlan (France) is Professor Emeritus of Biophysics at the University of Paris VI and the Director of the Human Biology Research Center and of the Department of Medical Biophysics and Nuclear Medicine at the Hebrew University-Hadassah Medical Center.
 - 11 Prof. Howard Cedar (Israel) is the Edmond J. Safra Distinguished Professor at the Faculty of Medicine of the Hebrew University of Jerusalem and Chairperson of the Department for Developmental Biology and Cancer Research at the Institute for Medical Research, Israel-Canada (IMRIC).
 - 12 Prof. Maya Bar-Hillel (Israel) is Professor Emeritus at the Department of Psychology at the Hebrew University of Jerusalem. A former Head of the Center for the Study of Rationality at the University, she is an expert in the psychology of judgment and decision making, probabilistic reasoning and rationality.
 - 13 Prof. Richard Axel (USA) is a University Professor at Columbia University, Professor of Biochemistry and Molecular Biophysics and of Pathology at Columbia University's College of Physicians and Surgeons, and Investigator of the Howard Hughes Medical Institute. In 2004, together with Linda B. Buck, he won the Nobel Prize in Physiology or Medicine.
 - 14 Prof. Noam Sobel (Israel) is the Head of the Olfaction Research Group in the Department of Neurobiology at the Weizmann Institute of Science.
 - 15 Dr. Hillel Aviezer (Israel) is Senior Researcher at the Psychology Department of The Hebrew University of Jerusalem. His research is focused on understanding the behavioral and neuropsychological dynamics of social and emotional perception and expression.
 - 16 Prof. Daniel Kahneman (Israel/USA) is a Senior Scholar at the Woodrow Wilson School of Public and International Affairs and Professor of Psychology and Public Affairs Emeritus at the Woodrow Wilson School, the Eugene Higgins Professor of Psychology Emeritus at Princeton University, and a fellow of the Center for Rationality at the Hebrew University in Jerusalem. In 2002, Kahneman won the Nobel Prize in Economic Sciences.
 - 17 Dr. Joseph "Yossi" Vardi (Israel) is an angel investor and hi-tech entrepreneur and Chairman of International Technologies.
 - 18 Mr. Tim Armstrong (USA) is the Chairman and CEO of AOL. He served as President of Google's Americas operations and served on the company's operating committee.
 - 19 Ms. Weili Dai (USA) is the Co-Founder of the Marvell Technology Group. She is the only woman co-founder of a global semiconductor company.
 - 20 Mr. Udi Segal (Israel) is a journalist and the Diplomatic Correspondent of Channel Two News Israel.
 - 21 Mr. Maurice Lévy (France) is Chairman and CEO of *Publicis Groupe*, the world's third largest advertising and communications group.

- 22 Mr. René Obermann (Germany) is the Chief Executive Officer of Deutsche Telekom AG. Formerly, he served as the CEO of T-Mobile International AG & Co. KG and the Deutsche Telekom Board Member for Mobile Communications.
- 23 Mr. Marc Benioff (USA) is the Founder, Chairman and CEO of salesforce.com, a cloud computing company. Benioff served as Vice President of the Oracle Corporation and was Co-Chairman of the President's Information Technology Advisory Committee under President Bush.
- 24 Mr. Robert LoCascio (USA) is the Founder and CEO of LivePerson, Inc.
- 25 Mr. Richard Gelfond (USA) is the Chief Executive Officer of IMAX, one of the world's leading entertainment technology companies, specializing in immersive motion picture technologies.
- 26 Mr. John Chambers (USA) is the Chairman and CEO of Cisco. He served as Vice Chairman of the President George W. Bush National Infrastructure Advisory Council (NIAC), and on President George W. Bush's Transition Team and Education Committee, and on President Bill Clinton's Trade Policy Committee.
- 27 Mr. Udi Segal (Israel) is a journalist and the Diplomatic Correspondent of Channel Two News Israel.