

Fellows of the Royal Society from Punjab

## Khush: Mitigating Hunger

**Gurwinder Singh**

Gurdev Singh Khush, agronomist and geneticist, popularly known as the ‘Father of Rice Revolution’, was born in 1935 at Rurkee in Jalandhar district of Punjab in British India. His school had a single room with a single teacher who taught four different classes. He grew up facing extremely hard conditions and studied until late at night with a kerosene lamp as there was no electricity at home. In high school, he enjoyed writing poetry and added “Khush” to his name which means happy or joyful. After studying plant breeding in Punjab, he went to University of California, Davis and earned his PhD in Genetics in 1960. After completing his studies, he served as a faculty member at the University of California for seven years. Later, he joined the International Rice Research Institute (IRRI) in Philippines as a plant breeder in 1967. Before joining IRRI, he had never seen a paddy plant because paddy is not a traditional crop in Punjab.

Henry Beachell from the IRRI and Dr Khush began crossing IR8, a variety of paddy, with at least thirteen other varieties from six nations and eventually developed IR36, a short-height variety with high resistance to pests and diseases. IR36 matured very fast, in only 105 days instead of 130 days of the IR8 and 170 days of other traditional varieties. By the 1980s, at least eleven million hectares were planted with IR36 around the world. As a result, many paddy-producing countries became self-sufficient and some became exporters of rice, including India. Khush’s contribution in the developing world is truly immense,


especially when the population was growing at a very fast pace in the Third World. He developed and improved more than 300 varieties of paddy. He visited and promoted research and training programmes in many paddy-growing countries and helped local farmers to grow modern varieties of paddy.

Dr Khush was awarded the world’s top prizes in agriculture including the Japan Prize (1987), the World Food Prize (1996) in the U.S., the Padma Shri (2000) from the President of India and the Wolf Prize in Agriculture (2000) from Israel. He was nominated Fellow of the Indian National Science Academy (1978), U.S. National Academy of Sciences (1989) and the Royal Society of London (1995). He was awarded an honorary doctorate from Cambridge University and by various other universities in the U.S., India, England and Canada. Dr Khush joined University of California, Davis as an Adjunct Professor in 2002. He established the Dr Gurdev Singh Khush

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HERscope

## BUSHRA ATEEQ: Curing Prostate Cancer



**Nandita Jayaraj and Aashima Freidog**

Every so often, Bushra Ateeq receives emails from around the country asking for advice. Most of these emails are from people who believe that her research on cancer can help cure their loved ones of some form of this dreaded disease.

Bushra tries her best to help out, but she always lets them know that, as a molecular oncologist, her research, no matter how ground breaking, has still not made its way to clinics. However, she is determined that one day it will.

As a little girl, Bushra liked – just for fun – to collect biological samples of grasshoppers, wasps, butterflies, seedlings and such. Once, she even caught a small bird and brought it home. Her parents scolded her for trapping the poor bird, but saw this as a sign of natural curiosity in their daughter. To encourage her interest, they gladly bought her scientific objects like a prism and magnets.

As her interest in biology deepened, Bushra learned about genes and their mutations, which are the small changes that develop in genes. She started her scientific journey by studying the damage that occurs in fish DNA on account of the fish being exposed to chemicals used in agricultural fields. The results of her study horrified Bushra. If these chemicals can cause so much of damage at the chromosome level, surely they might also be affecting the human body when we consume food and water from toxic environments? she pondered.


This was the movement Bushra’s scientific interest shifted simply studying mutation to studying human diseases like cancer. Cancer is a deadly disease in which cells in particular part of the body keep dividing, forget to die and cause havoc in the body, often leading to death. Cancer is caused by mutations in genes that we can acquire from environment toxins and stresses. It can even occur naturally in a person if an error in DNA goes unchecked or if a person is born with the tendency to develop cancer. Usually, a single mutation is unlikely to cause cancer, but multiple mutations over a lifetime could trigger the disease. Fascinated by the world of cancer biology, Bushra decided that this was the field for her.

She re-trained herself in cancer biology. After two years of training, Bushra was ready to work on cancer research herself. Over the next seven years, she gathered more experience at famous labs in Canada and United States of America. Finally, the self proclaimed ‘late bloomer’ was ready to return to her country as an expert in prostate cancer.

As the lifespan of the average India increases, age-related diseases like

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Guest Column



**Rahul Siddharthan**

We live in a data-driven world. “Big data”, “machine learning”, “artificial intelligence” are buzzwords pervading all aspects of life. Corporations such as Google and Facebook harvest enormous amounts of user data with the aim of individualized suggestions, localization, machine translation, and more importantly, targeted advertising. In basic sciences too, new experimental techniques as well as the increasing acceptance of an “open data” philosophy has caused the amount of available data to explode, perhaps even outstripping scientists’ capability to analyse such data.

“Machine learning” simply means using a computer to identify patterns in data. This may be “unsupervised” (for example, the computer can identify clusters in a dataset that indicate that it is a mixture of different populations); or it can be “supervised” (after “training” on an annotated dataset, the computer program is asked to annotate a new dataset; for example, the goal could be diagnosis of a disease given various clinical parameters and test results and the computer could be shown various examples with a confirmed diagnosis, and then provide a diagnosis in new cases).

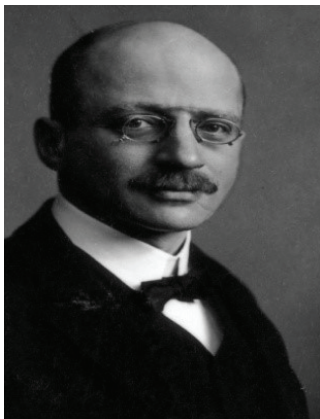
Machine learning tasks can vary from simple classification and prediction problems to tasks (such as image recognition) that are considered hard for a computer but easy for a human being. For the former, several well-understood and widely-used techniques exist, from linear regression (writing the output as a linear function of the inputs, learning the coefficients from training data), to variants such as logistic regression (transforming the output into a binary value), decision trees and tree-based methods (random forests, gradient boosting), support vector machines and more. Efficient implementations for all these things are freely available in toolkits such as python’s scikit-learn library.

But for the harder tasks, these do not suffice. For example, humans can easily recognize faces of other humans as well as everyday objects. Humans can also write prose, poetry, music, create artwork and prove theorems.

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Do you Know?



Fritz Haber  
(1868-1934)

Fritz Haber was a Prussian chemist, famously known for his work on the Haber-Bosch process. Through his research, he contributed to the fields of electrochemistry, textile and surface chemistry etc. He is known for his work on the production of ammonia gas, from nitrogen and hydrogen, on an industrial scale. Haber's discovery was used for the artificial production of fertilizer and also, munitions. His discovery boosted the agriculture sector all across the globe as it increased crop production. This, in turn, went a long way in solving the global hunger problem. For his role in ammonia synthesis, Haber received the Nobel in Chemistry in 1918. However, during the First World War, he was also the chief of Chemical Warfare Service in Germany. He is responsible for initiating chemical warfare during the First World War. He helped in developing a technique that released toxic chlorine gas, which led to the death of thousands of enemy soldiers. For his role in the War, Haber was severely criticized by the scientific community the world over.

(Courtesy: Daniel Charles, *Master Mind: The Rise and Fall of Fritz Haber, the Nobel Laureate Who Launched the Age of Chemical Warfare*, Ecco, 2005.)

Curated: Aryan Chugh

Wonders

Botanical Garden: Shrubs, Climbers, Plants



Parampreet Singh

The role of Botanical Gardens is to maintain a documented collection of living plants for their conservation, propagation and distribution, scientific research, education and display. S.S. Bir Botanical Garden at Punjabi University, Patiala has a variety of documented, labelled and scientifically arranged plants. Dr K.S. Narang, the then Vice Chancellor of Punjabi University, inaugurated the Garden. It is well laid out and spread over 25 acres of land, including twelve acres of natural vegetation.

The Botanical Garden has a plant wealth of more than 750 species, which includes trees, shrubs and climbers. The plantation in the Garden is based upon the Bentham and Hooker's system of classification and is divided into four sectors named Rosarium, Gymnosperms,

Bamboo and Palm, Arboretum and Shrubs and Climbers. Each sector is further subdivided into sections which include Rosarium, Glass House, Bamboo Section, Palm Section, Gymnosperm Section, Arboretum, Succulent Section, Fern House, Bougainvillea Section, Tropical House and VIP Section. The Rosarium has a collection of forty-eight varieties of Roses. In the Glass House are planted xerophytic plants. The Bamboo Section has a collection of sixteen species of bamboos. The Gymnosperm Sector includes a Palm Section which has twenty different palm species. The sector has also a collection of sixteen Gymnosperm species. The Arboretum Sector includes indigenous and exotic trees, trees of aesthetic and recreational value along with timber trees. The Aquatic

Plants Section contains about twenty different types of plants. The Succulent Section has a collection of over sixty cacti and succulents. In the Fern House are planted various ferns and some shade and moisture-loving plants. The Tropical Plant House is equipped with mechanised mist system to maintain humidity essential for the plants of tropical region. The Bougainvillea Section has a rich collection of about thirty-six varieties of Bougainvillea.

The VIP Sector of the Garden is reserved for plantations by eminent personalities visiting the University from time to time. Important dignitaries who have planted saplings include Dr Manmohan Singh (Former Prime Minister of India and then Chairman of UGC), Dr M.S. Swaminathan (Father of Green Revolution), Mother Teresa (Nobel Laureate) and General M.M. Naravane (Chiefs of Staff Committee and Chief of Army). The rare plants which are of attraction for the visitors include *Ginkgo biloba* (Maiden hair Tree), *Elaeocarpus ganitrus* (Rudraksh), *Sapindus mukorossi* (Sweet Soapnut), *Costus pictus* (insulin plant), *Tylophora indica* (Asthma curing plant) and *Stevia rebaudiana* (Stevia plant).

S.S. Bir Botanical Garden is  
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Khush: Mitigating Hunger

Foundation, a non-profit organization for the advancement of Agricultural Studies to promote agricultural development in Punjab in 2010. At present, he lives in Davis with his wife, Dr Harwant Kaur Khush.

(Source: [www.worldfoodprize.org/en/laureates/19871999\\_laureates/1996\\_beachell\\_and\\_khush/](http://www.worldfoodprize.org/en/laureates/19871999_laureates/1996_beachell_and_khush/) [www.youtube.com/watch?v=k6Y6U4-S3fk](http://www.youtube.com/watch?v=k6Y6U4-S3fk))

Iconoclast

Rito Chophi

Galileo Galilei is a world-famous Italian astronomer, physicist and philosopher. He was born on 15<sup>th</sup> February 1564 near Pisa. He began to study medicine at the University of Pisa but shifted to philosophy and mathematics. In 1589, he became Professor of Mathematics at Pisa. In 1592, he began teaching as a Professor of Mathematics at the University of Padua, a position he held until 1610. During this time, he worked on a variety of experiments, including the speed at which different objects fall, mechanics and pendulums. In 1609, Galileo heard about the invention of the telescope in Holland. He constructed a superior version and made many astronomical discoveries. These included mountains and valleys on the surface of the moon, sunspots, the four largest moons of the planet Jupiter and the phases of the planet Venus. His work in astronomy made him famous and he was appointed Court Mathematician in Florence. On January 7, 1610, he turned his 30-power telescope toward Jupiter and found three small, bright stars near the planet. One was off to the west, the other two were to the east, all three in a straight line. The following evening, Galileo once again took a look at Jupiter and found that all three of the "stars" were now west of the planet, still in a straight line. Observations over the following weeks led Galileo to the inescapable conclusion that these small "stars" were actually small satellites that were rotating around

The Italian Star Gazer



Jupiter. If there were satellites that did not move around the Earth, wasn't it possible that the Earth was not the center of the universe? Couldn't the Copernican idea of the Sun resting at the center of the solar system be correct?

In 1612, Galileo published his *Discourse on Floating Bodies* and, in 1613, *Letters on Sunspots*, in which he openly expressed his support for the first time for Copernican heliocentrism – a theory that the Sun was at the centre of the Solar System. Thereafter, he was summoned to appear before the Inquisition in Rome. He was convicted and sentenced to life imprisonment,

which was later reduced to permanent house arrest at his villa in Arcetri, south of Florence. He was also forced to publicly withdraw his support for the Copernican theory. After his death on January 8, 1642, he was not buried in the family vault for fear of Papal disapproval. "He occupied himself with almost every branch of physics, but is chiefly remembered for the example he gave of the efficacy of the hypotheco-deductive method combined with quantitative experiments. In general history too he occupies an important place because of his personal fate, which was an important factor in the widening fissure between natural science and the spirituality of the counter-Reformation". The Church eventually lifted the ban on Galileo's *Dialogue* in 1822 – by that time, it was common knowledge that the Earth was not the center of the Universe. Still later, there were statements by the Vatican Council in the early 1960s and in 1979 that implied that Galileo was pardoned and that he had suffered at the hands of the Church. Finally, in 1992, the Vatican formally and publicly cleared Galileo of any wrongdoing.

(Source: *Stanford Encyclopedia of Philosophy*, [www.plato.stanford.edu/entries/galileo/](http://www.plato.stanford.edu/entries/galileo/) [www.thoughtco.com/galileo-galilei-biography-1991864](http://www.thoughtco.com/galileo-galilei-biography-1991864) Ioan James, *Remarkable Physicists: From Galileo to Yukawa*, Cambridge UP, 2004)



## Narinder Singh Kapany The Magician with the Indian Optical Rope Trick

Parampreet Singh

Narinder Singh Kapany is also known as the 'Father of Optic Fibres'. He was a scientist, teacher, entrepreneur, philanthropist and a patron of art. He coined the term fibre optics and played a leading role in developing the optical fibre which could transmit data quickly and efficiently. Among his many achievements are over 120 patents under his name.

Narinder Singh was born on 13th January 1926 to a Sikh family in Moga district of Punjab. He completed his early education from Dehradun and went on to complete his graduation from Agra University (now Bhimrao Ambedkar University). After completing his graduation, he worked at the Indian Ordnance Factories Services as an officer where he was working on design and manufacturing of the optical instruments. Working there, Narinder Singh gained more interest in optical instruments. To study further about this technology, he went on to get a PhD from Imperial College, London. He was successfully able to transmit a high resolution image through a bundle of glass fibres with very high efficiency. He used to show the workings of optical fibre to common people by calling it 'Indian optical rope trick'. By 1965, he had authored and co-authored 56 research papers in this field.

After a conference in Italy where he demonstrated the workings of optical fibre, he was offered to join University of Rochester as faculty.



He was later to join the faculty at University of California, Berkeley and University of California, Santa Cruz. Narinder Singh was a promoter of entrepreneurship. He established the Centre for Innovation and Entrepreneurial Development (CIED) at University of California, Santa Cruz. He also taught in the Department of Physics at Stanford University. Kapany established the Chair of Opto-Electronics at University of California, Santa Cruz. He endowed other chairs as well in University of California schools. In 1979, Dr Kapany, along with other University of California faculty, set up the University of California Santa Cruz Center for Innovation and Entrepreneurial Development (CIED). He was a Member of National Inventor Council, USA and a fellow of Optical Society of America, Royal Academy of Engineering and American Association for the Advancement of Science. Kapany was also the founder of Optics Technology, Kaptron Inc. and K2

Optronics.

Narinder Singh was a promoter of Sikhism and was a Sikh art patron. He established the Chair of Sikh Studies at University of California, Santa Barbara. Kapany also formed the Sikh Foundation in 1967 in California. He helped construct a new building at Asian Art Museum in San Francisco where Sikh art donated by Narinder Singh Kapany is put on display. He was a trustee of the University of California, Santa Cruz Foundation and Menlo School, California.

Narinder Singh Kapany is well known in the scientific community for his work that changed the face of internet, communication and medical technology. Medical technology like endoscopy and laser treatment became efficient because of his feat. He was named among top ten scientists of 20th century by *TIME*. He was considered "Unsung Hero" of 20th century by *Fortune*. He passed away on 4th December, 2020. He was awarded India's second highest civilian honour, the Padma Vibhushan posthumously. The world remembers Narinder Singh Kapany as 'The Man who bent Light'.

(Sources:

[www.economictimes.indiatimes.com/industry/telecom/telecom-news/narinder-kapany-unsung-hero-who-coined-term-fibre-optics-and-touched-billions-of-lives/articleshow/80324973.cms](http://www.economictimes.indiatimes.com/industry/telecom/telecom-news/narinder-kapany-unsung-hero-who-coined-term-fibre-optics-and-touched-billions-of-lives/articleshow/80324973.cms)

[www.tribuneindia.com/news/punjab/narinder-kapany-unsung-hero-who-coined-term-fibre-optics-and-touched-billions-of-lives-200123](http://www.tribuneindia.com/news/punjab/narinder-kapany-unsung-hero-who-coined-term-fibre-optics-and-touched-billions-of-lives-200123))

### An Ode to Science

#### "The Tomb of Galileo"

Walter Malone

But here lies one, the brave, the great, the good,  
Worth all the kings and queens the whole world round;  
Make bare your head in reverential mood,  
For here indeed you tread on Holy Ground.

His life, from selfish earthly motives purged,  
Was consecrated unto you and me;  
He took the blow, that we might go unscourged,  
And wore the chains, that we might wander free.

He found the long-lost Pleiad, Saturn's band,  
And brought Jove's moons to yonder Tuscan hill;  
The second Joshua, at whose command  
The heavens ceased turning and the sun stood still.

The moon in starry-frosted skies of night  
Shall write in splendor Galileo's name,  
And sun to sun at noon and morning light  
Shall blazon heaven with Galileo's fame.

*Selected Poems*, John P. Morton & Company, 1919, pp. 161-162, Lines 13-28.

### Guest Column ... Continued from page 1

"Artificial intelligence" is the goal of teaching computers how to perform such tasks. While this has been a field of study for decades, a tremendous amount of progress has been made in the last ten years. The breakthrough has been the development of "deep learning".

Artificial neural networks have been studied in the 1940s; these can be regarded as implementations of learning functions on input data using artificial neurons that combine their inputs into outputs that further feed into other neurons, or eventually emerge as outputs to be read. (A pioneer in this field, John Hopfield, is a co-winner of this year's Boltzmann medal for Statistical Physics. The other winner is Deepak Dhar, currently professor emeritus at IISER Pune.) For

decades, neural networks consisted of an input layer, an intermediate layer and an output layer. But in the last decade, improvements in computing hardware have enabled "deep networks" that have many intermediate layers. It turns out that these are capable of performing extremely sophisticated tasks and now serve as the engine behind image recognition, speech recognition, machine translation and much else at corporations including *Google*, *Apple*, *Facebook* and *Microsoft*. They have also penetrated academic research. Again, free open-source toolkits for deep learning, such as Tensorflow (*Google*), PyTorch (*Facebook*) and CNTK (*Microsoft*), are widely used in both academia and industry.

A particular arrangement of deep

networks called a "generative adversarial network" (GAN) has proved extremely powerful in text and image generation; the idea here is that the network has a "generator" that tries to generate realistic data and a "discriminator" that tries to distinguish synthetic from real data; the generator tries to fool the discriminator and the discriminator tries not to be fooled and both, essentially, learn from each other.

While applications of these technologies are limited only by the human imagination, a particularly important role could be played in clinical research and diagnostics, a current interest of several in India including myself. Machine-learning and AI may be able to see patterns in data that are not evident

even to the most experienced doctors. Such techniques can also combine multiple factors in ways that a human would not be able to do. If validated, the result would greatly improve diagnostics, predictive power for disease outcomes and targeted interventions. This field is in its infancy and most medical literature still uses extremely basic statistical analysis, but the future is exciting. This field requires collaboration across multiple communities: clinicians, basic biologists, computer and data scientists, modellers – all of whom will find the results rewarding.

(The author is a Professor of Physics at the Institute of Mathematical Sciences, Chennai.)

### Data, Machine Learning and Artificial Intelligence

### HERscope ... Continued from page 1

#### BUSHRA ATEEQ: Curing Prostate Cancer

prostate cancer become more common. Prostate cancer occurs in a walnut-shaped organ called the prostate gland, which is an organ only those born male have. After oral cancer, it is the second most common form of cancer found in Indian males. By 2020, the number of cases of prostate cancer is set to double. However, as it is a disease that mostly affects men as they get

older, it does not receive as much attention as breast or oral cancers. In fact, Bushra is one of the very few people in the country conducting research on this type of cancer.

Bushra wants to steer her research in a direction that will improve the lives of cancer patients as quickly as possible. She is looking for certain gene 'signatures' in prostate cancer

patients. These will help clinicians to tailor treatment according to the needs of individual patients. Bushra and her students conduct many experiments with mice in their laboratory to identify gene modifications that could reduce or completely stop the growth and spread of the cancer.

She also wants to change how prostate cancer is diagnosed.

In India, at the moment, painful tissue removal is the only way to test whether a person has cancer or not. Often, the wrong diagnosis is made. Bushra believes that she can come up with a less painful way of diagnosing prostate cancer, perhaps, through blood or urine. Along with prostate cancer, Bushra's group is also investigating breast cancer and

colon cancer. Managing and finding a cure of cancer has been at the top of many scientists' lists. Much progress has been made in the field, thanks to the hard work of researchers like Bushra.

(Courtesy: 31 *Fantastic Adventures in Science: Women Scientists of India*, Puffin, 2019.)



Wonders ... Continued from page 2

Botanical Garden: Shrubs, Climbers, Plants

recognized as Lead Botanical Garden by Ministry of Environment, Forest and Climate Change, Government of India, New Delhi. This Botanical Garden is internationally recognized under 'PATPU' abbreviation by International Association of Botanical Gardens (IABG). For further information please contact Head, Department of Botany, Punjabi University at head\_botany@pbi.

Quiz

1. What is the name of acid found in lemon?
2. Which metal is the most abundant metal in Human body?
3. Which phenomenon is used to see things around us?
4. Which organelle do ATP Phosphorylation in the cell?
5. Why cyclic AMP level is low when glucose levels are high?

Only the first three (3) respondents will be aptly rewarded.  
Submit your answers on: daljitami@pbi.ac.in



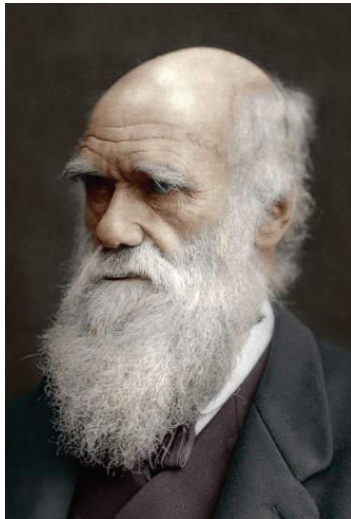
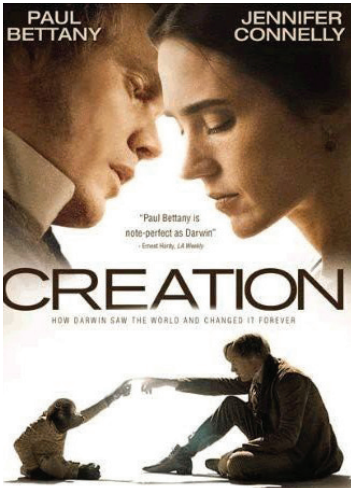
Curated: Rumanipreet Kaur

Science on Reel

Creation, 2009

Starring: Paul Bettany

The film showcases the struggles Charles Darwin had to face due to his work on the origin of species. When age-old religious beliefs clash with scientific point of view, it takes the form of a conflict between Doubt and Faith.



Curated: Brahamjeet Singh

Photo Gallery

Glimpses of Activites at Punjabi University Campus and Constituent Colleges during Science Week



Editor: Daljit Ami

Assitant Editor: Navjot Khosla

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