

1ST ANNIVERSARY

SPECIAL EDITION



A YEAR IN REVIEW
SCIENTIA PAKISTAN MAGAZINE

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Editorial Note

1st Anniversary Scientia Pakistan Magazine



Innovation distinguishes between a leader and a follower, whereas creativity could be a pass time or hobby, but the best creativity is a result of a lot of hard work, dedication, and inspiration. One and a half years ago, when I kick-started the planning of digital science, mainly an Astronomy magazine, I got an overwhelming response from science communities and astronomers societies. Still, the project got delayed multiple times due to the inconsistent attitude of our youth and Astronomers societies.

Finally, in February 2019, on the eve of Valentine's Day, we launched Scientia Pakistan magazine, thematically based on "love for science." A much-needed initiative in Pakistan and for one year I, along with my team, mostly University students, tried our best to provide equal opportunities to all the skilled science writers and to those who are willing to pursue an off-beat career in science journalism.

At times our stories caught the attention of international media and science communities like SETI Institute, Gulf News, and Khaleej Times, but we have had a hard time to convince our own media in Pakistan that science could be a genre in mainstream media. At its best, science writing is an emerging field of journalism worldwide that needs more than a desire to become a science writer. At present, we have been communication obstacles in Pakistan, the eroding truths in media, and misinformation in social media, as we have witnessed in ongoing Wuhan-virus-outbreak.

The situation is equally alarming as we may have such epidemic outbreaks or sort of natural disaster anytime in our country as well. We need skilled and super-intended science journalists and more science magazines as well as a science channel that broadcasts science news with all their authenticity.

We are striving for our dream of the first Pakistani science channel, and we believe that an idea never turns as reality so quickly, it takes sweat, determination, and a lot of hard work, and we have trust in our instinct and pursuit.

On the 1st anniversary, we are launching our special edition "Year in Review" in PDF format with a hope that "as long as there is hope, there is joy in living. I want to say a humble thank you to Yawar Hussain, Maham Maqsood, Abdullah Khan, Aniq Mazhar, Mubaris Bashir, and other team members who volunteered their precious time and energy to this magazine.

Enjoy your deal!

Saadeqa Khan

CEO/EIC Scientia Pakistan

Editorial

Goddard's Great Redemption

By [Saadeqa Khan](#)

In 1921, The New York Times discredited a discovery made by the father of modern rocketry, Robert H Goddard. This is a tale of how an innovator was lambasted, shunned and embarrassed ... only to be proven right 24 years after his death

Robert H Goddard

In the early 20th century, American physicist Robert H Goddard came across the idea of liquid fuel propellant while he was conducting a series of practical experiments in rocketry. Goddard, at least figuratively, was over the moon.

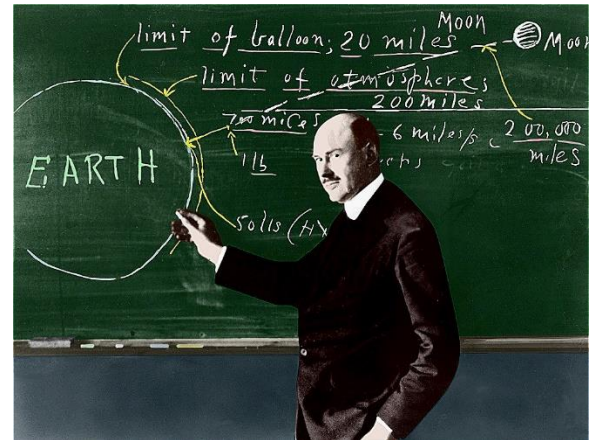
Goddard's fascination with space flight tracked back to his college days at Worcester Polytechnic Institute. He was actually interested in achieving higher altitude but it was a daunting task to build a liquid fuel rocket than solid –propellant rockets. Despite a lack of resources and sufficient funding, Goddard was able to build a liquid-propellant rocket by 1926. This was game-changing.

But the euphoria of Goddard's discovery did not leave everyone in awe.

Some thought he was a charlatan, others believed science could not have such a leap of discovery in the 1920s. Such was the disbelief in Goddard's work that the *New York Times* in an editorial not just ridiculed Goddard's intellect and integrity but, also accused him of not understanding Newton's third law of motion.

"Professor Goddard with his chair at Clark College and countenancing of Smithsonian Institution [from where he held the grant to continue his research independently] does not know Newton's third law of motion," read the editorial, "and the relationship between action and reaction, and of a need of something better than a vacuum against which to react. Of course,

he only seems to lack the knowledge ladled out daily in high schools."



In the same year, a similar campaign simultaneously sparked out another controversy when Goddard published one of his research works in *Scientific American* that intensified the prevailing wave of harsh criticism. This propelled other science outlets also arguing that space travel is nearly impossible. Some even claimed that rocketry can be traced back to more than 2,000 years and never had anyone been able to do the unthinkable: travel to space.

But Goddard was a scientist and such criticism by non-scientists was mere noise to him.

Perhaps the greatest influence and the lifelong gift of Goddard to humanity was his deep understanding of rocketry, inspiration, and celebration that space travel would be a reality in a few decades or so later. It was actually Goddard who initially outlined an uncrewed mission to the moon. Little did he realize that this work would become instrumental in American foreign and defense policy. Goddard's legacy has arguably quietly been absorbed by engineers and scientists at NASA and the Russian space agency, Roscosmos, who worked frantically on Vostok, Gemini, and Apollo space programs.

According to Goddard's works, a rocket should essentially be a heat engine that can able to convert the heat energy or chemical energy of fuel into mechanical energy. The critical component in this energy conversation was the nozzle from which the jet blew onto the wheels. Goddard along with his counterpart De Laval found that the best conversation takes place when the nozzle initially narrowed and eventually

gives rise in the speed of jet to the speed of sound. Using a De Laval nozzle, Goddard was succeeded to attain the real jet velocities between 7000 and 800ft/sec. Later with a specially designated compact device, he showed that rocket can work in a vacuum as well.

By then, NASA and several other space agencies were also working on the same principle of rocket propulsion but the only way they followed to learn was projecting heavy objects into the other planets of our solar system. At that time, it was widely assumed that when rockets acquired a certain escape velocity they are still in a thin layer of earth's atmosphere and it's almost impossible to survive for a rocket from the heat of reentry. Goddard was ahead of them in some ways and one of his rockets with explosive payload would successfully crash into the moon.

In 1919, Goddard published his research work entitled "*A method of reaching high extreme altitude*", *condensation* February 1920, *Scientific American* and *Nature* August 1920. The paper thoroughly explained the method of attaining high altitude around 20 miles, beyond the range for surrounding balloons and developed a theory of rocket propulsion taking into account the air resistance and gravity.

Goddard concluded with the statement that if most of the mass of the rocket consists of propellant, its superiority will increase enormously.

Fifty years after, when NASA's mission "Apollo 11" successfully landed on the moon with Neil Armstrong, Buzz Aldrin, and Michael Collins on July 1969, those who doubted that space travel was a possibility were left stunned. Those in scientific communities who had belligerently opposed the idea of a small capsule being able to land on the moon could not believe the images.

But it was the *New York Times* who first came to realize its biggest mistake — dismissing the notion of rocket propulsion and the scientist behind it.

"Further investigation and experimentation have confirmed the findings of Isaac Newton in the 17th century and it is now definitely established that a rocket can function in a vacuum as well as in an atmosphere. *The Times* regrets the error."

Though this correction was made 24 years after Goddard's death, history absolved him.

Scope of Cancer Research in Pakistan

By [Saadeqa Khan](#)



Cancer is a disease whereby affected body cells grow uncontrolled and deprives healthy body cells of nutrients and appropriate function. According to a fact sheet of WHO, released in 2017, cancer is a chief cause of mortality worldwide, resulting in every 1 per 6 deaths being cancer mediated. In 2019, around 140,690 cancer cases have been recorded in Pakistan, and a murky side is that the majority of these patients will continue their fight against cancer lifelong.

A recent **demo-graph** conducted by **JPMA** under the supervision of Agha Khan Hospital showed some common cause of cancer-related deaths in women is breast cancer, followed by Lung and blood cancer. But most of the population is entirely unaware of the causes behind the rapid growth in disease and of the fact that death risk can be minimized with early diagnosis or annual mammograms of women.

Certain risk factors are contributing to the fast pace of cancer cases, including Hormone deficiency, heredity, metabolic, or irregularity in the immune system. Whereas external sources

like alcohol, smoking, excessive radiation exposure, and imbalance in dietary are instrumental in this deadliest disease. Nanoparticle toxicity is another major cause of genetic mutations that can prove to be carcinogenic as these Nanoparticles are present in smoke, paints, and even in the air.

In Pakistan, no population-based study has been conducted so far to figure out the nationwide incidence of cancer cases. According to a rough estimation, Pakistan stands as a sixth nation in the world where more than **80 million of the total population** is suffering through such a chronic disease. However, cancer is needed to be monitored monthly with a proper cancer monitoring policy and prevention strategy.

Moreover, there is a severe lack of awareness for gender-based cancer types like breast, skin, and ovarian cancer; they are still a taboo subject in our society, patients and their families used to hide the diagnosis. A thorough analysis with detrimental effects on psych-social aspects of a patient's life should be done to identify the financial stress on the family when a member diagnosed with cancer. In this regard WHO provides an organized framework that maintains global guidelines on cancer enlistment and restorative coding data. In Pakistan, only Shaukat Khanum Memorial Cancer Hospital, working around 19 years, and Agha Khan Hospital Karachi, are contributing to information collection on cancer analysis and treatment and equally providing research facilities to tackle health challenges. SKMH has its own cancer registry and record of cancer cases which reveals an upward trend in progress and prevalence of breast/blood cancer due to the lack of awareness and facilities among patients.

Pakistan has no dearth of talent, our great scientists and researchers are working hard in the international organizations, and an example is **Dr. Waqas Usman Hingoro**, based in Liyari, a small town in the premises of Karachi, his research on advanced treatment of cancer has recently been published in prestigious Nature Communication journal. Dr. Hingoro with his team unleashed the ability of red blood cells' components called extracellular vesicles, which can successfully carry drug delivery nanoparticles (NPs) into the affected human body parts.

Nonetheless, we are short on job opportunities and cancer research facilities in our Universities and educational institutions. This inappropriate culture is the primary cause of unawareness as it never encourages local medical students and researchers to develop a strategy or a coping mechanism for our fight against cancer. However, navigation in the cancer path will be more straightforward when young researchers are provided with a proper support system and guidance. Our Government and private sector should prioritize investment in cancer and a committed training program and mentorship of next-generation scientists should be included in the equation.

Interview

Extraterrestrial life: A conversation with Dr. Bruce Damer

By Fatima Zahra

Bruce Frederick Damer, Ph.D. (brought into the world 31 January 1962) is a Canadian-American multidisciplinary researcher, creator, and creator. Dr. Bruce Damer works together with associates creating and testing another model for the starting point of life on Earth and in the plan of shuttle structures to give a reasonable way to the extension of human development past the Earth.

He started his profession during the 1980s building up probably the most punctual UIs for PCs, drove a network during the 1990s bringing the first multi-client virtual universes to the Internet, and since 2000 bolstered NASA and the space business on various reenactments and shuttle plans.

He has gone through 25 years chronicling the historical backdrop of registering in his DigiBarn Computer Museum and ministers files of counterculture figures, for example, Dr. Timothy Leary, Terence McKenna, and others. He at present fills in as Principal Scientist at DigitalSpace; Associate Researcher in the Department of Biomolecular Engineering at UC Santa Cruz; Associate of the NASA Astrobiology Center; Member of the International Society for the Study of the Origin of Life, and Founding Director of the Contact Consortium.

Additionally, he filled in as Visiting Scholar at the University of Washington and as an individual from the Faculty at Charles University, Prague. He got his Ph.D. from University College, Dublin; MSEE from the University of Southern California and BSc from the University of Victoria. Dr. Damer is a devotee of a logical form of the way of thinking of liminality involving a liminal limit between objective, reductionist, realist ways to deal with reality, however, open to motivation from elective conditions of awareness.

He has assembled a routine with regards to deliberately looking for visionary encounters through reflective states that can be grounded in

logical bits of knowledge or directing stories. He has refined this way of thinking since youth when he involved himself entering imaginal universes and communicating those universes through his work of art. Dr. Damer is as of now looking into a book dependent on meetings with different experts of what he terms the "endo way", which means bits of knowledge sourced through endogenous techniques who at that point practically apply their bits of knowledge to certifiable applications.



Dr. Bruce Damer

You are a Canadian-American multidisciplinary scientist, designer, and author. Let us know who has been the real inspiration behind your great passion for astronomy?

I have a passion for the study of how life might have originated on the Earth, four billion years ago. I started on this quest as a nerdy 14-year-old in Canada. Later I got into computers which helped me test models and then met Prof. David Deamer at UC Santa Cruz and we have partnered to create a complete hypothesis for the Origin of life. I am attaching a figure from our main paper which explains the model. Feel free to use it.

How much time (years) will it take for the technology of Earth to be able to colonize other planets if it is possible?

I think we will build large structures in space long before we colonize the moon or Mars. Those places are probably too hostile to place large settlements. Think of a cruise ship going to Antarctica, people can visit but would rather stay on the comfortable and well-provisioned ship.

According to you, where scientific research is lacking in solving the puzzle of extraterrestrial life?

We can only image distant exoplanets with faint signals for the Origin of Life and determine their atmospheric content or rough size. So to detect life that way is difficult. Most life outside the Earth is probably microbial communities. Complex life is probably extremely rare and life making mega-structures or traveling between the stars even rarer still. So to solve the puzzle of whether life exists elsewhere faces major challenges.

Is there a working definition of life? What are the environment limit or “extremes” under which life can survive?

A couple of years ago, NASA worked with a group of our colleagues to come up with an exact definition of life and ended up on these words that:

A self-sustaining chemical system capable of Darwinian evolution.

This is probably pretty broad, but safe. Life probably needs liquid water to get started and be sustained. Winston Churchill wrote about the conditions for life way back in the 1930s, this article is worth reading.

What is Astrobiology? What life might look like on another planet?

Astrobiology is the study of extraterrestrial life or life in the Universe, other planets and what might make them habitable. It is about a great deal more but this is a core mission of the field. Life on other planets would start by being composed of simple cells, which form aggregates, and if they are lucky enough, they evolve into complex multicellular organisms.

What would you say about your TedX talk on “Coupled Phases Model for the Origin of Life”?

This talk first introduced Dave and my hypothesis to the public, back in 2015. It was followed by a paper that our colleagues have cited and hopefully read.



Winston Churchill at his desk in 1939: a prolific writer, he covered scientific topics as diverse as evolution and fusion power.

Would you like to share about DigiBarn Computer Museum?

It is a personal passion of mine to collect and document the evolution of computing. This passion led me to meet Dave Deamer in 2009 so I am glad to have this hobby.

The DigiBarn Computer Museum seeks to capture personal stories and track technological evolution through a large collection of vintage computer systems, manuals, videos, interviews, and other fossil relics of the “Cambrian explosion” of personal computing that ignited in 1975. When we get visitors who “burst into tears” upon seeing certain systems which may have defined their lives and careers, our cameras roll to capture the inevitable stories. Thus the interconnected redwood rooms of the museum constitute a kind of “memory palace” for the nerd-inclined and help us piece together the amazing story of the invention of personal computing and Cyberspace.

Let us know about the “Terrestrial Origins Hypothesis”?

We are calling it the Hot Spring Hypothesis for the Origin of Life these days. I am copying the cover

article from Scientific American here for the interest of readers.

Origin of Life researcher, Professor Bruce Damer, presents an exciting four-part essay on the Hot Spring Hypothesis for the Origin of Life, and how this connects to the Extended Evolutionary Synthesis.

Would you like to share about your effort in designing a concept spacecraft capable of harvesting resources from asteroids?

This is another passion of mine I took up when I was 16 years old. I felt that life should have a pathway to move beyond its birthplace of Earth out into the universe so that the Origin of Life (and we) have a chance to continue on.



The Digibarn curator

What would you say about the most highlighted question that is “how Origin of Life occurred and how it evolves?”

How can molecules self-assemble into a complex system capable of making copies of itself, passing on all of its traits? That copying requires a really complex machine. I think we now can see that big complex machines can emerge through the interaction of simpler ones, that that is a big clue.

What were the objectives behind the establishment of “psychedelia” and how much it has been achieved so far?

That is a project of mine to archive the talks, papers, and visions of psychedelic explorers such as Timothy Leary and Terence McKenna. These and other people explore worlds that seem otherworldly, but that come into their consciousness through the use of psychoactive substances, mainly plants. One could ask: where do these visions come from? Visions come to many people, not only through these plants, so we can ask that question in general.

Would you like to share about your experience in storytelling performances such as at the Lightning in the Bottle Festival, California, 2015?

Yes, it has been a lot of fun! I bring my stories of science into poetry with DJ and VJ friends illuminating them with visuals and lovely music tracks. It is an interesting way to reach the new generation and hold their attention away from their phones and social media for a while.

Moreover, for the 50th Levity Zone podcast, I offered “Fire in the Sky”, a four-part full tilt poetic journey from the birth of the cosmos through the origin of life and human conscious awareness. This piece was later performed on stage with Android Jones and Val Santana at the 2016 Lightning in a Bottle festival.

What are your future goals in the development and promotion of astrobiology? let us know about the Astrobiology network of Pakistan?

Yes, the Astrobiology Network of Pakistan is a wonderful initiative and an emerging international network that equally connects the local talent to international platforms. I have been serving as an advisor to them. I delivered a talk to help launch it a couple of years ago at your Quaid-e-Azam University in Islamabad.

A Talk with Dr. Fauzia, Pakistan's first female Cyber Security Analyst

By Muhammad Abdullah Khan

Dr. Abro, is Pakistan's first female with a doctorate in Cyber Security from a foreign University, the first female Ph.D. of Pakistan Armed Forces.

Today's digitalized world is characterized by the connectivity provided by internet, smartphones, tablets, smartwatches and smart glasses. While on one hand, this connectivity has opened a plethora of innovations such as the Internet of things (IoT), whereby everything can be controlled from within the touch of fingertips, it eventually gives rise to the big threats such as National and global security. Increasing incidents of cyber-attacks, cyber-theft and bullying point to nowhere but an imminent threat of regional or global cyberwar.

While it is a general misperception that Pakistan does not have any contributions in the field of Science and Technology and that women are discouraged from education, let alone pursue STEM, Dr. Fauzia Idrees Abroo, Pakistan's first female cyber-security analyst, is a pleasant surprise for many science enthusiasts.

Dr. Abro started her educational career when she obtained her Bachelor of Engineering in Electronics from Mehran University of Engineering and Technology (MUET), Jamshoro. She hails from rural Sindh and despite all the hurdles against the education of women, she pursued her passion and obtained masters in Cryptology from NUST. This was just a beginning in her career which took her to pursue a Ph.D. in Cyber Security from City, University of London.

Her research interests are malware analysis, detection and prevention, mobile security, VoIP, network security, machine learning, IoT and Artificial Intelligence, most of them have been published in various academic journals and conference proceedings. She serves on several editorial boards and program committees of international journals and conferences.

Currently, she is working on the security of the Internet of Things (IoT). This scribe had a chance to interact with Dr. Abro, who is Pakistan's first female with a doctorate in Cyber Security from a foreign University, the first female Ph.D. of Pakistan Armed Forces (Tri-services) as well.



Following are the excerpts from my conversations with Dr. Abro.

Let us know about your childhood and who inspired you most during your academics?

I belong to a remote area of Sindh. Life was quite hard, getting an education was extremely difficult due to social and cultural problems. I used to study a lot because I always dreamed of becoming an outstanding professional. I was lucky to get an unending support from my family. Today, I have everything one can dream for and I'm content that all is earned through sheer hard work. During my studies in Pakistan, I was inspired by my mentor Professor Bhawani Shankar who has been supporting and helping out many students of Pakistan to excel through

their education. I'm also inspired by Professor Rahman Aziz of City University London who has never stopped supporting thousands of students from all over the world.

Do you encounter obstacles in your life and career? How do you manage and what will you suggest for working ladies in Pakistan?

Yes, I do, especially in my career. I opted for Engineering and Military, both being male-dominated fields and especially in third world countries like Pakistan, there are people who do not support women in male-dominated fields. There is a big list of obstacles from gender discriminations to biases against working women and mothers of young children. I have two children and before each of them, I had to go through miscarriages due to non-conducive working conditions.

I knew that I had to be strong, communicative and competent to survive in order to see my dreams turn into reality. I had to give extra time to my work to fill the gaps created during my absence due to maternity leaves. I was able to manage the circumstances with selfless support from my husband. I would not be where I am today without his support after my marriage. I would suggest to the working ladies, work hard and keep a balance between family and work life. There is no peace without a peaceful family life and there is no happiness without. Don't isolate yourself in workplaces, be active, inclusive and participate in activities positively. Try to minimize the communication gap between you and the people you work with.

You have diverse academic experience from being an electrical engineer to cryptologist. What were the factors which led you to pursue these fields?

I joined Pakistan Air Force as an Electronics Engineer and was trained to work on avionics systems besides networks, IT and electronics equipment. I had an interest in security and luckily PAF selected me for Masters in Cryptology/information security to fulfill its cryptology and cyber security requirements. After my masters, I assigned to work in information/network security which further increased my interest in cyber security. Eventually, I was selected for European Union scholarship for Ph.D. from the UK. My work

experience in PAF Cyber security setup and my Ph.D. in Information security have contributed to my career choice. Now it has become my hobby, career and something I'm passionate about.

The concept of security has evolved from the traditional security dilemma of a state to the vulnerabilities faced by individuals. What are the threats and challenges faced by individuals and states in the context of cyber security?

With the ever-increasing role of internet in almost everything we do, we're more and more vulnerable to cyber threats. Anyone using the internet for anything is exposed, hence awareness about requisite security measures is extremely essential for each individual. It's an ever-evolving field which requires persistence and continuous focus of both the developers and end-users. Although, every organization is conscious of the threat and ensures regular measures but still we see so many breaches all over the world very frequently. This implies that the importance of cyber security will always remain extremely critical for both individuals and organizations all over the globe.

The emergence of cyberspace has opened new battlegrounds. How will future developments in cyberspace and new technologies shape any future warfare?

Almost all contemporary and future concepts of warfare have a very heavy dependence on cyberspace. With the emergence of super computational technologies and rapid developments in associate gadgetry, each segment of cyberspace is being exploited as an essential tool of warfare. A paradigm shift in warfare is that cyber warfare is now an everlasting activity which would only intensify in times to come.

What can be done at an individual level to get secured from cyber threats?

First of all, each individual should get himself acquainted with the potentials and impact of cyber threats on our daily life. Usage of social media is increasing and so are the chances of cyber threats for the users. We need to educate especially our children to be careful while sharing their personal information on social media. We should realize that each smart gadget is not very

smart against cyber threats and each social media application is accruing our personal information from our gadgets.



Dr. Abro was recently awarded sixth global Cyberjutsu award

We must know that Cameras, Mics and our files in our gadgets are accessible to cyber attackers. We need to be careful about what are we sharing on social media, storing on our smart devices and how are we accessing the internet. Use strong passwords for online services accounts, install good anti-virus programs and update the software regularly.

Are there any global efforts done by the international society and bodies to overcome the threats of cyberwar between states or any cyber-attack by a group or individual?

There are international bodies that are monitoring the hackers and cyber activities but we must know that all international intelligence agencies are intensely involved in cyber monitoring and are using individual's data for their covert activities. There are on-going global efforts by UN, Council on foreign relations and some other international

organizations and think tanks for regulating the cyberspace especially in terms of cyber-attacks and cyber warfare.

Pakistan drafted its cyber security policy in April 2019. Is this policy comprehensive enough to tackle the challenges faced by Pakistani users and state?

As per my knowledge, some work was kick-started to formulate the cyber security policy guidelines but it's not complete yet. Cyber security policy is a subject which needs to be reviewed very frequently and should be formulated by competent professionals with the involvement of different stakeholders of the state.

You are currently working on IoT (Internet of Things). Let us know about the latest developments and challenges in this technology?

The Internet of Things (IoT) is a rapidly growing network of connected smart sensors/devices. It is becoming the foundation of many services such as smart homes, smart cities, health monitoring, agriculture system, smart environment, and smart water control systems. IoT will bring the next Industrial Revolution because it's changing the way people live, work and communicate.

In 2017, around 29% of organizations had already installed IoT technology (Vodafone IoT Barometer, 2017-18). According to research by management consulting firm Bain, the IoT market is set to grow to around £397 billion by 2021, more than double the £179 billion that was spent in 2017. It is envisaged that by 2020, the number of connected devices will rise to 20.4 billion worldwide (Gartner report 2017) and the global IoT devices market is expected to reach around USD 158,140 million in 2024 (Zion report 2018).

You got several awards including the Mohtarma Fatima Jinnah and Benazir Bhutto lifetime achievement award. What are your future targets to achieve and your future research plans?

I always try to motivate and encourage our young students especially the females to opt for STEM studies. I would also like to work on drone security. I have started an organization for women: Women in Science, Technology, Engineering & Mathematics (WiSTEM) to help

and support the women working or studying STEM. I'll continue working for the empowerment of women. I'll be using the WiSTEM platform to work for equal opportunities for women. As for as my research is concerned, I will be working on IoT security especially the intrusion detection system for IoT connected devices.

What is next for you? Your message for womenfolk in Pakistan?

I try to remain abreast with the latest research and development in the domains of cyber security. I see myself as a leading cyber security entrepreneur in the next five years providing its products and services worldwide. I'm an enthusiast to provide a flexible and conducive working platform for women in cyber security and STEM.

My message to women of Pakistan is to work hard and know their potentials. Only courage can lead to success and motivate others who struggle to survive in very challenging environments. To get something extra you need to do extra.

Mansoor Ahmad: A Peek into the life and work of Pakistani astrophysicists working at NASA

By Saadeqa Khan

Mansoor “Moonie” Ahmed, was brought up in Peshawar, Pakistan in the northwest region on the fringe with Afghanistan. He retired from NASA where he worked as an Associate Director of Astrophysics. He anticipated Division and Program Manager for the Physics of Cosmos and Cosmic Origin Programs.

Mansoor has a B.S degree from the University of Maryland and M.S. from George Washington University, both in the mechanical building. He received a couple of prestigious awards like NASA Exceptional Service Medal. Mansoor has worked as a part of the US government Senior Executive Service (SES) in 2007.

Mansoor is at present filling in as the Associate Director of the Astrophysics Projects Division just as the Program Manager for the Physics of the Cosmos program and the Cosmic Origins program at NASA Goddard Space Flight Center.

Mansoor Ahmed has spent the majority of his vocation in serving the Hubble Space Telescope (HST) program in various limits, including the Flight Operations Manager and the Project Manager for HST tasks. He has taken an interest in everything except one Hubble adjusting missions. During a short spell far from HST, Mansoor has filled in as the Mission Manager for the Compton Gamma Ray Observatory Orbit mission and afterward as the appointee venture administrator for the James Web Space Telescope. Here are some excerpts of his conversation with *Team Scientia*.

You were born and grew up in Peshawar, let us know about your family background? Do you recall any interesting story regarding your childhood/teenage or by any of your elder relatives that you think worth talking?

My father was a Subedar-Major in the army. We lived in Peshawar city, near Fort Balahisar. For the first 5 years of education, I went to a Christian mission school and from sixth grade onwards, I went to the Government High School # 1 in Peshawar city. Our house was across the street from Naaz cinema, the only cinema in the city that played English language films. This is where I got my very first exposure to films. My father took me to see the film “The Vikings” and I was hooked from then on.



While addressing the national space symposium

Even though I didn't really understand any English. My answer to the question “what do you want to be when you grow up?” was; I want to become the ticket collector for Naaz cinema so that I can see every film playing there. After watching a film, I would tell the story, scene by scene, in detail to my cousins. I guess that is where I picked up the art of storytelling that is coming in handy now in my filmmaking endeavor.

Then one day, I was visiting some relatives who lived right next to the Pakistan Airforce base in Peshawar and I witnessed an F-86 land on its runway. As the plane taxied right by me, I could see that the cockpit was open and the pilot in it. The pilot waved at me as he passed by and right then my career goals changed. I wanted to be a fighter pilot.

In the Government, High School, a close friend of mine, Ayub told me about the Airforce cadet academy in Lower Topa, a tiny town near Murree. A boarding school that selects 60 children each year as pre-cadets to prepare to enter the air force flying academy after FSc. Ayub said he was applying for it and encouraged me to apply as well. Fortunately, both of us got selected and we

entered Lower Topa in May of 1966, at the age of 13.

Who was the most influential person to you as a child? Is there a teacher that you remember having been particularly influential?

I attended the air force pre-cadet academy in Lower Topa from 8th grade to FSc first year. These were the most impressionable years of my life. The academy taught us discipline, comradery, leadership, and sportsmanship together with an excellent education. The best part about this academy was the teachers. They really cared about the students, did everything to engage us directly in the lessons instead of just giving lectures.

They made us interested in science and math as well as literature and poetry. Even though I have been away from Pakistan for more than 40 years, my interest and taste in good poetry go back to the good old days of Lower Topa. We all made a very close bond with a lot of our teachers. Even though most of us have dispersed all across the world, we still keep in touch with a lot of our teachers.



In an experiment

You had been a BS from the University of Maryland & MS George Washington University in mechanical engineering, If you could do it again, would you take a different academic path or you satisfied with the route you followed?

This is a very interesting question to answer. First, I must admit, there is no direct path connecting my current career at NASA to my educational goals when I was a student. As I mentioned earlier, my career goal was to become a fighter pilot. I was happily pursuing it in Lower

Topa when I became unfit for flying due to my eyesight. My parents had already migrated to America while I was still in Lower Topa, and once unfit to fly, I was given the option to join my parents in the US. I exercised this option.

When deciding my educational path, I was still driven by the love of flying and figured I should study aeronautical engineering so that I can still work with jet planes. As I started my BS degree, it became apparent that job opportunities in aeronautical and aerospace engineering were diminishing. The Apollo program was coming to an end and there was no real vision NASA was pursuing. So, my advisor advised me to change my major to mechanical engineering. Out of all my courses, I enjoyed thermodynamics and heat transfer the best.

America was entering the energy crisis era and the government was focusing on commercializing alternate, renewable energy resources, such as solar and wind energy. These needs were in line with my BS training and I was encouraged to continue my master's degree in the area of energy resources. It is by chance that NASA was in need of someone with heat transfer experience, which opened the door for me into NASA.

The point I am trying to make is that where I am today is because of the circumstances that ended up in my favor. There were several opportunities where I could have gone astray, making wrong friends, making wrong choices and pursuing a course of studies resulting in a different career. Who knows if that career would have been as exciting as the one I have now. So personally, I would not want to go back to my student's days with the risk of making a wrong choice and not end up where I am today.

In Pakistan, only specific mindset have interest in Astronomy and commonly parents do not support their kids in astronomy as a profession, let us know how much you had been encouraged by your family during the early years of your career? Would you encourage your own child if he/she do prefer astronomy/astrophysics as a profession?

I think there are two aspects to this question. Parents are concerned about the livelihood of their children when they grow up. They are concerned whether their children will be able to

earn a living and support a family. So, their tendency is to push their kids towards careers that are known to provide a good living. Unfortunately, most often their preferences are also tainted by the apparent status of certain careers in our society and ignore the interest and aptitudes of the children in areas that may not rank high in the status hierarchy in Pakistan.

It is very likely that if allowed to pursue their own interests, the children would really thrive in any careers, whether it be engineering, medicine, music, business, sports, etc. Taking astronomy as an example, even though there may not be too many job opportunities in astronomy in Pakistan, if a child is genuinely interested and has the right aptitude in the subject, encouraging him/her to pursue their passion may result in an illustrious career that might answer the most profound mysteries of the universe, possibly getting worldwide recognition. I recognize it is a tough choice for a parent. Especially in Pakistan where there is a stigma attached to certain careers and are discouraged by parents.

In my situation, I am not sure if my parents would have encouraged me to become the ticket collector for Naaz cinema but they definitely did not discourage me in pursuing my career in the air force. In the case of my children, I believe in allowing them to pursue their passion, be it astronomy, plumbing or driving a taxi. It is easy for me to say because in the US, there is generally no stigma attached to any career and a person can make a decent living in any job, as long as they are willing to work hard at it. And if one is in a career following their passion, it is easy to work hard at it.

Do you think science could be made more popular and accessible in Pakistan if more scientific literature was available to the masses in Urdu?

I'm not sure if that will help any but it's worth a try. In my opinion, the first step required is to create an environment where the population is trained to question everything before believing anything. My experience has been that our folks are very quick to accept any rumors, tales and conspiracy theories without logically analyzing it. In the current situation, unless you control scientific knowledge that is disseminated to the public, anyone can post erroneous scientific information and folks will believe it. Having an Urdu based

outlet of science information would have to be carefully controlled to avoid misinformation.

JWT is infrared while Hubble is an optical telescope. What do you feel about the future of Hubble? Is it true that JWT got more importance than Hubble?

Hubble and JWST are equally important tools for answering astrophysics questions. Just like Hubble cannot see infrared light, JWST cannot see optical and ultraviolet light. Together they can solve more mysteries than either one can by itself. Hubble continues to be in perfect health. We predict that all its systems will still be functional until 2022 and most likely beyond. JWST will be launching in early 2019. The scientific community is eagerly awaiting when both of these amazing observatories will work for hand in hand.



With colleagues

How our knowledge has expanded via space-based astronomy with observations like Hubble & JWT?

Hubble has made amazing discoveries up to now. It has determined the exact age of the universe, it has proved the existence of black holes that were only theoretical before Hubble, it has observed gravitational lensing as predicted by Einstein and so much more. As it has answered so many questions, it has also introduced us to so many more mysteries that we didn't know existed.

Dark matter and dark energy for example. Being an optical telescope, Hubble's eyes reach a limit

when looking for the oldest galaxies and stars. The older the galaxies, the faster they are moving away from us so their light reaches us in infrared (due to Doppler shift) and Hubble cannot see them. With James Web, we will be able to see those galaxies and determine how and when the very first stars in the universe were born.

Let us know about your services as a project manager for LISA, the mission that was a collaborative endeavor between NASA & ESA? What do Gravitational waves tell us & how would LISA implement our knowledge about the beginning, evolution & structure of the universe?

Up to now, all of our astrophysical discoveries have been done with analyzing the electromagnetic spectrum. The visible light, which human eye can see, and Hubble is optimized to see in this wavelength, is just a small subset of this spectrum. The spectrum ranges from radio waves at one end and very energetic gamma rays on the other end. We have satellites in space observing in most of these wavelengths and together they have informed our knowledge of the universe to date. But the electromagnetic spectrum is generated by the stars when they are born and start to emit electromagnetic radiation.

There were no stars at the time of the big bang. Only elementary particles that coalesced together to form electrons and protons which in turn formed hydrogen. The hydrogen atoms started to coalesce to form blobs of hydrogen, eventually forming a mass large enough to have enough gravitational force to initiate hydrogen fusion in the core of this blob, thus igniting the blob into becoming a star that started to emit electromagnetic waves. This process took hundreds of thousands of years. So, there were no electromagnetic waves during this time. We call it the dark period because there was not light and as a result, we can only predict theoretically what happened during that period.

Gravitational waves, on the other hand, were generated right at the start of the big bang because mass always existed and mass creates gravity. LISA mission is being designed so that we can see the universe with gravitational waves. A completely new way of looking at the universe. With LISA, we will be able to look at the dark period from the very beginning of the big bang. We would also be able to see deep inside black

holes where electromagnetic light cannot escape from. While we are in the process of building LISA, there are several ground-based gravitational observatories now coming into action already.

How long have you been serving for NASA? What advice do you have for your countrymen regarding your type of services?

I have been with NASA for almost 35 years. NASA is a government agency so I am a civil servant, doing this work on behalf of the American public. As a civil servant, one has to always keep in mind that we serve at the pleasure of our population, who have contributed their hard-earned money to the government so that the entire nation can benefit from the work of the government. As a civil servant, it is an honor to be given this responsibility and we should do our utmost to work hard and honestly to fulfill our obligations to our public.



Have you encountered obstacles during your career, what is the most interesting thing about your job at Goddard Space Flight Centre, NASA, & what is the least?

I don't think I can imagine a single dull moment during my career at Goddard. It has been amazing to be working on so many interesting and challenging projects with so many amazing scientists and engineers who are motivated and hard-working to meet the mission objectives.

We found an apparent dichotomy in Mansoor Ahmad, besides your arduous services for NASA, you have been directed sixteen short films and a movie. Let us know about your experience as Technical Director of the

television show 'Pakistan vision'. What's harder getting started or being able to keep going?

I don't see it as a dichotomy. My work at NASA is my career. Filmmaking is my hobby and not intended for earning a livelihood. It is very important for one to follow one's passion. And it is not necessary that one should have only one passion. We should pursue all our passions. It is important to do that to feel complete. Pakistan Vision was a passion of a friend of mine, Mr. Saleem who was a pharmaceutical representative during the day and in his spare time wanted to develop a news and entertainment program for the Pakistani population in the Washington DC area.

My interest in the technical side of filmmaking and figuring out the right equipment for developing, editing and airing the show went hand in hand with Mr. Saleem. It was a great learning experience for both of us. This partnership evolved into us launching into the production of our feature-length film Bhoool.

Do you think that cinema has the power to influence the minds, if so what should be the role of a filmmaker in a society like Pakistan?

I believe so. Cinema remains to be the most popular form of entertainment worldwide and especially in our country. So, I do believe the filmmakers have the moral obligation to honestly expose the issues facing the country as well as create material that minimizes the divide among us, whether it is political, religious, status, and gender. The filmmakers can help eliminate all kinds of stereotypes existing in our society.

As a filmmaker, how much did you compromise because of financial restrictions, how did you & your fellows manage time during the making of BHOOL besides professional responsibilities?

As I said earlier, filmmaking is my hobby and not a money-making endeavor. We took on this venture as a learning process. Other than buying the necessary equipment, there was no other expense. All the cast and crew were volunteers, following their own passions. The locations were obtained through favors by our friends and families. And frankly, we didn't really know enough to know if we were compromising

anything. And since we are our own customers, following our own schedule, we were free to mold the storyline based upon the available resources. It was only after we finished the film that we realized all our shortcomings.

Do you think that Pakistani University students are different from any American or other country students in capabilities and core skills like mathematics, reasoning, research, and analytical approach? What would you suggest to the new generation in order to cope with the challenges of time regarding space-based astronomy?

I had the privilege of meeting young students in several institutions in Pakistan. I must say I was very impressed by their curiosity, their intelligence and their interest in astronomy and astrophysics, even with the limited resources available to them in Pakistan. I was very encouraged to see that there was almost an equal number of girls as boys attending the talks. A lot of them were enrolled in Ph.D. programs in physics, which is not an easy subject. Some of them have found their own ways to continue research in astrophysics, especially in finding planets around other stars, which is the first step in finding life elsewhere in the universe.

I have made commitments to the leadership of these institutions that I will do my best in connecting these students with the scientists and engineers at NASA who can provide guidance to these young students in pursuing careers in space-based astronomy. I have already obtained commitments from NASA scientist to give periodic lectures by skype to the interested students in Pakistan.

Note A few parts of this interview have been published on Dawn.com in Jan 2018.

Special Report

An Exclusive Tour of the Pakistan Museum of Natural History

By Aniga Mazhar, Maham Maqsood, Komal Nadeem, Iqra Bibi

Corresponding to the theme of our wildlife edition, we decided to take a tour of the Pakistan Museum of Natural History (PMNH) that is located near Shakarparian National Park, Islamabad. Housing more than 1.4 million specimens, the museum features extensive collections of wildlife and nature reserves. Other than sections for the public, it also has labs for Taxidermy of animals and allows researchers to work on their projects. It is currently managed by Pakistan Science Foundation under the Ministry of Science and Technology.

Our team was lucky enough to visit the museum and have an exclusive look at their collections for researchers. Mr. Muhammad Asif, who is an Associate Curator at the Zoological Sciences section, graciously gave us the tour of the entire museum. Following is our conversation and interview with him about PMNH.



Skeleton of blue whale displayed outside the museum

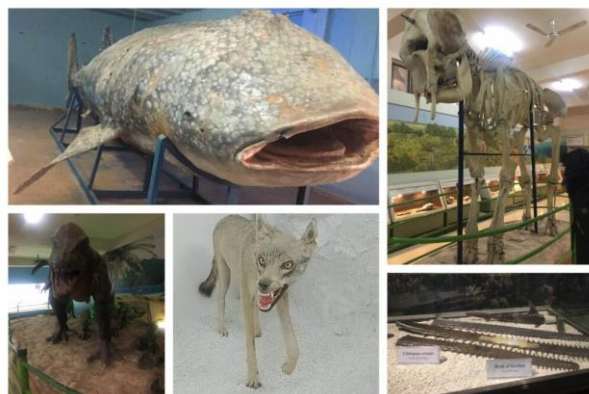
Team Scientia: We are thankful for giving your time, Sir. Shall we start the tour?

Mr. Asif (Tour Guide): Sure. So, most of the things here in the museum are related to mammals, specifically their taxonomy. There is a researcher here for every discipline and tasked with looking into the matters related to their field.

Here, we have our research block, which includes our reference collection from all over Pakistan.

Ph.D. students from different universities come here and work on collections as per the requirement of their advanced research. From Molecular Biology to Genetics to Classical Taxonomy and other research fields, everything is included.

This is our Entomology lab. We had a project where the goal was to collect and preserve all the butterfly species in Pakistan. Other than butterflies, various other groups of insects have also been displayed here.



The museum houses around 1.4 million specimens

TS: Are these crafted models? What are they made up of?

TG: No. These are bodies that have been preserved via the process of stretching. It begins with the collection of animals in the field, especially insects.

TS: Are all these displayed species from this region (referring to Pakistan)?

TG: Yes. PMNH tends to collect the *COMPLETE* collection of rocks, minerals, flora, and fauna of a particular region for ease of reference and research. This gives us the complete picture of a region and what kind of wildlife, animals, etc. it inhabits, under one roof.

TS: And does the general public have access to these collections? What if some member of the public wants to observe and work?

TG: This section is specifically for researchers. The displays on the first floor are for the general public.

TS: Coming back to the preservation process of these insects, can you please elaborate on the process of stretching?

TG: So, we begin by simply preserving them in the core and bringing here in the labs. After that, *Pinning* is done i.e.; we give them different positions on a thick board with the help of pins. In the case of insects, they have an exoskeleton made of Chitin, which is very hard. Their legs also need to be adjusted to set them in a proper posture. Pins are used to fix them at the place.



(Top Left and Right) The entomology section has almost all specimens of the insects' species in the region. (Bottom) Pinning of insects is done to fix them at a proper place

TS: What about the new species that are being discovered or are not a part of these assortments? After how long do you review your collections?

TG: We keep sending expeditions to the wild from time to time. It depends on the focus group of the research team. Students work on their species of interest, but our goal is to ensure the availability of all the species present in Pakistan here at our respective sections. Other than that, people donate foreign or exotic species as well, which we add to our displays and collections.

We have almost all the specimens of the bird species in Pakistan. Many of these are migratory as well, especially the ducks.

TS: Wow, there are so many! These preserved animals look so fresh! For how long do they remain unwithered?

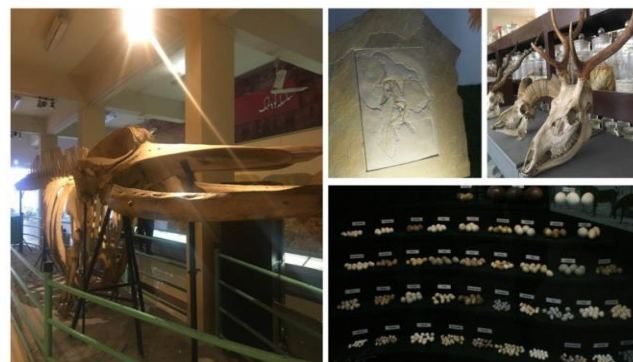
TG: The process is known as *Taxidermy*. When a bird or animal dies, skinning is done. It is easier and shorter for birds as their skin is not as thick. Mammals and reptiles require more time.

After skinning, dehydration is performed, and then chemical preservatives are applied. It is followed by stuffing. For that, casts are made, the posture is prepared, the skin is mounted, and the final touches are given. The specimens are preserved and good to go for almost 20 years, but if bacteria invade, this time may decrease, and we will have to refresh it.

We also have the depository of freshwater fishes and amphibians. This section covers all the freshwater fishes and species of Pakistan though the amphibian collection is not complete due to the lack of input to it.

TS: Are there other special methods for the collection?

TG: Yes. There is wet and dry preservation. Stuffing comes under dry preservation. Preservation done in chemicals is wet. There are further two types in wet: via alcohol and formalin. We are gradually shifting to alcohol because formalin is carcinogenic, and the coloration of the specimen also changes when it is used.



Clockwise from left: Skeleton of a juvenile whale; a replica fossil of a bird; skulls of animals; variety of eggs on display

TS: Being students of Biochemistry, we have studied that snake venom is used for designing pharmaceuticals and vaccines, etc. Given that you have an extensive collection of snakes, do you provide companies samples if they need it?

TG: No, because we preserve in wet. The venom is stored in a pouch above the head. And it

denatures with time. For that purpose, NIH has the venoms that can be used in drug development, so most companies contact them.

TS: So, how do you decide where and in which section to put an animal? Do you classify geographically?

TG: We create it taxonomically, not geographically. By orders, species, etc. or based on morphological features. It is the job of the taxonomist to classify and decide using the features of the specimen. Mr. Riaz here does Taxidermy.



(Top Left and Right) Taxidermy mounts in the Zoological Section of the Museum; (Bottom) The taxidermy of a bat is being performed

TS: AOA, Sir! Please do share the process with us.

Mr. Riaz: So, the steps are as follows: The specimen is cut at the center, and a wire is inserted into the legs and wings followed by mold. For example, this here is a bat. The muscles are made to denature. If traces are left, then long-term storage of the specimen is not possible.

So, we take it out completely and fill it with cotton, plaster of Paris, and poly compounds, mainly polyurethane. These are used to preserve body shape as they are light-weight and easy to maintain.

TS: Are they renewed from time to time?

Mr. Riaz: Yes, definitely! And that is due to the ectoparasites present on the skin. For that, specimens to be processed are placed in a freezer. The temperature is -30 degrees, and it kills the ectoparasites. The specimen is then taken out, and further processing is proceeded with.

TS: That's great. (Moving on to the next section)

TG: This right here is our *Pre-Partition Collection*. It includes vertebrates and marine wildlife, among others. Before partition, there was the combined Zoological Survey department for both regions. After partition, Pakistan's collection was set up in Karachi. But there were some issues related to the museum's building, so the collection was shifted here. We have mammals, birds, and reptiles, etc. preserved here as well. Our collectors go to deep and far regions around the country to get these animals. For instance, we have sent deep-sea expeditions from Balochistan to various other ranges.

We also have here our bird collection. We have placed the same species within these drawers. For hair and DNA analysis, our specimens come into use.



(Top Left) The pre-partition collection that was provided to PMNH by Pakistan Zoological Survey Department; (Top Right) Many specimens are preserved in drawers that are used by researchers; (Bottom) Seashells in a jar collected from the Manora Island in Karachi

TS: That's quite impressive. On your website, there was a mention of a biodiversity database. Can you share what that is?

TG: That is the complete database of all our collections. We have a link with international **GBIF** as well. We are working on that.

We also have exotic species like ostrich etc. Zoos of different cities have contact with us. When an animal dies, they donate the specimen to us.

TS: Speaking of exotic species, there was a lot of uproar recently on social media when a license was given for hunting of Houbara Bustard. Is hunting of endangered animals in Pakistan being done to a large extent?

TG: That is really not the case. Several initiatives are being taken to conserve animals like Houbara Bustard and Markhor. Their population is relatively stable, and to prevent any more damage, trophy hunting is allowed once in a while. But it should be noted that even if there are special rules and regulations, the local hunters do more damage than the foreign. And as far as these birds are concerned, they come from different migratory routes and are also hunted along the way in regions of Central Asia, Russia, etc. So, it's not just that they are only hunted in Pakistan.



(L) Markhor on display; (R) Trophy heads section, some of them are the courtesy of the Pakistan Zoological Survey. Information about these animals is mentioned in detail at the bottom with their name and status.

TS: What about *Markhor*, the national animal of Pakistan? Is it still considered endangered?

TG: Actually, endangered species are those whose quantity in their natural habitat is less than 2000. Such are classified into the "Endangered" category. Markhor is not endangered as it is well above the limit in the wild. And it varies with each animal. For instance, Black Buck is extinct in the wild. But its breeding in captivity is being done at the Lal Suhanra National Park in Bahawalpur. Its active habitat is not available anymore, but it is present in quite a large amount in captivity. But there are many other species under threat in Pakistan e.g.; the snow leopard has been recently added to the list of endangered species as well as the leopard in the Margalla hills.



Clockwise from top left: Display section curated for a younger audience; a sea turtle; biodiversity section; Atomic-bombed Hiroshima stone on display; Pangolin

TS: We see. What about the public section?

TG: This public section features various displays. There is a depiction of prehistoric life in caves. We also have displays of wildlife in the coastal area, specifically Hawkesbay. The turtle preserved with its eggs link to that. Other animals include crocodiles, pangolins, and otters, as you can see for yourself. These animals are under threat as well. Otter is now considered endangered here due to fish farming, and pangolins are being trafficked at a very high rate.

We keep introducing changes in the museum every now and then to appeal to the public. For example, this is the Ecology section that we developed a while back. It shows the food chain concept in a simple and basic manner for the understanding of young children. All these other displays are curated specially for the younger audience.

TS: What about this giant tree trunk?

TG: This is a transverse section of a tree trunk dating back to many years. It has its annual rings that can tell about its age. It can also tell us about the weather. We can tell that by looking at the circles within its trunk. When there's rain, growth increases, and so does the distance between the rings. During harsh conditions, there is petite growth, so the rings are dark and narrow. We can predict the weather history the tree grew in.



Dendrochronology is the method to date trees using their annual rings

TS: So, how much biodiversity is there in Pakistan? Compared to other regions?

TG: The more biomes there are, means the more species there are. Pakistan has quite a large number of diverse species, almost all of those in South Asia. At our biodiversity section, we cover all zones from the coastal areas to the peaks of mountains.

TS: Climate change is a very hot topic these days. We also see its effects around the world, from Australian wildfires to flooding across various regions. Is wildlife at threat from climate change in Pakistan as well?

TG: Not really. We have changes in this region as well, but mostly we have the normal phenomenon of earthquakes, heavy rainfalls, and snowfalls.

And as these are all-natural processes, there is flexibility in the environment to absorb its effects, and they can help in biome regeneration as well. But for species that became extinct in Pakistan, the major threat was and still is, urbanization. When their habitats are destroyed, the ultimate effect is on its population and survival. As you can see in Australia, there is a natural calamity happening at the moment, and within the next five to ten years, the surviving species will be able to regain their survival rate hopefully.

TS: Please tell us about the Baluchitherium? (Referring to the life-size model standing in the PMNH grounds)

TG: It is the largest mammal ever found in this area. It was found in Dera Bugti, which has lots of vegetation. The Baluchitherium was a herbivore and required tons of thick vegetation to feed daily. Scientists from Switzerland signed a joint project with PMNH to find out more about it and its lifestyle.



The Life-sized model of the extinct Baluchitherium

TS: It looks quite a lot like the dinosaur. Is it its ancestor?

TG: No, not at all! The dinosaur was a reptile, and this was a mammal. They are not linked.

TS: All of your collection is so great. Why is there such a huge gap with the public? We looked at socials of other foreign organizations like American NMH on social media and other platforms. They have so many ongoing events that actively engage the public. On the other hand, your social page is quite dormant. Why is that so?

TG: Yes, we acknowledge that we do face problems. This right here is not a government priority. We do not get satisfactory support and funds. As you can see for yourself, the building construction has been incomplete for thirty years. We are trying our best we can with the resources we have. We often have events for the public, and students from schools also visit the museum fairly regularly.

TS: So, you not given enough resources and funds for the museum?

TG: Yes, there is not enough funding from the government. We have other different resources. We also collaborate with various international organizations, and funding is provided for research projects. We have an ongoing collocation with China, and we frequently work with other European countries on different programs.

TS: How is the public response?

TG: The Public response is quite good; visits increase day by day. According to our current data, we had almost 165,000 visitors in the last six months till December. The number of total visitors in the year is expected to add up to 195,000. Most of our public activities are concerned with students from schools and colleges.

TS: That is good to hear. We are so grateful for your time and this tour! Thank you so much.

TG: My pleasure!

Needless to say, we were much amused by the displays in the museum. So, the next time you are in Islamabad, make sure to check it out and see the great collection for yourself.

LSM 2019: Interview with CERN's Dr. Joao Antunes Pequeno

By Muhammad Abdullah Khan

A grand Science festival "Lahore Science Mela 2019" has recently been organized by a nonprofit organization, Khwarizmi Science Society (KSS) in collaboration with Ali Institute of education on 12 and 13 October 2019 at the Ali Institute, Lahore. From CERN to LAST (Lahore Astronomical Society), many incredible organizations and groups participated.



Thousands of residents of Lahore and other cities visited LSM 2019

The festival focused on the wonders of Chemistry, including elements, mining, mineral compounds, and significant industrial processes, for celebrating the 150th anniversary of the periodic table of elements. The Mela successfully provided an excellent platform for scientific organizations to introduce themselves to the public and hosted 70 schools from around Punjab this year. The Mela equally inspired kids, youngsters, and adults. Thousands of residents of Lahore and other cities visited in two days.

A significant highlight of the Mela was the collaboration with CERN's Media Lab, its representative Dr. Joao Antunes Pequeno visited Pakistan and exhibited the Large-Hadron Collider Interactive Tunnel. Moreover, the audience of the Mela had enjoyed with a live virtual tour of CERN's CMS from the Ali Auditorium.

Dr. Joao is the chief troublemaker at the CERN Media Lab. He has a background in physics but spends most of his professional time conceiving

interactive applications for science visualization and education. Over the years, his 3D animations, simulation images, and scientific illustrations have been frequently featured in several major media outlets worldwide. His main approach for science communication is the creation of visual and personalized metaphors for complex scientific concepts.



Dr. Joao Antunes Pequeno visited Pakistan and exhibited the Large-Hadron Collider Interactive Tunnel

Joao has been key in establishing state-of-the-art multimedia installations for science centers and visit points at top research institutions worldwide. He regularly collaborates with artists developing science-inspired pieces, coaches' scientists on public outreach and mentors many students. One of his big side projects is "Phantom of the Universe" (<http://phantomoftheuniverse.com/>), an award-winning planetarium show about Dark Matter viewed by over 10 million people in more than 500 planetariums in 82 countries and 22 languages.

Here are some excerpts of his recent conversation with Scientia's editorial team member Abdullah Khan on the first day of Lahore Science Mela 2019.

Q. What can you tell us about the Large Hadron Collider?

A: So, I'll start with the Accelerator. The Large Hadron Collider is a 27 km long accelerator where we accelerate very fast protons (which are the nucleus of hydrogen atoms). We push them very fast with lots of energy, two beams going in opposite directions, and we make them collide at four precise points. At these points, we have detectors to observe and measure what comes out of these collisions. One of these detectors is the CMS detector (or the CMS experiment as we call it). CMS stands for Compact Muon Solenoid and is one of two generic detectors, the other one being the ATLAS detector, which is the bigger one. This detector, together with ATLAS, was responsible for the discovery of the famous Higgs boson in the year 2012.

It is an experiment that has over 4000 scientists and engineers from all over the world, including Pakistan. Pakistan is an Associate Member State of CERN, which means that Pakistani engineers and scientists have the same standing at CERN as those from any Member State or Associate Member State. As seen in the virtual visit, physicists work at the CMS experiment. In CMS, all these collisions that happen at a rate of many millions of times per second generate massive data, and what researchers do is analyze the data and try to find patterns that indicate the presence of particles which can be vital for us to understand the universe.



The Large Hadron Collider is a 27 km long accelerator

Q: So, the purpose of this work is what Stephen Hawking said, "Small questions, big answers." Does it base on finding new particles?

A: It's more than finding new particles! It dives deep into some critical questions like, why is the

universe the way as it seems, and how did it become like that — trying to find a logic behind it. There must be a logic somewhere. Laws are governing this universe, we are already aware of a few of them, but we don't know what is behind them. So, we are finding little by little, what may be at its origin. For example, do you know that 80 percent of the matter in the universe is dark matter? We don't know much about it or even what it is. We are trying to find out why is it that most of the universe is made up of matter, not antimatter. Every particle has a mirror image particle (like an evil twin), which is its antiparticle. Why is it that there are only particles and not antiparticles outside the laboratory? These are the kind of questions which are fundamental for us to understand why the universe is the way it is.

Q: But there are some particles whose life is concise, like nanoseconds. How could we detect them?

A: That's an excellent question. We don't detect these particles directly, even the famous Higgs boson, and we can't see those directly. What we see is the products of the disintegration of these particles. You see, these particles are very short-lived, which means that after a fraction of a second, they die and break down into something else. And it is that "something else", which has a pattern, that we detect. Research in experimental particle physics in great part consists of finding such techniques, of distinguishing these patterns, in the middle of all the noise that is generated.

Q: That's great! So, how many Pakistani scientists are working at CERN, and do you know any of them?

A: I know half a dozen at CERN, but there are many more. I can't give you the exact number. That can be found online.

Q: So, the CERN's lab and Large Hadron Collider is between borders of Switzerland and France. Who's funding it?

A: The Member States fund CERN. It's an international organization, like the UN. CERN has a council and the Member States, and they contribute an equal proportion of their GDP. But Pakistan is not a Member State; it is an Associate member state. Pakistan also contributes, but not in proportion; it is different in that case.

Q: How can Pakistani students visit and work at CERN? What are the opportunities for researchers?

A: For students, there are many options. Just go <https://careers.cern> and there is a zone that says, “students opportunities” where one can find many programs. There are short term internships, summer student programs for undergrads, and there is a technical student program which is an excellent one-year job for students who can be integrated into a research team with attractive salaries. It is a life-changing experience! As for researchers, the best is to coordinate with the Pakistani universities and research institutes already involved with the organization.

Q: Let us know about your career and achievements and who inspired you most in pursuing such an off-beat career?

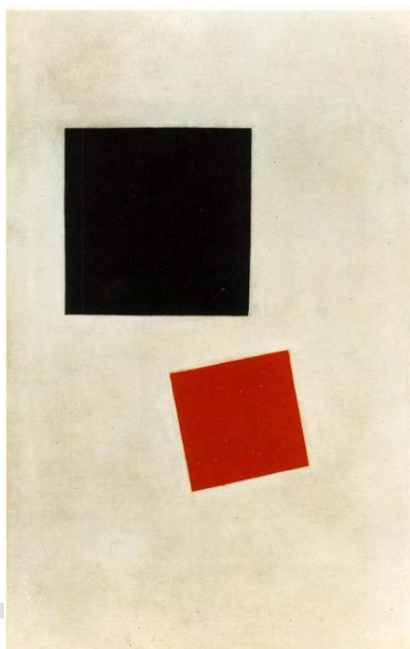
A: When I was 14 years old I had a little accident. During the weeks I spent at the hospital, someone offered me a copy of “Cosmos”, by Carl Sagan. That book changed radically the way I perceived the Universe and made me decide to pursue a scientific career. I also had a neighbor who was an engineer and since the age of 4 gave me great playful lessons on rocket science, planetary dynamics, and Flash Gordon! I was very influenced by Sci-Fi movies and the cool graphical representation of scientific interfaces and physical phenomena. At the age of 15, I started coding and doing visualizations. I always liked art and storytelling, so it was just a little step to put Science, Technology, Storytelling, and Art together to build my career a few years later.

Cover Story

Artificial Intelligence is on its way to conquer the art scene

By Maham Maqsood

Almost two years ago, an unusual case shook the art world. Art theft and forgery are not uncommon but claiming an exhibited art piece to be “Fake” definitely induce disorder. The issue arose when in a German public collection, a painting thought to be made by artist Kazimir Malevich in 1915 was labeled as counterfeit and a judicial trial was held to seek the truth. Some witnessed and art experts said that it was original enough and “could hang in Stedelijk” while some stated to the authorities that such works were terribly “awful imitations”.

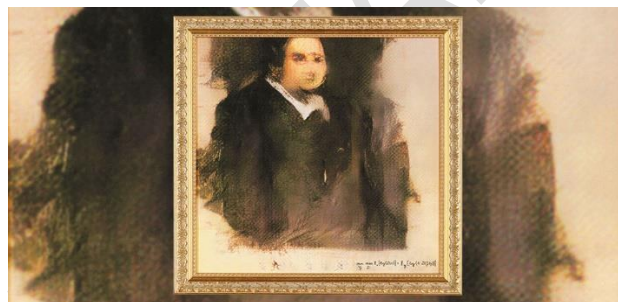


“Black Rectangle, Red Square,” thought to have been painted by Kazimir Malevich

A similar case in 2018, led to the closure of the Ghent Museum of Fine Art in Belgium after some of the artwork raised suspicion among the critics and as a result, the director of the museum was suspended. These are troublesome matters that occur frequently in the world of art and not only cause harm to the reputation but do monetary

damage as well. One may ask why not come up with a solution to address such recurrent inconveniences? Well, we might have an answer now: *Artificial Intelligence*.

Usually, when we think of AI, it is in terms of machine learning for robots or better technology for industries. Art and AI are a combination that few have heard of. It might be because it is still in the growth phase but surely a lot of work is being through combining these two and just like every other field, AI may conquer art as well in the future.



Portrait of Edmond Belamy

A look into AI's contribution to the art

At the moment, AI is playing diverse roles in art. From art investigation to creating art, it has managed to make its place in this diverse area. Art forgeries investigation and general study are pretty tough jobs and take up a lot of money and time. There is the use of methods like spectroscopy with infrared radiations, numerous types of separation techniques like gas chromatography, etc. But Artificial Intelligence, being the brilliant thing it is, can do this job without all these expensive resources and only needs an art piece to do the investigation. Before discussing that, it should be noted that AI is not just probing into art, it is also creating it!

Yes, you read that right. Don't feel threatened that AI will take over your Crayola makers or your paintbrushes and strip you of your creativity. That is not going to happen anytime soon. But it most definitely is creating art using digital techniques and advanced algorithms and has even managed to auction a piece at Christie's titled “Portrait of Edmond Belamy” at a hefty price of \$432,500.

Such type of artificial art generation has been going for around 50 years and coding enables it to learn aesthetic and creative values by interpreting and looking at thousands of images.

A new system called generative adversarial network (GAN) has been designed by researchers which pair a generator for making images with a discriminator that analyzes the pictures. The combination enables the creation of an intricately done art piece. In a survey conducted with the public, it was found that people liked the AI art more than human-made paintings and considered it to be more inspiring and complex.



AI can study the speed of brush strokes using new algorithms

Beware, art forgers!

For recognizing whether a presented art piece is real or not, new and powerful Artificial Intelligence technologies are being created and developed that can accurately detect forgeries. A team at Rutgers developed a process that analyzed three hundred drawings by famous artists including Picasso and Egon Schiele at the tiny level of strokes. The designed algorithm was then put to test and the success rate reached up to 80 percent.

The gestures, shape, and even the speed of the brush stroke is inspected and uncovers a lot of information and provides very useful data. Just an image is needed to judge if it is really original or made in an amateur workshop. A big database is extremely helpful and with more improvements, the practical use of this technology would be immense. The team is hopeful that it will be “a hugely valuable addition to the arsenal.”

AI as a tool for art conservation

Artificial Intelligence has also penetrated various other domains of art and a recent project that gained worldwide attention was its use for uncovering hidden details in old masterpiece paintings including the renowned Ghent

Altarpiece. In investigative research done by a team from UCL, digital X-ray images of a high resolution were studied and viewed using AI which helped in the conservation of the piece. For those who might not know about it, Ghent Altarpiece is a famous twelve-panel painting made by Netherlandish brothers Hubert and Jan van Eyck. For studying it, new algorithms and X-ray images of the different panels of the altarpiece were used and later made into two clear and detailed images. Usually, the use of X-ray images of paintings is hard to interpret for everything gets in the path of the rays and especially in retouched pieces.

Recently, X-ray imaging was used to uncover a hidden painting underneath Picasso's *La Misereuse accroupie* (The Crouching Beggar). On the surface it is an image of a figure in a blanket and a scarf but underneath it lies a landscape painting as revealed through the imaging techniques. Moreover, it showed the creative process of how Picasso painted the figure. Other methods implying the study of the chemical nature of pigments were used as well. But as mentioned before, in such processes X-ray images may get mixed up and these signals need to be separated to perform detailed study and accurate interpretation.



The Royal Institute for Cultural Heritage is using artificial intelligence for the Ghent Altarpiece preservation

Researchers proposed a Convolutional Neural Network (CNN) based self-supervised network. Through this method, signals of varying origin are captured and accurately separated, something that other similar approaches haven't been able to successfully perform. AI separates these images and original master paintings are made visible which helps in the conservation and

restoration process like it is doing for the Ghent Altarpiece investigation being done by the Royal Institute for Cultural Heritage (KIK-IRPA). Such approaches give insight into the hidden details and technicalities that are not visible to the naked eye. The potential can be used to evaluate how a masterpiece was developed and how unique and iconic works of art can be saved from different threats. Conservationists and academics have commended the use of AI and are pleased with the turnout of the data that can be used for various purposes.

A bright creative future

AI still lacks behind in a lot of the things but surely it won't take a long time to catch up and perform even more extraordinary feats and otherwise impossible tasks. One should appreciate the accomplishments so far, from identifying fake and forged paintings to baring the secrets in an artwork, it is becoming a right hand for the art investigators and even for art enthusiasts who feel the need to respect and admire beautiful creations without any doubts or fears. It is a creative tool, not threatening as some may perceive, but a promising aid to the future of art.

SETI – Search For Extraterrestrial Cognoscentibus

By Mohammad Iftekhhar Yezdani

The urge to explore, wander into uncharted territories, reach out and establish communication with other beings has been the master key to human civilization. Skies and stars were not a limitation to the imagination, even before humans mastered fire. Centuries later, the proliferation of curiosity, knowledge, science and brilliant advancement in computation around the world lead humans to space exploration and search for extraterrestrial life. There are many who believe with great passion that there is more out there than what can be imagined. Well before the space age, radio pioneers such as Heinrich Hertz, Nikola Tesla, and Marconi were foreseeing 'interplanetary communication'. Elmer Sperry proposed using a giant array of searchlights to send a beacon to Mars in 1919.

Many people at some point in time or another have looked at a clear, night sky and wondered, "Are we alone?" SETI hopes to, one day, be able to answer that question. The Search for Extraterrestrial Intelligence (SETI) is now known as a collective effort by independent organizations, government agencies, educational institutions, and individuals. Although Sci-fi content producers have invariably made people think of flying saucers and little green or grey aliens, it is important to make a distinction between SETI and "paranormal" research.

SETI is now known as a collective effort by independent organizations, government agencies, educational institutions, and individuals

Arthur C. Clarke summed it up as "Two possibilities exist: Either we are alone in the Universe or we are not. Both are equally terrifying."

To accomplish the mission of SETI, two approaches are being used mostly. Debatably categorized as either passive SETI, which relies on receiving communication and listening for

radio signals from intelligent alien life or active SETI (also known as METI), by producing communications that may one day be heard by other civilizations.



Passive SETI can easily be understood through concepts of radio communication, such as those broadcasted by television and radio stations, that take the form of a wave that radiates out from a broadcast point in all directions. These waves don't stop at your radio. In fact, once radio waves reach the vacuum of space, they just go on and on forever. Picture this! Though in need of significant amplification, Television broadcast could be picked up on Mars! Large radio observatories, such as "Big Ear" or the Arecibo Observatory, are configured so that if radio waves produced by a civilization somewhere else ever collide with earth, then we'll hear them!

Active SETI, also known as METI (messaging extraterrestrial intelligence), has the goal of producing communications to alert other civilizations of our presence. In 1974, the Arecibo Observatory broadcast a high-powered transmission in the direction of a star cluster located approximately 25,000 light-years away.

Assuming there is intelligent life in other parts of the universe, then it is almost certainly rare.

In 1961, Dr. Frank Drake proposed a formula to calculate the number of intelligent civilizations in our galaxy.

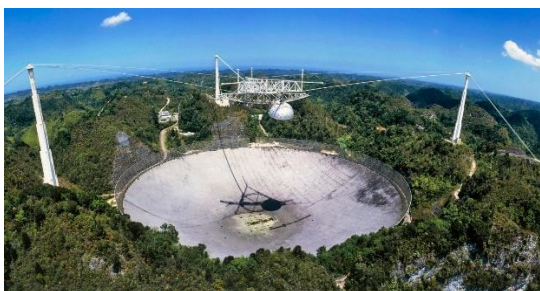
The Drake equation model is the number of civilizations in our galaxy with which communication might be possible equal to the multiplication of rate of star creation in our galaxy, the fraction of those having planets orbiting them, the number of exoplanets or planets that have the capability of supporting life, the fraction of those that go into

development of an intelligent lifeform, the number of civilizations that could have the capability to communicate and how long can that communication be detected) highly speculative.

Unfortunately, an exact result of the Drake equation has not been reached because of many of the factors in the equation, such as the average rate of star formation which is not fully known.

Another mindboggling argument is the Fermi Paradox, which summarizes as the universe is old and large enough to have even more habitable planets. Yet, where are they? Perhaps we have not been looking long enough.

Only a century ago, scientists and enthusiasts gathered around the concept of scanning the sky and “listening” for puzzling non-random patterns of electromagnetic emissions in order to detect another possible civilization somewhere else in the universe. The SETI (Search for ExtraTerrestrial Intelligence) era began with people such as Frank Drake, Giuseppe Cocconi, Philip Morrison and others suggested and began their first SETI search around 1959-60.



The Arecibo Radio Telescope in Puerto Rico was the site of NASA's High-Resolution Microwave Survey

In the late 1960s and early 1970s, NASA took up SETI efforts. at a low-level as Project Orion, the Microwave Observing Project and Toward Other Planetary Systems. On 14 October 1992, NASA initiated a formal 10-year \$100m High-Resolution Microwave Survey project, a more intensive, SETI program. However, Congress canceled the program based on political expediency, barely a year later.

Part of the canceled program was picked up by the private, non-profit SETI Institute which was incorporated in 1984. Facing funding challenges every now and then, the SETI Institute currently

employs more than 130 scientists, educators, and administrative staff. SETI Institute continues as a non-profit organization and is among the top 100 subcontractors to NASA with ample funding to do research in Astronomy, Astrophysics, Astrobiology, Exoplanets and much more. SETI runs the data pipeline for the Kepler program. Planetary exploration is also another field of research at SETI and the X-Ray diffraction system on Curiosity for Mars developed by the institute.

Along with all that, the SETI Institute pursues research for extraterrestrial intelligence using radio and optical technologies built for the same purpose. New directions were for the SETI Institute, under CEO Bill Diamond who took charge in June 2015 including a restructuring of the operations of the Institute, folding the SETI research program into the larger science umbrella of the Carl Sagan Center. Education and Public Outreach has always been an integral part of the Institute, including space science and astrobiology curricula for formal and informal education, the popular radio show/podcast Big Picture Science, the SETI Talks lecture series, public lectures by scientists, and popular science writing. Outreach to the general public via social media and other efforts has received new emphasis as the Institute looks forward to continuing its mission to explore the possibilities of life in the universe and share discoveries with the public.

SETI is usually considered one of the most high risk, and high gain endeavor in all of science and often people say it's more related to science fiction than to astrophysics but if we were to someday detect alien civilization, this would be one of the greatest discoveries of mankind ever. A famous distributed computing project called SETI@Home uses the BOINC software platform created by the Berkeley SETI Research Center and hosted by the Space Sciences Laboratory, to analyze specific radio frequencies emanating from space. With dexterously designed algorithms, AI could be scientists best shot at helping intercept signs of extraterrestrial intelligence.

With serious ongoing discussions over both approaches to date, another very important matter is post-detection protocol and the preparation for this eventuality even in the absence of confirmed evidence of

extraterrestrial intelligence. Such a discussion could lead to the development of a procedure/protocol on this matter. If an alien intelligent lifeform is detected, the message to be prepared for communication should be sent on behalf of all Humankind, rather than from individual countries or groups.

Imagine being born in a closed hall, growing up and meeting people of your kind who have been confined to the same hall, many having everything good in life to live with and then eventually pass away. Would you not want to look outside and explore beyond the walls of the hall? Would you have the urge to seek even a tiny hint to the plethora of unanswered questions such as “Among the septillion stars in the known universe, are we alone?”

Consanguineous marriages and genetic ailments in Pakistan

By Suhail Yusuf

Samina is a nineteen years old girl from Hunza, Pakistan. She has been facing problems in body movement those are increasing with each day and now she can no more raise arms in front of her face. Understably, her muscles are fading slowly just like an eroding wall gradually losing its bricks. A genetic time bomb hides inside her body cells.

Around three years ago, Samina started feeling weakness in her muscles. After a couple of tests, she diagnosed with an incurable genetic disease called "Muscular Dystrophy." Mukhtar her father, who is also a heart patient, sells snacks at a rented shop, the only work he can do due to his ailment.

Samina desperately needed highly priced drugs and medical tests on a regular basis and a fully formatted house in her steep village with easy access to things and a transformed toilet. It was nearly impossible for her family who can not even afford the medical expense of Mukhtar.

Later on, a few donors proceeded and helped the family in some expensive medical tests (worth 200 thousand rupees) to further evaluate the situation. The results revealed a bleak picture as they suggest the worst situation for this brave girl and predicted severe cardiopulmonary problems and even her death at the age of 30. But there was another challenge awaiting the family because Sarah – the younger sister of Samina – is also on the same way of Muscular Dystrophy.

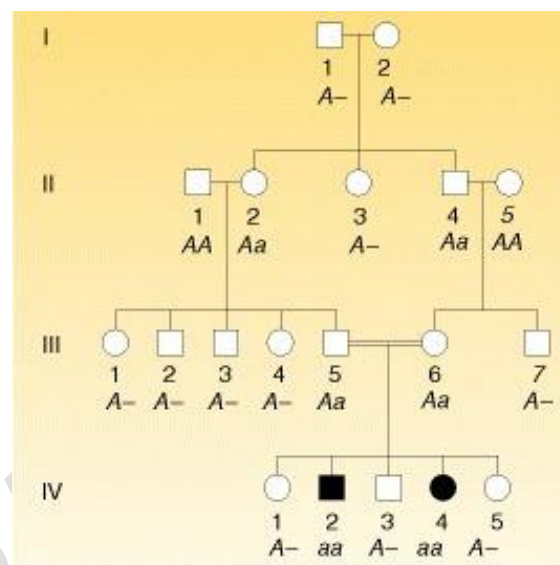
Samina's parents are close cousins and even their parents or Samina's grandparents were also close cousins who shared the same genetic pool.

Pakistan – a hub of genetic disorders

Marriages among close relatives are common in Pakistan and responsible for many genetic ailments and a majority of them are still needed to be further investigated. According to a research paper, 50 percent of marriages are

consanguineous or take place between common family members in Pakistan.

Recently, a new genetic mutation, responsible for eye defects leading to blindness in Pakistan, has been unearthed with the collaboration of Pakistani and Swiss scientists.



Pedigree of a rare recessive phenotype-a classical case of interfamily marriages

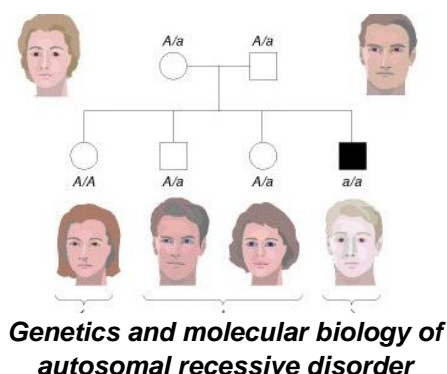
Geneticists from the University of Geneva Medical School (UNIGE) and the Liaquat University of Medical & Health Sciences, Jamshoro, have analyzed the genome of many families having mutant – changed or abnormal copies – in a new gene called MARK3.

They found mutations in the MARK3 gene in a family having three affected children. Both parents were cousins, dubbed as a consanguineous family in medical term. The infected children inherited two copies of genetic mutation, both from the mother and father.

The mysterious eyeball disappearance disease was unexplainable until this research. Now, we have found that the mutation is responsible for the shrinking eyeballs in children leading to the blindness. These findings published in the journal, Human Molecular Genetics.

"We found a pathogenic mutation in a new gene that was not linked to any disease before – named as MARK3 in a Pakistani family of three affected individuals. These individuals developed progressive Phthisis bulbi (shrinkage of the

eyeball),” says Muhammad Ansar, a researcher at the Department of Genetic Medicine and Development at UNIGE.



The mutation is also responsible for the disease as eyeball of a sibling was almost reduced to vanish by the time he reached the age of 30.

ADCY3 genetic defects – discovered in the UK and confirmed in Pakistan

A decade ago, the geneticist from the Imperial College London, discovered that adenylate cyclase or ADCY3 gene is responsible for abnormal obesity and other problems when it was first tested in mice when they applied deformed or mutated copies of the gene in their bodies. These animals were abnormally fat and found with a poor sense of smell.

In 2018, the mice model was confirmed by human subjects in Pakistan. Scientists found some very obese children with deformed ADCY3 gene in Punjab because of the high level of consanguinity (inter-family marriages) in its population.

“Besides being severely obese and lacking in sense of smell, subjects with ADCY3 mutations suffer from mild to moderate intellectual disability and are slow learners. There is also evidence that the affected children may predispose to have diabetes at a later stage of life,” says Sadia Saeed, a researcher in the study. A campaign is much needed to aware of the health risks of cousin marriages in Pakistan, she added

“Genetic counseling of the affected families is undoubtedly an effective way to deal with the alarmingly high rate of genetic disorders. Moreover, in cases that have a family history of genetic disorders, the couple should undergo genetic testing before getting married. Such initiatives can help reduce the number of children

afflicted with severe hereditary disease. These measures are already mandatory in several inbred countries that have a high rate of consanguinity,” she further added.

In particular, Pakistan needs a mass campaign to aware the people about the problems of interfamily marriages. Electronic and print media can play a vital role to curb the interfamily marriages

National institute of genetic diseases

Geneticists from Kohat University of Science & Technology set Pakistan's first Genetic Mutation Database, that covers 1,000 mutations of 120 disorders and syndromes. Surprisingly many of them only discovered in Pakistan. Our country urgently needs a national center for genetic disorders with clinical geneticists and state of the art research labs to ensure a healthy future of the next generation.

The policymakers should set at least 4 to 5 centers across Pakistan to find the unexplored genetic disorders in Pakistan. Also, a rural community should be made in focal areas because the consanguinity level is relatively very high there as compared to major cities and towns of Pakistan.

In particular, Pakistan needs a mass campaign to aware the people about the problems of interfamily marriages. Electronic and print media can play a vital role to curb the interfamily marriages. For a healthy and disease-free generations, we need efforts a clarion call.

Astrophotography

NASA releases ghostly images in the spirit of Halloween

By Maham Maqsood

NASA marked Halloween by releasing fascinating and spooky images of the cosmos, that gives the creeps to some and excites others. Some of those were captured by telescopes such as Hubble and Spitzer Space Telescope. Most of these included nebulas and stars colliding with each other and even the Sun looking like jack-o'-lantern. Check out the freaky visuals down below!

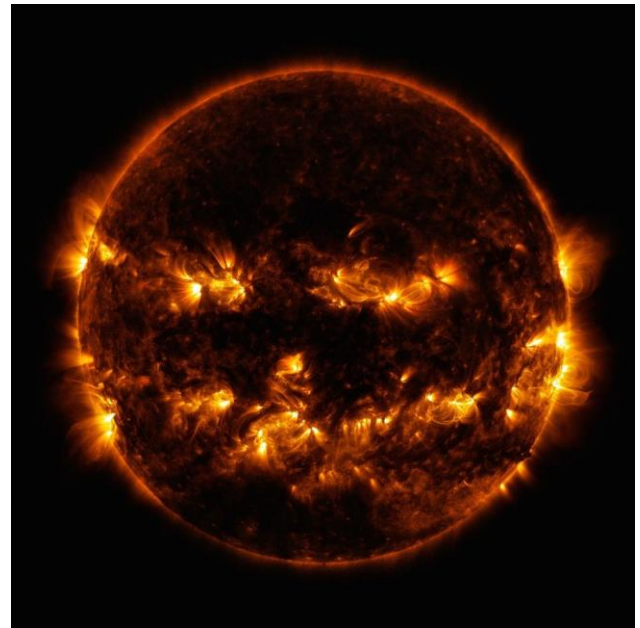


This image shows two “eyes” which are actually the cores of two colliding galaxies
Image credit: NASA/ESA

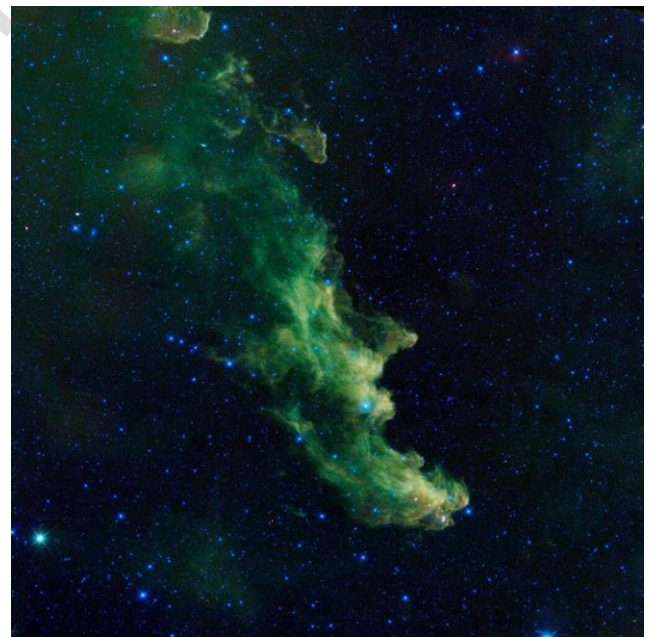


Spitzer captures a massive star in the center of a cloud of dust and gas creating the “Jack-o-lantern Nebula.”

Image credit: NASA/JPL-Caltech

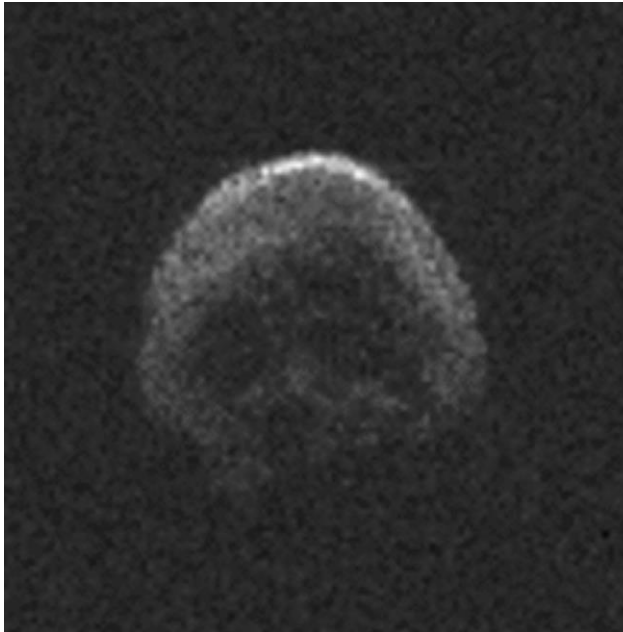


This picture released on the time of Halloween shows the active regions on the sun giving it the appearance of a jack-o'-lantern
Image credit: NASA/GSFC/SDO



This image shows the Witch Head nebula, which is estimated to be hundreds of light-years away in the Orion constellation

Image credit: NASA/JPL-Caltech



NASA recently shared this spooky image of asteroid 2015 TB145 which is a dead comet
Image credit: NAIC-Arecibo/NSF



IRAS 05437+2502, also known as Ira's Ghost, is a small, faint reflection nebula filled with dark dust and a mysterious bright sharp arc
Image credit: ESA/HUBBLE, R. SAHAI, AND NASA

Stunning Electrifying Photos captured during epic storms

By [Iram Farooq](#)

Everyone is in love with the moments when winds start blowing fast and the temperature drops just before the rain. These moments in a hot summer remind us that more often changes happen in our life when we least expect them. These epic storms and tornadoes are very common during the hot summer, especially in North and Middle America often referred to as tornado season. These epic storms usually strike in the evening or midnight and cause destruction but they can be beautiful when caught by the camera in the right moments. Take a look of stunning photos of some of the rare epic storms captured in recent summer around the globe.



Photo credit: National geographic



Photo credit: National geographic



Photo credit: National geographic



Photo Credit: Douglas Taylor



Photo credit: Jeremy Holmes

An electrifying image caught by the camera during the rare phenomenon of the Cloud burst.



Photo Credit: Pinterest



Photo Credit: Pinterest

Nature photographer Jeremy Holmes captured this beautiful image during a tornado usually hit American states in the evening.

A stunning photo captured during some of the rare epic storms in a volcanic region.



***A Volcanic thunderstorm
Photo Credit: Pinterest***

Opinions

Astrobiology: From the Editors' Desk

By Editorial Team

Following the theme of our Astrobiology edition, we asked some renowned personalities of Pakistan to share their views on man's search for life.

Questions

1. How do you view astrobiology? What will be your definition of it?
2. How many chances are there for the existence of ExtraTerrestrial life and has it made any contact with us yet?
3. What do you think about the "WOW Signal" and other theories about regarding aliens?
4. What can life look like on other planets? Can it be like what we see in popular culture or not?
5. Should we be able to unravel the mysteries about our origin on this planet after learning about ExtraTerrestrial life? How can it be so?

Namira Salim

Namira Salim is the first Pakistani to have traveled to the North and South poles and the first Asian to skydive (in tandem) from Mount Everest. She hoisted a peace flag on behalf of the nation at the two poles of the world. She is also one of the founder astronaut of Sir Richard Branson's Virgin Galactic, the first private space-line of the world.



Namira Salim

1. Astrobiology is an interdisciplinary scientific field that explores the origins, early evolution, distribution, and future of life in the universe. I view it as important research into the origin and evolution of planetary systems, the origins of organic compounds in space, life processes and habitability. This scientific field is exciting, not only in terms of what may be discovered about the potential for life on other planets – for example, through the exploratory work of NASA's Mars Science Laboratory mission carrying the Curiosity rover to probe for past and present planetary habitability of microbial life on Mars – but also for its potential to bring us greater insight into life processes on Earth.
2. In our own solar system alone, there are many places that life might exist, not to mention the rest of the expansive universe that is yet to be explored. We simply have not evidenced it with our limited vision or when seeking ingredients for life – such as water, oxygen, chemicals, and energy – which may not even be important for other forms of life in the universe. So, we are limited but—by our six senses and have perhaps, totally missed all evidence of life out there!!
3. The Wow! signal has been a source for great speculation since it was picked up in August 1977. However, the **Center of Planetary Science (CPS)** has suggested that the 72-second Wow! signal might have come from a hydrogen cloud accompanying a comet which had not yet been discovered when the signal was heard. Two comets had been in the same part of the sky at the time and the movement of the comets would explain why the signal was not seen again during subsequent monitoring. The CPS team recently got a chance to test their idea as the two comets, P/2008 Y2 (Gibbs) and 266/P Christensen, appeared once again in the night sky from November 2016 to February 2017. Radio signals from 266/P Christensen matched those from the Wow! signal 40 years ago. To verify their results, they tested readings from three other comets, as well, and found similar results so I am convinced by their findings. However, the universe is so vast, and we know so little about it in relative terms so we should remain humble and accept that someone somewhere may be trying to reach out to us in other ways we do not currently comprehend.
4. There are so many planets, all with their particular characteristics and which may or may not be capable of supporting life, as we comprehend it. In my view, one only has to look at our own planet Earth and observe the variety of life forms

supported by diverse environments to be able to conceive of a very multiform life existing on another planet somewhere in the universe at some time or another. In my view, however, it is unlikely to exist as it has been portrayed in popular culture and we should keep an open mind about the form it may take. And most importantly it doesn't have to be like the one on Earth and based on the limitation of our minds.

5. Scientific research always provides us with new insight, whatever the field of study. Whatever we learn about the planets and life forms beyond our own planet will undoubtedly help us to deepen our understanding of the Earth's evolution and, hence, our own beginnings as its inhabitants. Let us not forget that space exploration to date and the experiments conducted there have brought us a significant number of inventions and technological progress that we take for granted today. The astrobiology will most definitely contribute greatly to unraveling some of the mysteries related to our origin on this planet.

Dr. Farrukh Shahzad

A medical doctor by profession, Dr. Shahzad had a passion for Astronomy since childhood and now he is the President of PakAstronomers, Islamabad. He is also an astrophotographer and regularly holds Astronomy events in Islamabad and Rawalpindi in public places and different institutions like Comsats, NUST, and IST. Here is what he had to say:

1. Astrobiology is a branch of science that probes into the origin of life, its evolution and spread in the universe and its future. It is specifically concerned with extra-terrestrial life and the factors responsible for its development. But to answer these questions we must first know how life developed on Earth.

2. In my opinion, there is a high likelihood of finding Extraterrestrial life, but there is less chance that it would be intelligent life. Billions of years are required for life to reach the stage of technically advanced civilization, for which a very stable and safe star system is required. For example, a simple Gamma-Ray Burst from a nearby Neutron Star can wipe out life on an entire planet. Detection of Carbon dioxide in a planet's atmosphere is a sign that life may exist on it. Earliest signs of life on Earth date back to 3.7 to

4.1 billion years. Likewise, I don't think that any Extraterrestrial life has made contact with us.



Dr. Farrukh Shahzad

3. The "WOW Signal" is a mystery. Received on August 15, 1977, by the Big Ear Radio Telescope in Ohio and later on discovered by Astronomer Jerry R. Ehman. It was a narrow band signal (10 kHz) that lasted only 72 seconds, corresponding to a natural oscillation of Hydrogen at 1420 MHz, coming from the region around constellation Sagittarius. The most probable explanation is that it came from hydrogen clouds surrounding two comets, 266P/Christensen and 335P/Gibbs that were roughly at the same spot the signal seemed to emanate. Due to lack of its repetition despite several attempts and the fact that it was an unmodulated wave-like signal with no encoded information, it is unlikely that it was sent by aliens.

4. Life can take any form from simple unicellular organism to advanced species capable of changing its environment. Likewise, life on other planets may range from a simple organism to advanced civilization. Yes, it can look like what we see in popular culture or it can be completely different. But one thing the scientists agree that the basic building blocks of all life forms must be based on six main elements: Carbon, Nitrogen, Oxygen, Hydrogen, Phosphorus, and Sulfur. The carbon atom is unique as it can make four strong bonds with other elements and is building block for all the organic compounds and all living things on Earth. It is therefore presumed that Extraterrestrial life would also be carbon-based.

5. Origin of life on Earth, the mysteries are just unraveling, and we may never know all the answers, but there are a few basic things the scientists agree upon:

Our Sun, medium-sized yellow star with a stable lifespan of 8 to 9 billion years.

Our position in the Solar system, the habitable zone or the Goldilocks zone, where liquid water can exist.

The Outer Giant planets Jupiter and Saturn protect Earth by deflecting giant objects and asteroids, thus helping life take hold on our planet.

Our Moon, formed around 4.5 billion years ago when a Mars-sized object hit Earth. Face-locked Moon helped stabilize Earth's rotation, thus 24 hours day-night cycle, a stable climate and ocean tides that bring nutrients from deep in the oceans to the land and helped life getting a hold on dry land.

Plate Tectonics that helped form Volcanoes and giant mountain ranges and emission of Carbon Dioxide into the atmosphere.

Active Outer Core made of liquid Iron and Nickel that rotates to form Giant Magnetic field around Earth protecting life on Earth from deadly Cosmic radiation and Solar wind.

The volume of Oceans or Water on Earth which constitute 71% of the surface of Earth.

Earth's Atmosphere and its composition, about 480 km thick; 78% Nitrogen and 21% Oxygen. But the early Earth atmosphere consisted mainly of Nitrogen and Carbon dioxide.

Diversity of species and Ecosystem ensure the sustainability of life on Earth. Plants are vital for converting carbon dioxide to oxygen. Bacteria and carnivores regulate the carbon cycle. All the living things on Earth are dependent on each other for survival.

Newsbite

India's Giant Leap: Chandrayaan-2

By Muhammad Abdullah Khan

Chandrayaan 2 marks India's second lunar mission and third outer space mission.

India just takes its next “giant leap” and successfully launched its second lunar spacecraft Chandrayaan 2— moon craft— today from Sriharikota Space Station.



Chndrayan2 lifting off

The launch was initially scheduled for 15th July but was delayed due to a technical snag at the eleventh hour. Indian Space Research Organization (ISRO) chief said his agency had “bounced back with flying colors” after the aborted first attempt.

Chandrayaan 2 marks India's second lunar mission and third outer space mission; Chandrayaan 1 was launched in 2008 and; mission Mangalyaan, Mars orbiter mission in Mar's orbit since launched in September 2014.

ISRO hopes that Chandrayaan 2 will be the first human spacecraft to reach where no one has ever reached before—lunar south pool. India hopes to become the fourth nation to achieve a soft lunar landing. Only the former Soviet Union, the US, and China have been able to do so.

The mission is also a great feat for supporters of women empowerment as it is the first time in

India's space history that such a large scale mission is headed by two women — Muthaya Vanitha, the project director, and Ritu Karidhal, the mission director. The team also comprises mostly of women scientists who have worked hard to achieve this milestone.



Muthaya Vanitha, the project director, and Ritu Karidhal, the mission director

The mission is the most complex in Indian space history and was made possible due to a team of nearly one thousand scientists, engineers, and other staff. K. Sivan, ISRO Chief, lauded everyone and said in a speech after the launch “*It is my duty to salute all the people who have done the work.*”

The live launch was witnessed by an enthusiastic crowd of around 7000, apart from millions of online viewers, at the Sriharikota Space Station, an island off the eastern coast of India.

First-Ever Ebola Vaccine is Finally Here

By Sherdil Khan

Ebola is soon to become a thing of the past. The first vaccine against the Ebola virus has now been approved in Europe, which means now it would be distributed to most parts of the world. Vaccination against this virus has already been given to thousands of people during the deadly outbreak in the Democratic Republic of the Congo (DRC).

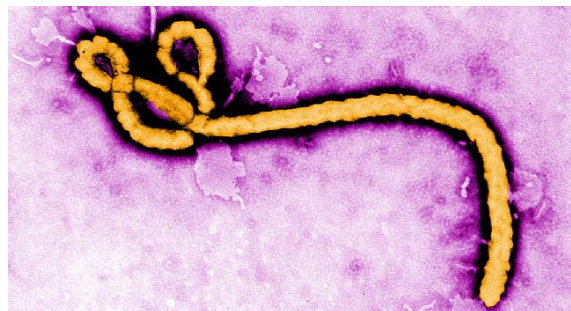
Merck's vaccine against the Ebola virus has finally been licensed by the European Medicines Agency (EMA) on November 11. Approval of this drug means that now it will be available in global markets in order to save many lives from this deadly viral infection, especially in Africa.



WHO recently announced that "Ervebo" meets its efficacy and safety standards

According to the chairman of US pharmaceutical company Ken Frazier approval and authorization of the vaccine called "Ervebo", is a great achievement and the entire world should be proud of it. Frazier says that Merck is now looking forward to vaccine prequalification by the World Health Organization (WHO). WHO prequalification is mostly used as assistance by the developing countries to approve the vaccine. And fortunately, WHO announced that it meets the efficacy and safety standards, just 48 hours after the European Commission granted authorization for this vaccine.

Merck is also looking for authorization of the vaccine by the US Food and Drug Administration. Gavi – an alliance based in Geneva, Switzerland, that helps and provides funds for the vaccine distribution in the under-developed countries – will also decide in the coming months, about the distribution of the vaccine worldwide.



Ebola outbreak in West Africa infected hundreds and thousands of people

Authorization of the vaccine has become crucial since the deadly Ebola outbreak in West Africa where hundreds and thousands of people were infected and killed by this devastating virus. This vaccine is highly efficient and potent against prevention from the infection. It has been used during the deadly DRC outbreak where more than 25,000 people were protected. Merck's vaccine Ervebo is made against the Zaire species of the Ebola virus and researchers are making efforts to develop vaccines against other strains and species of the virus also.

At Yale University, John Jack Rose developed a safe method for the exposure of the human immune system to the virus. A vesicular stomatitis virus (VSV) infects livestock but not humans, researchers genetically modified this virus and injected Ebola protein to it. As a result, a miraculous vaccine known as Ervebo came to existence. The vaccine will be available by the end of 2020 to most parts of the World as a protection against the exotic virus.

Forest fires and their anthropogenic cause, a rare discovery

By Bilal Tariq

Fires should be suppressed more effectively in the future and the forest should be restructured

From early ages, we have been reading stories of ancient forest fires which were devastating enough to eradicate entire populations dependent on them. Also, we have witnessed a good number of forest fires which have had no substantial initiation cause.

But now a recent scientific study conducted by an international team of researchers led by Elisabeth Dietze provides surprising answers.



Amazon forest fire devastation

Organized forestry

According to that research team, after the end of the 18th century, the number of forest fires were reported higher than ever with a variation in organized forestry. Organized forestry depicts that monoculture trees (trees of the same species) were planted in those forests during their restoring. For instance, in a region of northeastern Poland, the research team presented scientific data pointing out that the frequency of forest fires had increased by two-thirds of its original ratio.



Lake Czechowskie

Forest regimes

Scientifically every landscape has its own probability of how fire behaves there. This phenomenon is better known as “fire regime”. Fire regimes are directly influenced by an area’s climatic conditions, vegetative patterns, and landscape orientation. Any impactful interference of humans with any of these parameters can result in disruption of the forest regime of that area. In their research, the researcher observed a temperate forest landscape around Lake Czechowskie in the bory Tucholskie (English: tuchola forest) located in northeastern Poland.

They made an effort to identify the extent to which forest management influenced the fire regime of that area. Molecular fire makers which include pieces of charcoal, molecules formed during biomass combustion, particulate matter (specifically sulfur contents). A majority of these molecular entities originated from drilling cores of lake sediments.

A rehab for the forests:

In their research, the team of scientists mentioned that human activities have caused two major changes in the fire regimes of the 19th and 20th century. One, the amount of biomass combustion increased unintendedly during the mid-19th century. In the process, forests were restructured with huge addition of flammable pine tree monocultures crucial for industrialization.

At the end of the 19th century, polish ministry of forestry took serious notice of the “burning” issue and issued a fire protection strategy. Included in this strategy preview was a plantation of a wide variety of tree species, building of a denser network of paths, availability of extremely mobile

emergency fire brigade service designation near major risk sites. These methods proved worthwhile in the process of safekeeping of forests. But later on, history saw a rather odd change when the Soviet Union was shattered. At that time, there was an enormous need for rapid industrialization as a lot of independent state's future was at stake if the current energy demands would not be met. This, in turn, led to a greater plantation of pine trees in the forests. This resulted in a greater forest area of that region. And since then an estimated 14 major forest fires

have been reported in and around Soviet Union forest regimes.

In conclusion of their research, Elisabeth Dietze commented "In the course of climate change with its temperature rise and more frequent dry summers a new adjustment of forestry is necessary. Fires should be suppressed more effectively in the future and the forest should be restructured — towards a more diverse and less flammable tree and shrub species. This is our most important result for forestry."

SCIENTIA PAKISTAN

Contributors

Here is a look at the dynamic *Team Scientia* who majorly contributes in each edition.

Saadeqa Khan

The EIC and CEO of Scientia Pakistan, Saadeqa Khan, is a freelance science journalist based in Quetta. She actively contributes with Dawn, Express Tribune, Daily Jang and other Pakistani publications. She's a science fiction novelist and a skilled interpreter.



Maham Maqsood

Maham is a student of Biochemistry at Quaid-i-Azam University, Islamabad. She is a freelance writer, a science enthusiast and an avid reader who also gathers inspiration from nature to create art.



Muhammad Abdullah Khan

Abdullah has done bachelors in Chemistry from Government College University Lahore. He is a science enthusiast and loves to read and write about astronomy, cosmology and latest scientific endeavors.



Aniqa Mazhar

Aniqa is a student and writer based in Islamabad. Her particular interests include reading novels, watching movies, writing, and a variety of artwork. She loves food and is a photographer by nature.



Fatima Zahra

Fatima Zahra is a writer hailing from Rahim Yar Khan. She is interested in reading suspense stories, creative writing, and is also fond of cooking.



Iqra Bibi

Iqra is a research student at QAU. She is serving YOLO as an academic Secretary and is also part of the event management team of various non-profit organizations. She loves to write Urdu poetry and work for its promotion through her Youtube channel "Harf e Junoon".



Arooba Azeem

Arooba Azeem is a student at QAU Islamabad. She is an active member of the management team (QDLs) of debating and literary societies of her University. Her particular hobbies are cooking and book reading.



Eruj Qadri

Eruj is a Space & Astronomy enthusiast pursuing an MSc degree in GIS and Remote Sensing at Karachi University. She is the Management team member & Head of Social media at RaheQamar's Karachi chapter.



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Yawar Hussian is a dynamic web developer and experienced graphics designer. Besides freelancing he is serving as lecturer in computer science department. He was former HOD in a Multi-National company in Dubai.



Suhail Yusuf

Suhail Yusuf is a science journalist with more than twenty years of experience in both Urdu and English science journalism. He is currently serving as feature editor in Express-News.



Rida Nayyab

Rida Nayyab is a young activist and a Cricket freak. She is a student striving for a better future. Rida is also a freelance writer, social enthusiast, and love to reading, writing and exploring. She manages the social media team of Scientia magazine.



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