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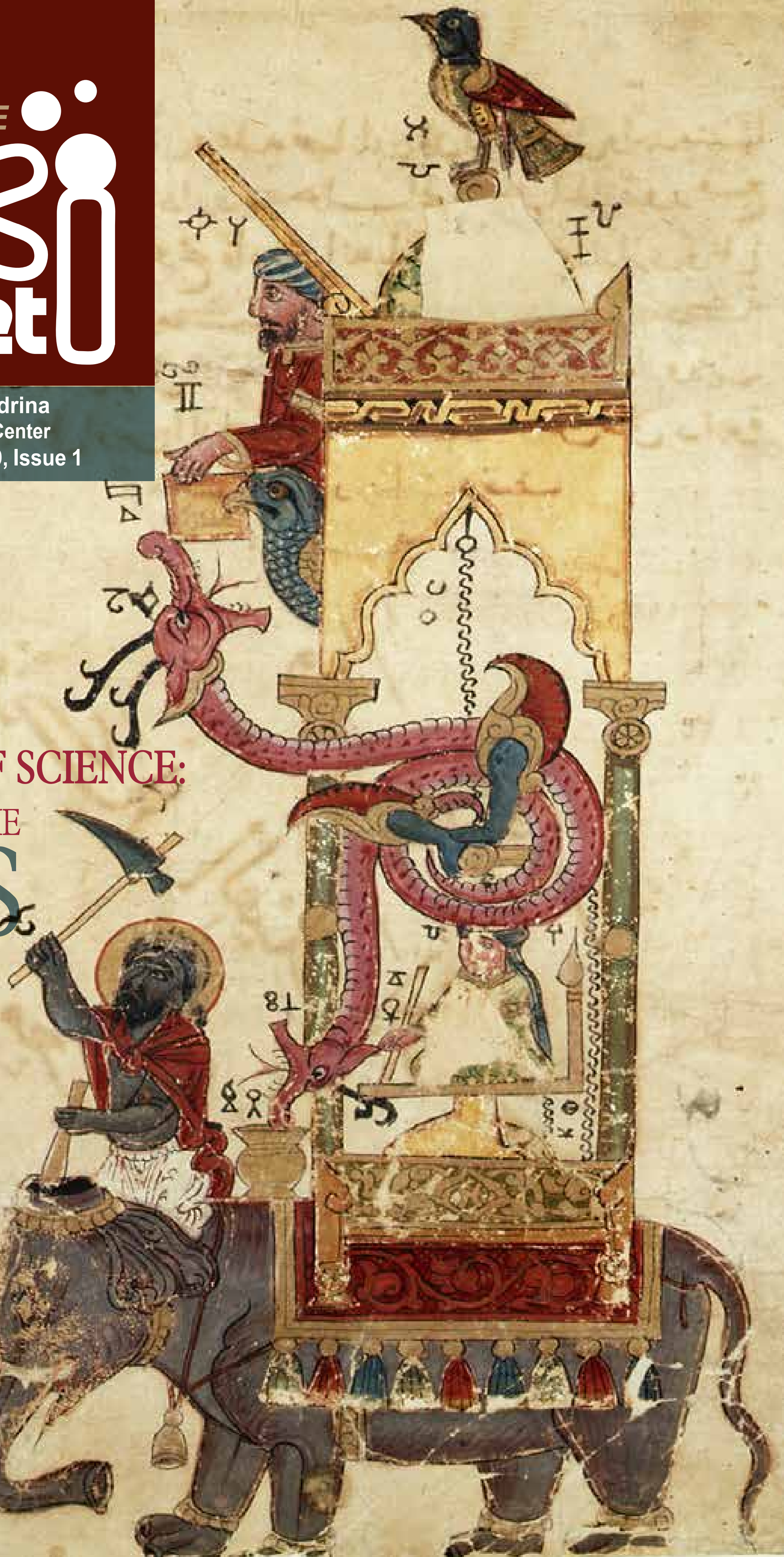
THE PEOPLE OF SCIENCE:
THE SCIENCE OF THE ARABS



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Planetarium Science Center

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Cultural Outreach Sector

Educational & Promotional Publications Unit (COPU)

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IN THIS ISSUE...

THE SCIENCE OF THE ARABS:

Legacies of the Past; Challenges of the Present

By: Maissa Azab

"The intellectual and practical activity encompassing the systematic study of the structure and behavior of the physical and natural world through observation and experiment"; this is the dictionary definition of the word Science. Science is indeed an activity; an activity conducted by humans; an instinctive activity that aims at understanding, unraveling, imitating, improving, becoming better, becoming stronger, and so on.

Science is thus part of human nature; a human nature that marvels at nature. Nonetheless, not all humans are the same; not all of them are driven or capable of dedicating themselves to observation, contemplation, investigation, experimentation, and thus revelation. Only some do; a very special some.

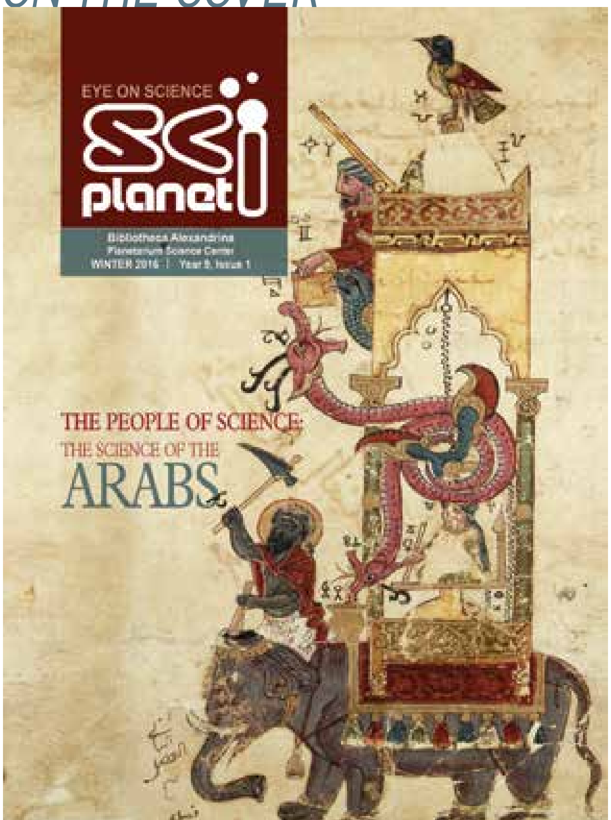
That is why we dedicate the issues of SCIplanet 2016 to the "People of Science". Naturally, because we could never do justice to all the people of science, we have decided to focus on four groups of such people that we, the Editorial Team, find most relevant to us Egyptians at this point in time.

Within this context, we are dedicating this first issue of 2016 to "Science of the Arabs". Despite many attempts to overshadow the immense historical influence of Arabs on science, and despite many challenges and obstacles that hamper the scientific efforts and ambitions of modern-day Arabs, Arabic scientific achievement, past or present, cannot be overlooked.

In this issue, we attempt to highlight some distinctive Arab scientists of the past and the present and their impact on different sciences, and in turn on our lives and the lives of all humans. We also try to shed some light on the opportunities versus challenges Arabs, especially Arab scientists, are exposed to.

Developed by the Cultural Outreach Sector Publications Unit, SCIplanet is published by and under the umbrella of the Planetarium Science Center. We are as always proud to present valuable collaboration from the Cultural Outreach Sector family; in this issue, the writings of Dr. Mohamed Soliman and Dr. Shyamaa Elsherif, in addition to the artwork of Mohamed Khamis.

We wish you a happy and blessed new year, full of achievement and progress.



By: Moataz Abdelmegid

THE ELEPHANT CLOCK

Badi'al-Zaman al-Jazari was an Arab engineer, scientist and inventor who lived during what is referred to as the "Golden Age of Islam" during the 12th and 13th centuries. Among his many inventions was the Elephant Clock; it consisted of a weight-powered water mechanism in the form of an Asian elephant. All the elements of the clock were kept in a housing on top of the elephant; they were designed to move and make sound each half hour. In addition to telling the time, the clock celebrated the universality of Islam by incorporating elements from China, Egypt, India, Iraq, Phoenicia, and Spain.

Al-Jazari built his clock in the shape of an elephant with a chair on its shoulders. On the column of the chair corners there is a citadel with a small dome on the citadel and a bird on the dome. A balcony is set on the citadel towards the elephant's head; a man is sitting on the balcony with two falcons on the right and left sides of the man.

Between the columns of the balcony lies an arm with two snakes coiled on it, a hemisphere on the center of the chair, and a platform on which there is a clerk holding a pencil in his hand. On the platform is situated an arc that is divided to 7.5 degrees; a handler sits on the elephant neck, holding an axe in his right hand and a staff in his left. Two vases are on the two sides of the elephant neck.

When the pencil of the clerk comes to 7.5 degrees in half an hour, the bird sings; half of one hole becomes white; the man sitting on the balcony lifts his hand up from the falcon bill on his right side and puts his left hand on the falcon bill on his left side. A ball falls from the falcon bill on the right side into the snake's mouth on the right side; the snake moves the ball in the vase to the right shoulder of the elephant; the handler of the elephant thrusts at the elephant head with his axe; he lifts his hand with a staff and strikes on the elephant head.

The ball comes out from the elephant chest; a bell hanging on its belly falls, making a sound, consequently announcing that half an hour passed. The pencil of the clerk comes out of the degree sign, after which the same process is repeated for the falcon and the snake on the left side; this time, one hole becomes completely white indicating that one hour has passed.

Al-Jazari's 900-year-old automatic elephant clock that exhibited the principles of physics and mechanical engineering stands today as an example of the Muslim origins of modern automation and robotics. The detailed design drawings and instructions are illustrated in Al-Jazari's 1206 CE *Book of Knowledge of Ingenious Mechanical Devices*, which is a manuscript describing 50 machines such as animal and humanoid automata, automatic gates and doors, as well as clocks.

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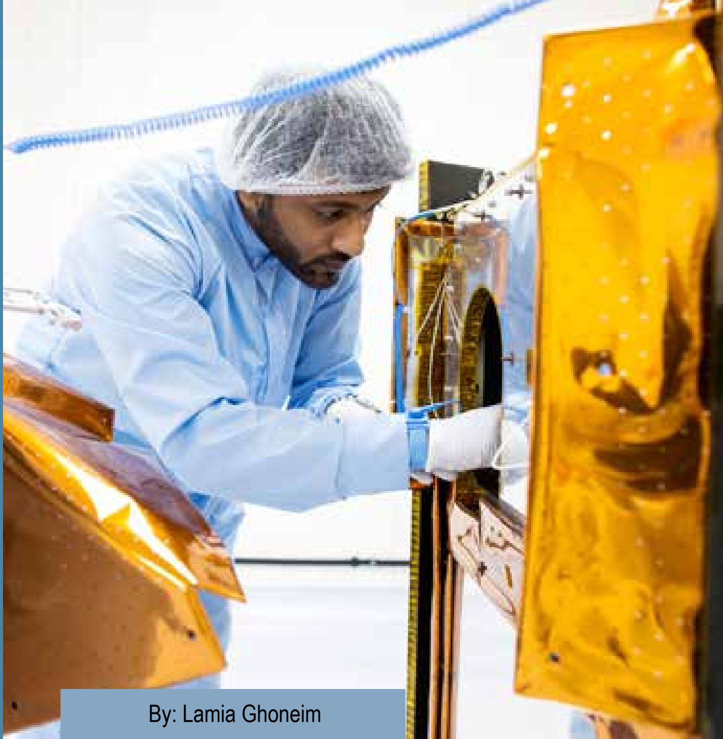


FIRST ARAB MARS PROBE IS THE NEW HOPE

By: Lamia Ghoneim

All eyes have turned to Mars lately with NASA announcing the discovery of water on the neighboring planet. Mars has been the target of human exploration for years, being the planet closest to habitability after Earth, which was further confirmed by the latest discovery. Numerous rovers continue to prowl the surface of Mars, in addition to satellites orbiting around it, gathering information and exploring the planet's surface and atmosphere.

Now the Arab World will join the Martian exploration race, as the United Arab Emirates (UAE) prepares to send the first Arab probe to explore the Red Planet's atmosphere, as early as 2021. Named Hope, the ambitious Emirati probe is designed from scratch in the UAE, and will study the planet's atmosphere and climate in detail, spending as long as four years in the Martian orbit, aiming to create mankind's first integrated model of the Mars atmosphere.

It is a giant leap for Arab technology; one that puts us on the map of space technology, signaling hope and optimism for Arab scientists and engineers everywhere. "If a small young Arab nation is able to reach Mars, truly anything is possible," as Emirates Mars Mission Project Manager, Omran Sharaf, says in the team's announcement.

The unmanned mission is scheduled for launch in 2021, to coincide with the 50th anniversary of the founding of the UAE, and is estimated to arrive in a mere seven to nine months. Once there, its work will include analysis of the Martian atmosphere in hopes of finding answers to ongoing conundrums involving Mars' long-term water loss via atmospheric photo-dissociation. That is, the reactive chemical breakdown of water (H_2O) brought on by the Sun's incoming photons.

The Emirates Mars Mission will be the first to study dynamic changes in the Martian atmosphere, creating a global picture of how the Martian atmosphere changes throughout the day and between its seasons. Its specialized instruments will enable scientists to observe weather phenomena such as clouds and dust storms, as well as changes in temperature, dust, ice, and gases, including water vapor throughout the layers of the atmosphere.

The probe will be a compact spacecraft the size and weight of a small car. It will blast off in a launcher rocket, then detach and accelerate into deep space. It will reach a speed of 126,000 kilometers per hour for the 600 million km journey around the Sun to Mars, which will take around 200 days.

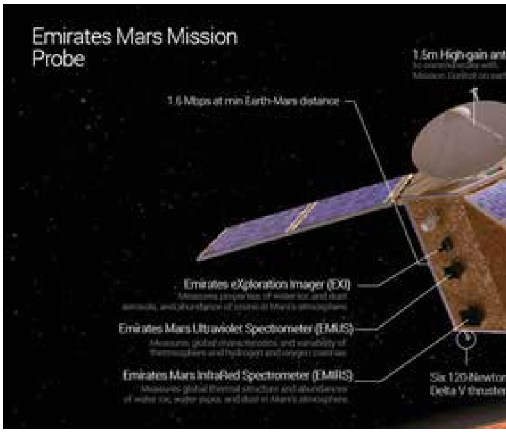
After being inserted into an elliptical 55-hour orbit in the first quarter of 2021, Hope will carry out its mission at altitudes ranging between 22,000 km to 44,000 km. Besides deepening human knowledge about Mars, the data will also help climate scientists understand changes in the Earth's atmosphere over millions of years. This knowledge will also help space scientists evaluate the atmospheres of thousands of newly discovered planets far across the galaxy, to determine which may have an atmosphere that could support extra-terrestrial life.

The probe will orbit the Red Planet until at least 2023, with an option to extend the mission until 2025. It will send back more than 1000 GB of data to be analyzed by teams of researchers in the UAE. The data from the space mission will also be shared freely with about 200 universities and organizations around the world, to ensure the spread of knowledge and for the mutual benefit of all space organizations.

As of now, around 75 engineers are working on the project, and the number is expected to double by 2020. The project is 100% Arab, fully staffed by local engineers and scientists.

Meet the Probe

The Emirates Mars Mission spacecraft will be a compact, hexagonal-section



spacecraft. It will be built from aluminum in a stiff, but lightweight honeycomb structure, surfaced with a strong composite face-sheet. Once in space, the craft will charge its batteries using three 600-watt solar panels. It will communicate with mission control using high-gain antenna with a 1.5 m wide dish.

The spacecraft will be equipped with star tracker sensors to help determine its position by studying constellations in relation to the Sun. The spacecraft's brain is a computer equipped with sophisticated software that can maneuver it into Mars orbit autonomously without human guidance. It carries three scientific instruments for its mission to study the Martian atmosphere:

- An Imager: a digital camera to send back high resolution colored images.
- An infra-red spectrometer to examine temperature patters, ice, water vapor, and dust.
- An ultraviolet spectrometer to study the upper atmosphere and traces of oxygen and hydrogen further in space.

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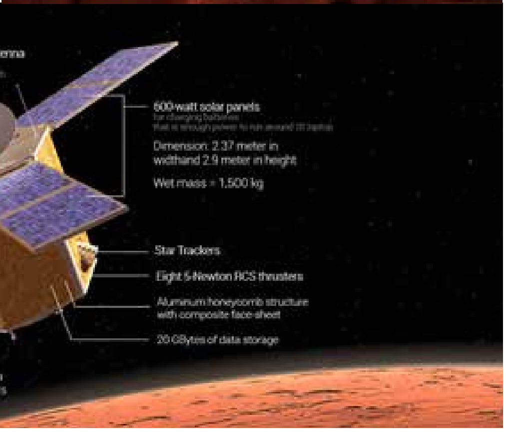

ESSAM HEGGY: A PROFILE

By: Shahenda Ayman

Childhood dreams and ambitions can make our future if we believe and exert our utmost effort to achieve them. Many scientists were encouraged to research and invent because they had dreams. Born in a small oasis in the desert, Dr. Essam Heggy was passionate to learn how to explore water and understand why stars are shiny in the clear desert night sky. Those two dreams haunted him through his childhood and ended him up participating in the hunt for water and volatiles on the Moon, Mars, and other objects of the Solar System.

Dr. Essam Heggy is a well-known name in the space field and an eminent Arab scientist at NASA, continuing the Arab's legacy and contribution to science. He is now a Research Scientist in the Radar Science Group at the NASA Jet Propulsion Laboratory and Visiting Associate in Geology at the California Institute of Technology. Heggy obtained his BSc in Astronomy from Cairo University, Egypt, then he obtained his PhD in Astronomy in 2002 with distinguished honors from the Sorbonne University Group-UPMC in France.

His main interests in space and planetary geophysics are Mars, the Moon, icy satellites and Near Earth Objects. His research involves probing structural, hydrological, and volcanic elements in terrestrial and planetary environments, using different types of radar imaging and sounding techniques, as well as measuring the electromagnetic properties of rocks in the radar frequency range.

Specialized in using Ground-Penetrating Radar (GPR) to detect and identify water and objects buried deep in the ground, Heggy has been involved in a number of projects with NASA and the European Space Agency (ESA). The first project involved the Sub-Surface Sounding Radar Altimeter (MARSIS) equipment on board the Mars Express Orbiter, taking subsurface images of Mars. The second project involves the development of the ground-penetrating radar onboard ExoMars, a rover that landed on Mars in 2012.

Currently, he is a member of the science team of the MARSIS instrument aboard the Mars Express orbiter, the Mini-SAR experiment aboard Chandrayaan-1, the Mini-RF experiment on board the Lunar Reconnaissance Orbiter, and the Comet Nucleus Sounding Experiment by Radiowave Transmission (CONSERT) on board the Rosetta mission. He is also a contributing scientist to several proposed planetary and terrestrial radar imaging and soundings experiments and participated in several NASA radar mission concept design at the NASA Jet Propulsion Laboratory.

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AL-QARAWIYYIN:

By: Jailane Salem

THE OLDEST UNIVERSITY IN THE ISLAMIC WORLD

There are numerous universities around the world; they are beacons of knowledge sought by multitudes of people, who journey across lands to join them in the hopes of expanding their minds and attaining enlightenment. A University in Morocco has claimed the title of the oldest university founded. Some contest that claims; however, according to UNESCO and Guinness World Records, it is the oldest educational institution that has been continually in use since its establishment, and is the first institution to award academic degrees.

This is Al-Qarawiyyin University, a centuries old university that was founded by Fatima Al-Fihri in the year 859. Her family used to live in Tunisia; they eventually migrated and settled in Fez. In the ninth century, Fez was a bustling cosmopolitan city that was an influential center in the Islamic world, produced many thinkers, and was a kaleidoscope of traditional and cosmopolitan influences.

Fatima's father was a businessman; his beginnings were humble, but as he continued working he amassed great wealth. When her father and brother, as well as husband, died in succession, Fatima and her sister Mariam were left with a large inheritance, which left them financially independent. Having been well educated, they put their money in projects that would be beneficial to the community. Each sister undertook the building of a mosque; the mosque that Fatima built had a *madrasa*, which later developed into a university that still functions to our day.

It is said that she oversaw the construction of Al-Qarawiyyin, and that she was attentive to all details even though she was not an architect. A great variety of subjects were taught at the University: The Quran, Islamic theology, medicine, history, chemistry, mathematics, astronomy, and much more. Many famous and prominent thinkers taught and were students at the University; by the 14th century, the University attracted 8000 students with its reputation as a place that has great teachers and a great place to attain knowledge.

Many well-known scholars have studied or given lectures at Al-Qarawiyyin University, including Ibn Khaldun, the famous historian and historiographer, who is also considered to be one of the founders of modern sociology. Ibn Khaldun is most known for a book he wrote entitled *The Muqaddimah*, (*The Introduction)*; it is about the philosophy of history and was a very influential book that had a great impact on later historians and sociologists.

Another famous scholar who is connected to Al-Qarawiyyin is Al Bitruji, who is a renowned astronomer who lived in the 12th century. He accomplished great feats in his field, and is well known for writing *Kitab al-Hay'ah*—a book on theoretical astronomy. In this book, he presented a planetary motion theory that was from the Ptolemaic astronomical system, which was dominant at the time, and instead offered an alternative model.

A great adventurer from the 16th century had attended Al-Qarawiyyin University; he is well-known as Leo Africanus, but he was Hassan Al-Wazzan Al-Fasi. His family had settled in Fez and it was there that he attended Al-Qarawiyyin University. After his studies, he travelled extensively and as he was interested in how the geography of one place differs from another, he wrote a book entitled *A Geographical History of Africa*.

This work was more of an encyclopedia than a book. It was well-received and was translated into many languages, serving for a while as the main authority on the subject. It was made up of nine volumes that discussed the varying climate of the different regions of North Africa, as well as the characteristics of the people and societies that lived in that region.

It all started when a woman in the 9th century dreamed of building a lasting contribution to her community, a place that could embrace worshippers as well as those who came to seek knowledge. Al-Qarawiyyin Mosque and University witnessed many changes across the centuries; as other people added and expanded the Mosque and University, it gained the patronage of powerful rulers and families, who also wanted to be a part of this enlightening place. To this day, this embodiment of learning still stands and the University's doors are still open to those who seek knowledge.

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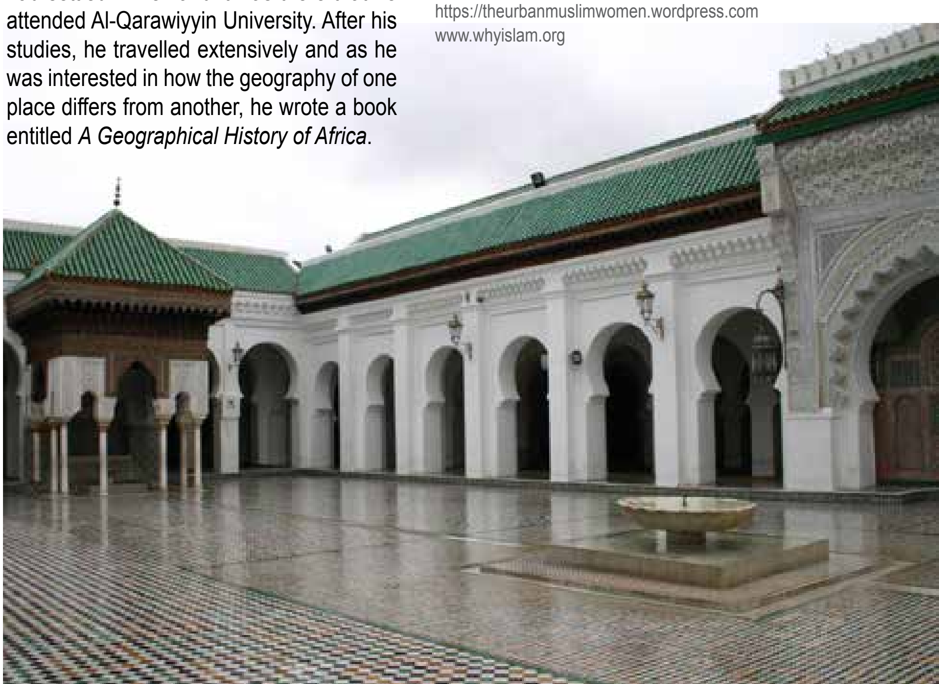
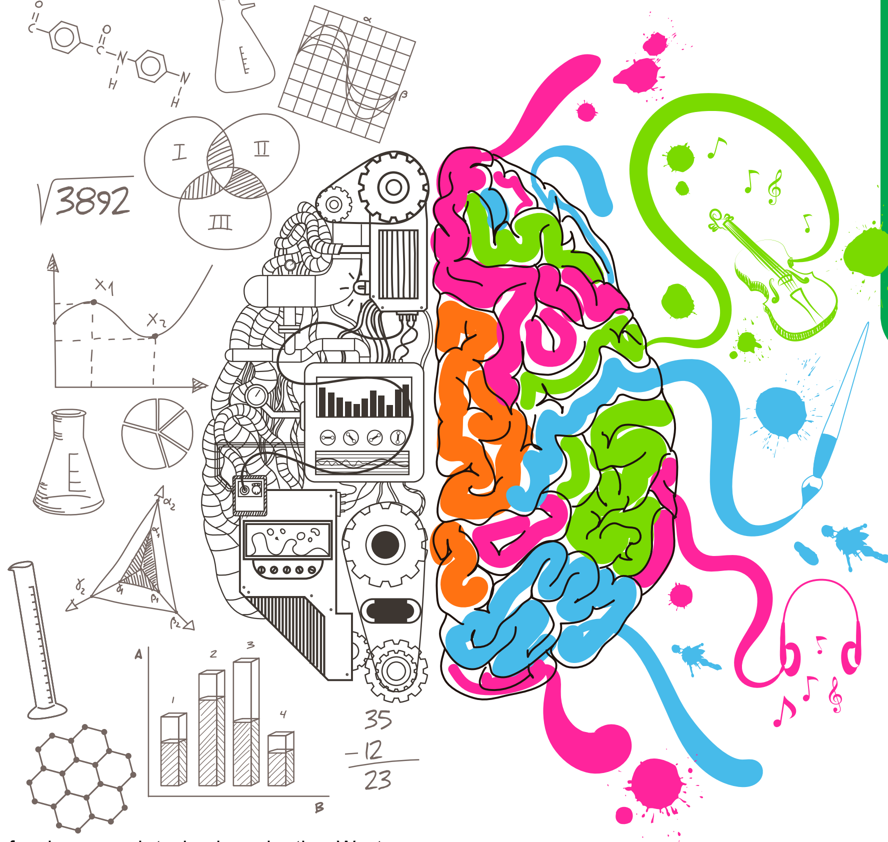


BRAIN DRAIN

THREATENS THE FUTURE OF ARAB SCIENCE



By: Lamia Ghoneim

There is no lack of talent in the Arab world; in medicine, physics, engineering, astronomy, and countless other fields, we have professionals who excel and innovate at every level. Then, why is the Arab world slow at progressing towards making science and technology advances? If so many talented people exist in our countries, why can we not make leaps and bounds in scientific fields like other more developed countries?

One apparent reason is that, while Arabs do excel in many fields, they usually excel away from their home countries. The phenomena that is the immigration of scientists, dubbed "Brain Drain", is one of the reasons why Arab countries no longer lead the race in science as they did previously.

Many factors contribute to the immigration of talents: lack of investment in research, few job opportunities, social and political instability, lack of a conductive learning environment and resources, and simply the desire for their talent to be recognized somewhere other than their home countries that often neglect them.

A study by Cairo's Gulf Center for Strategic Studies found that the immigration of intellectuals from the Arab world accounts for about one-third of the total "brain drain" from developing countries to the West. That constitutes the loss of half of our newly-qualified medical doctors, 23% of our engineers, and 15% of our scientists each year, with three-quarters of these moving to Canada, United Kingdom, and United States. This is estimated to equate annual losses to Arab countries of more than USD 2 billion!

Now many of these professionals have been highly successful, accounting for up to 2% of positions at the most prestigious institutions in Europe and the United States, contributing significantly to the development of science and technology in the West. Examples of those who made it to the absolute top of scientific excellence away from their Arab homelands are well known: Dr. Magdi Yacoub, or "The King of Hearts" as dubbed by the Royal Society; Nobel Prize winner Dr. Ahmed Zewail; space legend Dr. Farouk Al-Baz; and numerous other examples of genius Arab minds.

Imagine if their talents were effectively utilized in their home countries; how much could they have achieved for Arab research and scientific development?

While most of those who make it abroad do try to give back to their home countries, they are often faced with difficulties in executing their visions due to lengthy procedures, stacks of forms to be filled, and endless bureaucratic legalities. Recently though, there has been noticeable change in the appreciation of scientific research and development in Arab countries, with many countries taking steps towards reform, which will hopefully minimize and reduce "brain drain".

In the Gulf States, plenty of new scientific institutions and research centers have been established; such as the King Abdullah University for Science and Technology (KAUST) in Saudi Arabia, and the Qatar Science and Technology Park, both inaugurated in 2009.

Existing research centers are also benefiting from increased budgets for basic and applied research, allowing them to attract renowned scientists from abroad and invest in state-of-the-art facilities. This has resulted in an increase in the availability of research funding, more government-sponsored grants and projects, and more publications and patents.

In Egypt, in 2011, the interim government announced a whopping tenfold increase in spending on science up to 2014, and the creation of up to 50,000 jobs in research, partly funded by a Euro 20 million grant from the European Commission. The new constitution, voted in 2014, also stipulates that gross spending on research and development should be no less than 1% of the country's GDP up from 0.43% spent in 2011. That year also witnessed the establishment of the Zewail City of Science and Technology, the USD 2 billion project named after Dr. Ahmad Zewail.

However, there is still plenty that could be done. Arab countries could, for example, help create a network and directory of Arab scientists and technologists abroad, along with a foundation that supports collaboration between the scientists abroad and their counterparts in their home countries.

This small step could boost research and technology in Arab countries. Collaboration could produce a wealth of intellectual property shared by both sides that is capable of catalyzing and leveraging additional funding and commercialization, resulting in true transfers of know-how and technology.

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By: Jailane Salem

Human Flight

Adventures and Misadventures

Man has always been inspired by nature. By simply observing their surroundings, many an inventor sought to imitate natural occurrences and re-create mechanisms and processes they realized. One such occurrence is birds flying; elegantly soaring through the air, humankind has long been fascinated with birds and their majestic flight.

Many an ancient religion had birds as deities; many myths and legends told of hybrid creatures that could fly, and featured heroes who were able to fly or had attempted to fly. So it is to be expected that throughout our history we would find many incidents, trials and errors where people from around the world attempted to fly.

One of the more known earlier myths is that of Icarus, which is from Greek mythology. He was the son of Daedalus, a craftsman who had created a labyrinth to trap a Minotaur on the island of Crete; however, at one point he himself was imprisoned in the labyrinth and to escape a dreadful fate he created wings for himself and his son Icarus.

Daedalus made the wings out of wax and feathers; before attempting to fly, he warned his son not to fly too close to the Sun alas the wax would melt. Daedalus took off first; enthralled by the whole experience, Icarus being kept soaring higher and higher until he reached a point where his wings melted and the feathers fell. He soon realized he was flapping with no wings but only his arms, and fell into the sea to his death.

The first man to actually attempt to fly with a contraption similar to wings, was Abu Al-Qasim Abbas Ibn Firnas Ibn Wardus, also known as Ibn Firnas. Ibn Firnas was a Berber born in the 9th century in Ronda, a city in southern Spain. He later on moved to Cordoba. Ibn Firnas was a multi-talented man whose skills and abilities knew no bound; it is clear by the stories of his various eclectic ventures he pursued, how vast his imagination was.

Some of his achievements include the creation of a “sky simulation room” in his home. It contained machines and hidden mechanisms that could recreate the movements of planets, stars, clouds, even thunder and lightning. He also developed a method of cutting rock crystal, which was quite useful to people in Spain, since they did not have that knowledge to do so, and instead relied on sending their rock crystals to Egypt to be cut and refined.

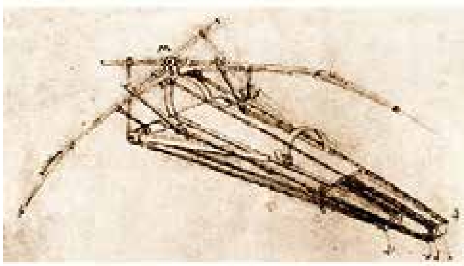
Ibn Firnas is also known for creating a water clock named *Al-Maqata*, which might have helped him in exploring different tempos since he was also a musician. This is in no way a comprehensive list of all of this polymath’s achievements; what cemented his name in history, however, was his successful attempt at flight.

He was fascinated by the idea of flight, and by observing birds he believed that he could build a device that could aid him in flying. His first attempt was in 852 CE; he had built a contraption similar to what we know as a parachute and tested it out by jumping off the *muezzin* of the Grand Mosque in Cordoba. His parachute, while not the most efficient, helped him slow down while landing, but he did sustain some minor injuries in the process.

Mostly successful, this experiment encouraged Ibn Firnas to pursue his dream of creating a device that would allow him to glide through the air like a bird. So, for the next two decades, he dedicated himself to the study of birds and the building of an ornithopter.

An ornithopter is an aircraft that is either manned by a pilot or powered by an engine; it achieves flight through the flapping of wings. Whilst Ibn Firnas did build an early ornithopter, he probably achieved flight through simply gliding and not the actual flapping of the wings he built, making his prototype more of a hand-glider.

His design had two sets of wings in order to adjust his direction and altitude while flying. He flew his device at the age of 65 years in 875 CE, proving that age is just a number. He is proclaimed to have said “Presently, I shall take leave of you. By guiding these wings up and down, I should



ascend like the birds. If all goes well, after soaring for a time, I should be able to return safely to your side". In front of a large crowd that came to witness this great experiment, he propelled himself off a mountain and, according to eye witness accounts, he flew for what seemed like ten minutes. This was the first time a man flew!

So how exactly was Ibn Firnas able to do that? What is the mechanism that allowed him to achieve such a feat? The answer lies with birds; so let us have a look at how birds fly.

Four main forces come together when a bird flies: weight, lift, thrust, and drag. The weight force is caused by gravity pulling the bird towards the ground; the lift force is what counteracts that, giving the bird the ability to move upwards, which is caused by the air when it moves over as well as under the bird's wing.

The muscles of the birds that flap their wings provides it with the thrust force that allows it to move forward, air resistance is what causes the drag force that occurs in the opposite direction of the bird's flying. The bird's tail creates the drag force needed for it to slow down its speed when landing; tails also help birds steer their direction, and when flying, by spreading its tail feathers, birds can create more lift and stability.

Ibn Firnas paid special attention to the function of a bird's wings, and realized how the shape of it is crucial in producing the lift force needed for flight. Due to the wings' shape, which is curved, big at the front, and tapers off at the end, the air interacts differently depending if it flows on the top of the wing or at its bottom. The air travels quicker on the top of the wing and so reduces air pressure, while it travels slower at the underside of the wing and therefore there is more air pressure, which creates the lift force that helps the bird fly.

Ibn Firnas spent twenty years studying flight and building his glider, making it appropriate to his weight and size. He built his glider with wood, and the wings were silk and actual feathers. He must have paid special attention in making it as light as possible since what aids birds is their relative lightness.

When finally he had completed his design, he assembled an audience, jumped off a mountain side, and was able to remain airborne for about ten minutes. Alas, Ibn Firnas forgot to create a tail on his contraption. With no way to slow down his descent, he ended up crashing to the ground. This oversight on his behalf would cause him to suffer from back pain for the remainder of his life, he passed away at the age of 77 years, twelve years after his triumphant experience.

Ibn Firnas would be followed by others who also attempted to fly. In the 11th century, a monk named Eilmer in England attempted to fly by attaching wings to his hands. Inspired by the myth of Icarus—some speculations say he was also inspired by the tales of Ibn Firnas' success—he fashioned wings for himself and attempted to fly. Though he was able to glide, he was airborne for a very short time, traversing around 200 meters. However, he was unable to make a good landing, and ended up crashing to the ground, breaking both of his legs and crippling him for the remainder of his life.

The first person to be able to make repeated successful gliding flights was Otto Lilienthal, a German who lived in the 19th century. In his lifetime, he built many gliders and made great contribution to the studies of aerodynamics; his success helped pave the way for the creation of flying machines. He was very passionate about his endeavor, he died as he sustained injuries when he lost control of his glider and crashed in 1896.

Anything is possible if only you put your mind to it. Looking over the course of human flight history, one is struck by the ingenuity and bravery of those who dreamed of soaring in the skies, and actually dared to make their dreams come true. It is to them that we must be grateful for they are the ones who planted the seed that has sprouted into the vast networks of airports and flight routes that can take us to every corner of the globe in our modern day and age.

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By: Esraa Ali

Arab Science Fiction

Science Fiction (Sci-Fi), as defined by *Merriam-Webster*, is a literary form that deals principally with the impact of actual or imagined science on society or individuals. This genre has been flourishing rapidly in the West. Nowadays, Sci-Fi is viewed in our Arab world as an extension of a foreign heritage, although it is not novel or strange to our culture. Arabs have produced many fantastical stories, as well as truly futuristic Sci-Fi works; however, they have not always been in the spotlight.

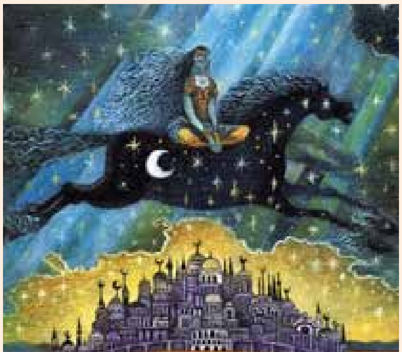
Many date Sci-Fi back to the 19th century in Europe; to Jules Verne's scientific romances and H.G. Wells' novels, or a few years earlier to the groundbreaking publication of Mary Shelley's *Frankenstein*. Others argue that Sci-Fi evolved during the Enlightenment and the Age of Reason, 16th–18th centuries, with the birth of early Sci-Fi works following the scientific revolution and major discoveries in astronomy, physics, and mathematics.

In reality, Sci-Fi dates further back several centuries in the East. Noticeable examples of proto Sci-Fi tales are recounted within the tales of *The Arabian Nights*. Some of these tales are *The Adventures of Bulukiya*, which depict cosmic pluralism through Bulukiya, who looks for a herb of immortality and travels across the cosmos to different worlds; *Abdullah the Fisherman and Abdullah the Merman*, where Abdullah, the protagonist, discovers an underwater submarine society after he gains the ability to breathe underwater; *The Ebony Horse,* about a mechanical horse capable of flying into outer space; as well as the commonly known *Adventures of Sinbad the Sailor* and *Aladdin and the Wonderful Lamp*.

Although these tales include fantastical journeys through various cosmoses, Sci-Fi in the East neither begin nor end with *The Arabian Nights*. The earliest known fiction was written in the 2nd century CE by the Syrian Lucian; it is *True History*, which recounts the story of a space voyage, wars between celestial planetary bodies, and encounters with forms of alien life. The novel is referred to as "the first known text that could be called science fiction".

There is also a long history of early Arabic Sci-Fi that goes all the way back to the 8th–13th centuries. Arab sci-fi, which is inclusive of fantasy and mythology, was witnessed in many works of intellectuals. In the 9th century, 500 years before Thomas More's *Utopia*, al-Farabi envisioned in his *Opinions of the Residents of a Splendid City*, a utopian society ahead of its time.

Moreover, Ibn Tufail's *Hayy ibn Yaqdhan*, written in the 12th century, is considered an early example of Sci-Fi literature and one of the most important books that had a profound influence on philosophy. In the 13th century, *Hayy ibn Yaqdhan* inspired the Arabian polymath Ibn al-Nafis to write *The Book of Fadil ibn Natiq,* later translated as *Theologus Autodidactus*, which is considered a Sci-Fi novel. It narrates the story of a wild child on a deserted island; as the tale progresses, elements of futurology, apocalyptic destruction, and other wild concepts arise.



Ibn al-Nafis explained these elements using scientific concepts in anatomy, biology, physiology, astronomy, cosmology, and geology, instead of giving supernatural or mythological explanations. For example, he explained bodily resurrection by introducing his scientific theory of metabolism and making references to his own scientific discovery of the pulmonary circulation. Furthermore, Al-Qazwini's *Awaj bin Anfaq* futuristic tale, written around 1250 CE, about a man who came to Earth from a distant planet also has proto Sci-Fi elements.

In the modern era, Arab science fiction has been witnessing a revival of interest after it was dominated by translations of Western Sci-Fi tales for many centuries. In the late 1950s, Tawfiq al-Hakim published *Voyage to Tomorrow*, followed by Mustafa Mahmoud, who wrote famous Sci-Fi novels, including *The Spider*. Both authors' works encouraged other writers throughout the region, including Nabil Farouq in Egypt, known for *The Future Archive*, Mohammed Aziz Al-Habbabi in Morocco, known for *Elixir*, and Kassem Al-Khattat in Iraq, known for *The Green Stain.* These are only a few names and the list goes on, which shows wide interest in that genre from Arabs seeking change, hoping to reach a future different from our present.

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A Beautiful Mind
Before Newton, there was
Alhazen

By: Lamia Ghoneim

Alhazen was the Arab scientist who birthed the scientific method, and the Father of Modern Optics. He was also the daring scientist who feigned madness to escape the madness of the Fatimid Caliphate, after failing to accomplish his impossible task. He was a genuine polymath, a controversial figure, and a brilliant mind.

The year 2015 marks the 1000th anniversary since the appearance of his remarkable seven-volume treatise on optics *Kitab al-Manazir*. We celebrate this event by narrating his life story, as accurately and as precisely as possible, for those who seek the truth.

Once Upon a Time

A little over 1000 years ago, in what is now known as Iraq, Al-Hassan Ibn Al-Haytham, or Alhazen as the Latins later dubbed him, was born in the city of Basra, during the reign of the Abbasid Caliphate. Little is known about his life as a youth in Iraq, even though an autobiography written by him in the year 1027 still exists. Being a true scientist, however, his writings say very little about his personal life; instead, it focuses on his intellectual genius.

What is known about his early years is that he was raised to be a civil servant and educated in Islamic studies in Basra and Baghdad, excelling to be appointed as Minister of Basra and the nearby region. Surrounded by the culture of learning in Iraq and the golden age of scientific advancements in the Islamic Civilization, he began to focus his interest on science and other empirical subjects.

In studying science, he found his true passion and self worth, until he finally quit his job and left for Egypt—then ruled by the enemies of the Iraqi Caliphate, the Fatimid Dynasty—to further pursue his scientific studies.

In the Land of the Nile

In Egypt, Alhazen flourished and his reputation grew as a scientist, until he gained sufficient fame for his knowledge in physics to be recognized by the then reigning Fatimid Caliphate, Al-Hakim.

Al-Hakim himself was interested in science, particularly astronomy; while known as a patron of science and supporter of scientists, he was also known to be ruthless and quite eccentric though.

Ibn Al-Haytham was studying how to regulate the flow of the water of the Nile in order to minimize flooding; Al-Hakim heard about his endeavors, and ordered him to undertake the task straight away. While seemingly feasible on paper, Alhazen realized after travelling with a team up and down the Nile that his idea would require the implementation of a huge dam, requiring large construction equipment that was not available at that day and age.

Upon realizing he had to report his failure to an unpredictable Caliphate and was very likely to lose his precious head, Alhazen then feigned madness, in an effort to escape the fury of Al-Hakim.

In a way, he succeeded in his performance, for he was granted leave of his actions and simply confined to his home. The seclusion was just what he needed to become one of the greatest scientists of all time.

Prisoner of His Own Home

Over the next decade, being under house arrest for the rest of Al-Hakim's life, Alhazen managed to explain the nature of light and demonstrate the correct model of vision that was previously misunderstood by revered thinkers as Euclid and Ptolemy.

The prevailing wisdom before him was that we saw what our eyes, themselves, illuminated; their theory was that sight worked because our eyes emitted rays of light, like flashlights. This did not make sense to Ibn Al-Haytham; if light comes from our eyes, why, he wondered, is it painful to look at the Sun? This simple realization catapulted him into researching the behavior and properties of light: optics.

In order to solve his dilemma, Ibn Al-Haytham concocted a methodology of investigation characterized by a strong emphasis on carefully designed experiments, to test theories and hypotheses and verify them; by that, he gave birth to the scientific method that is used today by scientists in their investigative research.

He managed to demonstrate, by both reason and experiment, that light was a crucial, and independent, part of the visual process. He, thus, concluded that vision would only take place when a light ray came from a luminous source or was reflected from such a source before it entered the eye.

He proved that light only travels in straight lines, and he set out the initial arguments that confirmed the existence of an optical nerve, which interpreted how objects sending many rays to the eye could be seen even if only the perpendicular ray mattered. He explained how mirrors work, and argued that light rays can bend when moving through different mediums, as water.

Alhazen used a dark chamber he called *Albeit Almuzlim*, which translates to *camera obscura* in Latin, to help explain the nature of light and vision; his device is credited as the basis of photography.

continued on page 23

TOP 10 Influential Arab S Then & N

By: Lamia Ghoneim

Strictly speaking, the measure of influence of a scientist is based upon complicated calculations and performance metrics that are built on values, such as citation ratings, research rankings, and how their scholarly records measure up against those of the past great scientists.

Theoretically this is a job for professional researchers whose careers are centered on establishing and comparing academic rankings of scholars and scientists around the world. For those of us who are not academic researchers, the influence of scientists can be simply measured by how much their work has affected our lives, and the world in which we live.

Selecting the top ten most influential Arab scientists of the past and of today has proved to be anything but simple though. Not for the lack of great Arab minds, but because it was very difficult to omit any of them from the list. Even more difficult was to rank those who actually made it on the list. In the end, we chose to arrange them randomly, and to pair the past with the continuing present.

Jabir ibn Hayyan (721–815)

Named the Father of Chemistry and the Founder of experimental science of Chemistry, ibn–Hayyan was the first man to change alchemy—a pseudo-science centered on turning cheap metals into gold—to the actual chemistry of today. He was a polymath; an alchemist, pharmacist, philosopher, astronomer, and physicist, but his major contributions in the field of chemistry are what influenced our world the most.

He discovered various minerals and acids; developed fundamental experimental techniques such as crystallization, distillation, calcination, sublimation, and evaporation; and developed several instruments for conducting these experiments. His emphasis on systematic experimentation was outstanding and the reason he is regarded as the Father of Chemistry.

Among his chemical contributions are the development of steel, preparation of various metals, prevention of rusting, lettering in gold, use of manganese dioxide in glass-making, dyeing of cloth and tanning of leather, varnishing of waterproof cloth and identification of paints and greases. He is known to the West as 'Geber', and his numerous writings have had a profound influence on the development of Western chemical knowledge.

Ahmed Zewail (1964–present)

Named the Father of Femtochemistry, Professor Ahmed Zewail was the first Egyptian and Arab to win a Nobel Prize in a scientific field. His pioneering work in femtochemistry earned him the Nobel Prize in Chemistry in 1999. Apart from inspiring millions of Arabs to follow their dreams and study science, how does his work in femtochemistry influence our lives, you might think?

Femtochemistry is the use of ultra-short laser flashes to observe fundamental chemical reactions occurring at the timescale of the femtosecond. It enables us to understand why certain chemical reactions take place but not others, and why the speed and yield reactions depend on temperature. It also allows us to study processes with femtosecond spectroscopy in gases, in fluids, and in solids, on surfaces and in polymers.

Its applications are wide and range from the production of catalysts and the design of molecular electronic components, to the most delicate mechanisms in life processes and the preparation of medicines. Future possibilities are immense, from gaining greater control over chemical reactions, to the possibility of artificial photosynthesis.

Ibn al–Nafis (1213–1288)

Chosen as the Father of Circulatory Physiology, Ibn al–Nafis was the first physician to discover our hearts. That is, he discovered the pulmonary circulation of blood and correctly described the role of heart and blood, and how blood flows from the right side to the left side of the heart via the lungs.

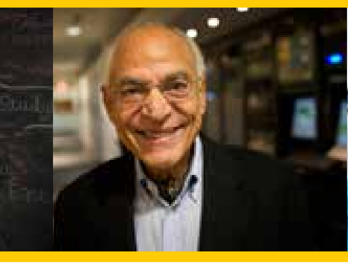
He corrected the mistakes of heart scientists who were before him, and documented his findings in more than 110 volumes of medical textbooks. His most famous book was *Sharh Tashrih al–Qanun* (Commentary on the Anatomy of the Canon of Avicenna) some of which was translated and influenced the work of European physicians who came after him.

Magdi Yacoub (1935–present)

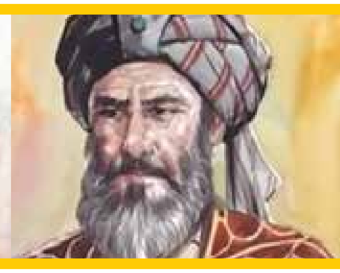
Selected as The King of Hearts and The World's Legend of Medicine, Egyptian Dr. Magdi Yacoub, UK's top heart surgeon, has performed more transplants than anybody else in the world, saving thousands of lives across the globe. In total, he has performed approximately 20,000 life-saving heart operations.

In 1983, Sir Magdi became the first person in the UK to perform a double heart and lung transplant. In 1987, he went on to pioneer and perform UK's first domino heart transplant, where a patient receiving heart and lungs donates their own heart to someone else. Sir Magdi is also credited with performing an operation on UK's youngest heart transplant patient at just 10 days old. He received countless awards and achievements, and continues to save lives and work in research that changes the world every day.

cientists: ow







Abu Abdullah al-Battani (858–929)

Recognized as one of the first actual astronomers in the world, al–Battani's pioneering work in astronomy was basis for much of the modern astronomy of today. His famous book *Al-Sabi Ephemeris, the Mathematical Table*, known as *Al-Zig Al Sabi*, greatly influenced his successors.

He successfully ascertained the positions of a lot of stars, accurately determined astronomical coefficients, and discovered the movements of the Moon and the moving planets. He worked on the timing of the new moons, the length of the solar and sidereal year, the prediction of eclipses, and the phenomenon of parallax. He also corrected Ptolemy views regarding the solar aphelion.

Aside of astronomy, he is credited with the invention of a string of trigonometric formulae, such as sine and cosine rules.

Farouk El-Baz (1938–present)

Recognized as the key scientist who helped NASA decide on the ideal Moon landing site for the Apollo 11 mission in 1969, and later for the Apollo 15 rover mission in 1971, Egyptian Dr. Farouk El–Baz is a renowned NASA space scientist who received numerous honors from all around the world. He is also a leading expert in the study of deserts and how to find and sustain water in dry environments such as the Arab desert.

He is also one of the founding fathers of using computer technology to describe geography, and in training astronauts the important skills of visual observation and space photography, in addition to instructing crew members on which rocks to collect and how to collect lunar soil.

Abu Ali Hasan ibn al-Haitham (Alhazen) (965–1040)

Ibn al-Haitham, known in the West as Alhazen, was a leading physicist, mathematician, astronomer, and the scientist who birthed the scientific method. Alhazen made significant contributions to optics, number theory, geometry, astronomy, and natural philosophy.

Alhazen's work on optics is credited with contributing a new emphasis on experiment, and earned him the title of The Father of Modern Optics. He managed to explain the nature of light and to correct Ptolemy's model of vision.

Mostafa A. El-Sayed (1933–present)

El-Sayed, a Regents' Professor and Julius Brown Chair at Georgia Institute of Technology, is a prominent chemical physicist, a leading nano-science researcher, and the scientist who birthed "El Sayed" spectroscopy rule.

His work in molecular spectroscopy has earned him critical acclamation all around the world, birthing molecular spectroscopy techniques to elucidate the molecular mechanisms and dynamics of molecules, gas-phase clusters, solids, and photo-biological systems.

More recently, El-Sayed's research group has focused on developing nano-scale materials and using those materials in catalysis, medicine, and sensing. The work has had quite an impact on the field, garnering numerous citations.

Samira Moussa (1917–1952)

Our list would not be complete without the women of firsts, Dr Samira Moussa, Egypt and Arab world's first female nuclear scientist, who inspired millions of Arab women to study science to follow in her footsteps. In 1939, Moussa obtained her BSc in Radiology with first class honors after her pioneering research on the effects of X-ray radiation on various materials.

She believed in "Atoms for Peace" and was quoted to say "I will make nuclear treatment as available and as cheap as aspirin". She worked hard for this purpose and was close to discovering an equation that would help break the atoms of cheap metals such as copper, paving the way for cheap nuclear energy. Unfortunately, she died in a tragic accident before her work was completed, but her legacy remains.

Hayat Sindi (1991–present)

Our list would not be complete without the women of firsts, young Dr. Hayat Sindi, Saudi Arabian medical scientist and one of the first female members of the Consultative Assembly of Saudi Arabia. The first Arab female to receive a PhD in Biotechnology from Cambridge University, Sindi is now a prominent nanotechnology researcher working to deliver affordable point-of-care diagnostic solutions to the developing world through the non-profit organization "Diagnostics for All".

Her greatest invention to date is a low–cost diagnostic tool that detects disease by analyzing bodily fluids cheaply and in less than one minute. Still under testing, the device has the potential to save millions of lives in poor countries. Sindi also has plans to build a world-class biotechnology center of excellence in Saudi Arabia with the support of Harvard and MIT.

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THE SCIENCE OF EGYPT:
TWO ACADEMICS' JOURNEYS

By: Jailane Salem

Egypt, a name that invokes a place filled to the brim with history, is a land that has been inhabited for millennia and whose people has always relied on the Nile for sustenance. Many say that Egypt is the gift of the Nile, and without it there would have been no Egypt as we know it.

The Ancient Egyptians made sacrifices to the River in order to show their gratitude for its existence and ensure a continuation of the abundance it provided them. The lives of farmers have long revolved around the cycle of the river, and in our modern times, the Aswan High Dam has played a central role in the lives of Egyptians.

Our unique location and landscape has inspired many to study the land of Egypt. Two academics in particular have made a name for themselves in their respective fields due to their diligence in the study of Egypt: Rushdi Said and Gamal Hamdan. One a geologist, the other a geographer, they both spent their lives studying the science that made Egypt the land it is.

Rushdi Said

Rushdi Said was born in 1920 in Shubra, Cairo, to a family that originally came from Assiut. Said studied at the Faculty of Science, Cairo University, and excelled at his studies; he graduated with honors in 1941. After working as Lecturer at the Faculty of Science, Cairo University, he continued his studies at the University of Zurich in Switzerland, and later obtained his PhD from Harvard University. He taught geology and was called the “Father of the Nile” as he was a pioneer in the study of the geology of Egypt.

What exactly is geology? Well, geology is a large field that comes down to the study of the materials that make up the Earth, as well as the processes that occur on Earth, such as earthquakes and floods. It encompasses the study of how Earth’s materials, processes, organisms, and structures have evolved and changed over time.

By studying the Earth’s past, geologists can better predict the Earth’s future; since Earth has passed through different phases of climate change, by learning about these past geological changes, we can better prepare for present and future climate changes. If a certain area is prone to floods, then a geologist would study it to understand the causes of the floods, and the information and data they discover is key for people who wish to develop these areas.

Geologists also study Earth materials, how they are formed, where they are found, and how they can be extracted from the Earth and put to use by people. Oil, metals, gases, groundwater and many more materials are studied by geologists, and they create methods and make plans for their extraction and use.

It is no surprise then to hear that Rushdi Said, a geologist, was the founder and head of Egypt’s National Mining Organization, which later became the Egyptian Geological and Survey Authority Mining Center. He also served as Minister of Industry and had visions of developing Egypt in a way to use its vast land, as well as looking into ways to preserve the ecology of the Nile.

He was a prolific writer and produced studies on the geology of Egypt, the Nile, and also on hydrology. By studying the geology of the Nile, he examined its history as well as its future uses, and was adamant that it should be safely managed in a sustainable way, since it is a key factor for the well-being of Egypt.

In 1993, *The River Nile: Geology, Hydrology and Utilization* by Rushdi Said was published; it is a book that delves in depth in all matters connected to the Nile, charting the history of the geological evolution of the river system. In this book, Said covers the origin of the Nile, as well as explores the different features that make the Nile unique.

Said tackles the different uses of the Nile from its uses in Ancient Egypt to Modern Times; he presents the developments in agriculture that have occurred over the ages, starting from the irrigation of the land when the Nile flooded on a regular basis, to the construction of the Aswan High Dam, and the changes it brought about to agriculture and the geology of the Nile.

The book is a must read for anyone studying the Nile and anyone interested in its geology, and has been a great contributor to the already existing Nile literature. He has also written many other books, including *The Geological Evolution of the River Nile* and *Science and Politics in Egypt: A Life's Journey.*

Rushdi Said wanted to make use of the Western Desert in Egypt and turn it into a place where people could live and where industries can thrive. The project he proposed was to connect the Western Desert with the Nile Valley; he realized that this area with its mild climate and flat topography would be an ideal place for urban centers to be built.

In 2005, when he gave a speech to the graduating class of the American University in Cairo, he said the following about his vision of new developments in Egypt: "Let me share with you my vision for the Egypt I want you to inhabit. It is an Egypt in which the Delta and the Nile Valley have been transformed into one great garden, a natural reserve free of industry, wholly devoted to agriculture, inhabited by a population limited enough in numbers to live in harmony with their environment and maintain a balance with natural resources. I envision the deserts of Egypt strewn with well-spaced and well-planned habitation centers, built around extensive industrial bases and fueled by locally available energy resources".

From geology to geography, we move on to another great mind, that of Gamal Hamdan. A geographer, unlike Rushdi Said who lived a very public life, Hamdan lived a very secluded, almost hermit-like life. A great intellectual, he chose to dedicate his life to research; in his self-imposed seclusion, he produced an encyclopedia that showcased his genius.

Hamdan was born in 1928, Qaliyubiya Governorate, but grew up in Cairo. He enrolled at Cairo University at the age of sixteen and joined the Department of Geography at the Faculty of Arts, where

Gamal Hamdan

he graduated in 1948. Thanks to his excellent academic record, he was offered to further his studies at Reading University in England.

In 1953, he returned to Egypt after obtaining his PhD and started working as Lecturer in the Department of Geography at the Faculty of Arts, Cairo University. In 1958, he was promoted to Associate Professor; but after five years, in 1963, he decided to resign from his post, and instead pursued a solitary life in order to focus on his academic research.

So what is exactly this field that Hamdan pursued so passionately? Well, geography is the study of lands, environments, its inhabitants, and features. It is a large field that is all-encompassing; it seeks to find the reasons behind natural and human phenomena. Geography links different disciplines since there are two main branches: human geography and physical geography.

Human geography deals with how cultures, societies, and economies work and interplay; whilst physical geography deals with the environment and physical landscapes of regions. Both branches are interlinked; studying geography creates a better and deeper awareness of the world we inhabit.

Gamal Hamdan published many books and articles, but he is most known for *The Personality of Egypt*, which was first published in 1967. It would be later republished and divided into four volumes, and the page count would reach 3552, which is the culmination of ten years of diligent research, and goes to show Hamdan's dedication to the subject. It is considered a masterpiece, and deals with the personality of Egypt as a country.

Hamdan did not follow the conventional geographical methodology in his research; instead he attempted "a fusion of geography and history" in order to understand his subject. For Hamdan, he realized that "the conventional regional geography is a description of place, but the regional personality is a philosophy of place. The former is only a reporting geography, but the latter is super-geography, transcendental geography".

In the first volume of *The Personality of Egypt*, Hamdan expands on the concept of "regional personality" and explains that "This regional personality transcends a mere mathematical amalgamation of characteristics and the distribution of regions; that is, it exceeds a mere body of regions itself. It defines what characterizes an area and differentiates it from other areas. It is an attempt to approach *genius loci* to clarify 'its own ingenuity' that defines its hidden personality".

Gamal Hamdan passed away in 1993, while Rushdi Said passed away in 2003; both had a passion for the land of Egypt that fueled their academic drive, eventually making them beacons of knowledge that we still benefit from and aspire to emulate.

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By: Moataz Abdelmegid

COMMUNICATION GURU HATIM ZAGHLOUL

Every day, thousands of people use cellphone navigators and Global Positioning System (GPS) to determine their locations and find their way to their destinations. This technology is commercialized to cellphones thanks to Egyptian telecommunication scientist Hatim Zaghloul, who founded a company that is believed to be the first to commercialize the cellular phone location determination/tracking technology. This is one of many cyber and communication possibilities we are enjoying today thanks to the years of research and the inventions developed by this exceptional individual.

Hatim Zaghloul is an outstanding scientist who escalated at rocket speed after graduating from Cairo University, 35 years ago, to become today the Chairman and CEO of one of the world's leading companies in the design, development, and global distribution of high-speed wireless data communication products and technology. Dr. Zaghloul holds six patents and has been published extensively in technical journals. He is best known for his inventions of Wideband Orthogonal Frequency Division Multiplexing (WOFDM), and Multi-Code Direct-Sequence Spread Spectrum (MCDSSS).

Dr. Zaghloul's name is knowingly connected to his invention "Multi-Code Direct Sequence Spread Spectrum" or MCDSSS. This technology introduces a unique approach to spread spectrum modulation for digital signal transmission over the airwaves. Through MCDSSS, the stream of information to be transmitted is divided into small pieces, each of which is allocated within a frequency channel across the spectrum.

A data signal at the point of transmission is combined with a higher data-rate bit sequence, what is commonly referred to as a chipping code, that divides the data according to a spreading ratio. The redundant chipping code helps the signal resist interference and enables the original data to be recovered if data bits are damaged during transmission.

Before Dr. Zaghloul introduced this technology, other common spread spectrum processes were usually employed, such as "Frequency Hopping Spread Spectrum" and "Frequency Hopping Code Division". In these processes, a broad slice of the bandwidth spectrum was divided into many possible broadcast frequencies.

Although this fact made the frequency-hopping devices use less power and are available at a cheaper price, the performance of Dr. Zaghloul's MCDSSS was proven to be significantly more efficient and much more reliable. The benefits of his technology over the conventional ones stem from its high resistance to intended or unintended jamming, ease of sharing of a single channel among multiple user, reduced signal background-noise level hampers interception, as well as determination of relative timing between transmitter and receiver.

When this technology was first brought to life, it was tangibly more expensive than the conventional frequency hopping technologies. Due to its high cost, the first market that showed great interest in it was the military. This is because it uses wideband signals that are difficult to detect and that resist attempts at jamming; this is quality that the military was willing to pay a lot to possess.

After years of research, the technology grew mature and more cost efficient. Today, it is affordable on the market at reasonable prices. Spread spectrum processes now became widely applied for many commercial purposes, especially in local area wireless networks.

Another significant contribution that Dr. Zaghloul presented to the world of communication technology was his invention of the Wideband Orthogonal Frequency Division Multiplexing (WOFDM). This is a method of encoding digital data on multiple carrier frequencies. This technology has quickly developed into a popular scheme for wideband digital communication, used in applications such as digital television and audio broadcasting, DSL Internet access, wireless networks, powerline networks, and 4G mobile communications.

The primary advantage of this technology over its competitors—for example, single-carrier schemes—is its ability to cope with severe channel conditions without complex equalization filters. Channel equalization is simplified because WOFDM may be viewed as using many slowly modulated narrowband signals rather than one rapidly modulated wideband signal.

Today, WOFDM is widely used in digital audio broadcasting applications, digital television, Wireless LAN applications, ADSL, and advanced 4G mobile phone standards.

It is thought that Hatim Zaghloul reached the peak of his career success in the year 2000, as he was intensively celebrated and worldwide known for his scientific and business achievements. Dr. Zaghloul, who holds a Canadian nationality next to the Egyptian one, was named by *Maclean's Magazine* as one of ten great Canadians of the year 2000.

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OMAR YAGHI: MODERN AGE ALCHEMIST

Omar M. Yaghi is a Jordanian chemist celebrated in the scientific communities for his outstanding contributions in the field of material science. Yaghi worked for long years on the development of new substances that have extremely high surface area and very low crystalline densities.

Omar Yaghi, has successfully produced classes of compounds known as Metal-Organic Frameworks (MOFs), Zeolitic Imidazolate Frameworks (ZIFs), and Covalent Organic Frameworks (COFs). He developed these materials from basic science to extensive applications in clean energy technologies, including hydrogen and methane storage, as well as carbon dioxide capture and storage.

To have an understanding of the nature of the materials Yaghi developed, one needs first to grasp a specific concept in material science. For starters, a metal microscopic structure consists of a crystalline arrangement of atoms, ions, or molecules. Let us think of this crystalline structure as a large box that is built of an array of smaller boxes, while each one of the smaller boxes in turn consists of much smaller boxes, infinitely repeating in all three spatial directions.

Such a unit cell is the smallest unit of volume that contains all of the structural and symmetry information to build-up the macroscopic structure of the metal lattice. The atoms or molecules are linearly connected to each other by bonds to form chains of molecules. The chains, in turn, are cross-link connected to each other forming the overall structure of the material. The nature of these bonds has a great influence on the physical properties of the material.

Yaghi developed a new material, Metal-Organic Frameworks, which is a compound that consists of metal ions coordinated to organic molecules to form dimensional structures that have high porosity. This material was made by linking inorganic and organic units by strong bonds. The flexibility with which the constituents' geometry, size, and functionality can be vary has led to more than 20,000 different MOFs that Yaghi reported and studied within the past decade.

Today, Yaghi's Metal-Organic Frameworks with permanent porosity are more extensive in their variety and multiplicity than any other class of porous materials known. These aspects have made MOFs ideal materials for storage of fuels—hydrogen and methane—capture of carbon dioxide and catalysis applications to mention a few.

After successfully developing his Metal-Organic Frameworks, Yaghi decided to zoom-in his work in developing a subclass of MOFs that can be employed in energy-intensive industries and produce tangible energy and cost saving. This was the Zeolitic Imidazolate Frameworks.

Industrial separation processes comprise approximately 10% of the global energy demand, driven largely by the utilization of thermal separation methods, for example, distillation. Yaghi studied these processes and realized that significant energy and cost savings can be realized through advanced separation techniques, such as membranes and sorbents.

One of the major barriers to acceptance of these techniques remains creating materials that are efficient and productive in the presence of aggressive industrial feeds. This is where Yaghi decided to employ his Zeolitic Imidazolate Frameworks as a thermally and chemically stable subclass of metal organic framework. The porous structures of ZIFs can be heated to high temperatures without decomposing, and can be boiled in water or solvents for a week and remain stable, making them suitable for use in hot, energy-producing environments such as power plants.

He did not stop there. Yaghi continued in upgrading the design and synthesis of crystalline extended organic structures and developed another subclass of metal organic frameworks in which the lattice building blocks are linked by strong covalent bonds. The upgraded materials were porous crystalline solids consisting of secondary building units that assemble to form a periodic and highly porous framework.

An almost infinite number of frameworks can be formed through various secondary building unit combinations, leading to unique material properties for applications in separations, storage, and heterogeneous catalysis. These are the Covalent Organic Frameworks (COFs). They are porous, crystalline, and made entirely from light elements—H, B, C, N, and O—that are known to form strong covalent bonds in well-established and useful materials such as diamond, graphite, and boron nitride.

The successful realization of Covalent Organic Framework materials through molecular building blocks provided unique frameworks that could be functionalized into lightweight materials optimized for gas storage, photonic, and catalytic applications.

In 2006, Omar Yaghi's work on methane and hydrogen storage was recognized by several publications, which listed him among the "most brilliant 10 scientists and engineers in the USA". In 2010, *Watch Science* published a list of the "top 100 chemists in the world"; in this list Omar Yaghi was the second name.

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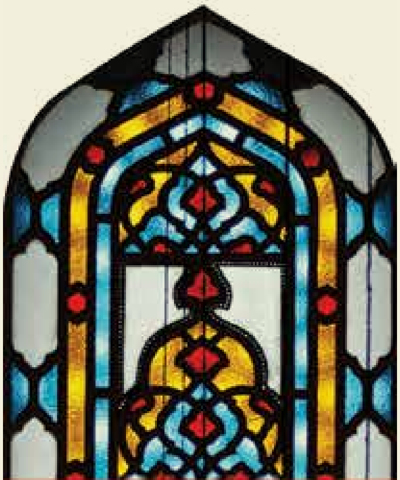
THE SCIENCE BEHIND THE INDUSTRY:

ISLAMIC GLASS–MAKING

By: Shereen Ramadan



The glass-making industry has accompanied humanity since Prehistoric Times, although it is not known who first discovered it. In one account, it is said that the ancient Phoenicians discovered it when a group of sailors docked their ships at the Syrian coast and could not find rocks to place their cooking pots on to make dinner. It is said they used lumps of sodium compounds they had on their ships; when they lit the fire, they noticed the merging of these lumps with the sand containing silica, producing a shiny, transparent liquid. That was the commencement of glass-making.

In any case, there is no scientific evidence about the truth of this account; however, glass-making was definitely present since Ancient Times in the civilizations of Egypt, Iraq, and Syria, then moved to the Greeks and Romans, and eventually inherited by the Arabs through the lands they conquered in Iran, Iraq, Syria, and Egypt.

In Medieval Times, the Arabs developed glass-making by introducing new techniques; they reached high levels of perfection in glass ornamentation thanks to the advancement of chemistry during that time, the encouragement of sultans and princes, and also for the need of glass products in daily life: bottles, vases, cups, lanterns, windows, as well as pints for fluids, perfumes, and medical prescriptions. Muslim scientists also knew natural crystal, which is excellent glass containing varying percentages of lead oxides, using it to make drinking glasses, pots, chandeliers, and rings.

The glass-making industry is one of the most complicated chemical industries, undergoing many stages until the product reaches the desired shape and form:

First: Melting

Glass is chemically created by mixing limited quantities of sand (silica), soda, and limestone, then placing this mixture in a high-temperature furnace until these elements melt and mix well together, transforming into soft dough that is easily shaped.

Second: Shaping

The mixture is shaped manually while it is hot by two methods. The first method is “blowing in the air”, where the manufacturer blows into a metal tube, at the end of which is a small piece of the dough, until it becomes a small bubble, which grows with continuous blowing, and is shaped into the required form. As for the second method, it is “blowing in the mold”, where the manufacturer blows the dough in molds of clay or wood, in two or more pieces, then assembling the pieces and sticking them together.

Third: Decorating

Decoration was done on the glass through different methods, among which are adding pieces or glass lines to the body of the product, and pressing metal stamps with protruding or grooving patterns on the glass while it is still hot. After cooling the final product to take its final form, the Arab artisan would unleash his imagination to decorate and ornament it, using his meticulousness and skill to produce the most beautiful antiques.

Calligraphic ornamentation was one of the most prominent features of Islamic Arab art, as artists yielded Arabic calligraphy with its different styles—Naskh, Tholoth, and Kufi—to write historical, commemorative, and religious phrases, using gold sometimes. Arab artisans also created a marvelous mixture of geometrical and botanical patterns that are intertwined and repeated to generate a new and unique art form known as Arabesque. They also used some animal and human forms on some of the products depicting scenes of polo games, hunting parties, and the court.

The Role of Chemistry in the Evolution of Glass–making

The Islamic community played a prominent role in the evolution of chemistry, and, thus, in the development of many industries, including glass–making, which is considered one of the most delicate and complex chemical industries, considering the preparation of its primary materials, its manufacturing methods, and its need for skillful, creative, and artistic hands.

Moreover, many scientists exhibited special interest in this particular industry, because they used glass equipment in their laboratories, leaving us an enormous legacy of detailed writings about many industries. For example, we have the great chemist, Gaber ibn Hayaan, describing in his book *Aldora Almaknouna* (*The Precious Pearl*) 46 methods of producing colored glass. He was also able to improve the quality of glass used in making the distillation device, *Alembic*, which he invented.

Arab chemists also played a major role in the development of metallic dyes used in the production of colored glass shards, which still maintain their colors to this day, surviving weather changes and temperature throughout hundreds of past years.

Glass Lanterns

The Arab Muslim craftsman invented glass lanterns used for lighting and decorating extravagant religious establishments that sultans, princess, and the rich competed to construct. These lanterns were made of the best quality of glass embedded with enamel; gold was used to write verses from the Quran and Hadith on its body, to be hung using chains made of silver or yellow copper.

As such, the Arabs played a central role in the development of glass; whether chemically, through its manufacture and shaping; or artistically, through its decoration and coloring. Antique glass products are still considered among the most beautiful and most valuable artistic artifacts; they also reflect the industrial and artistic strides of that bright period in Middle Eastern history.

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LEATHER TANNING AND FABRIC DYEING

By: Nourane Khaled

Leather tanning and fabric dyeing are two of the most ancient crafts that exhibited a significant progress. Arabs pioneered in these crafts adding much to their development. Our artisans have used leather and fabrics to create marvelous pieces of arts that remain to this day a symbol of our long-existing Arab civilization. The efforts made by our scientists have greatly improved these crafts.

Leather tanning is the process of chemically treating animal skins and hides to produce leather. The idea of tanning is based on the reaction of the collagen fibers of the skin with the tanning agent. The reaction withdraws the water from the skin, making it more durable and resistant to water, bacterial growth, and decaying.

The three main types of hides used in leather manufacture are from cattle, sheep, and pigs. Other animals' hides, such as crocodiles and snakes, are also used for making luxurious and distinguished products.

Due to the simplicity of the tanning procedures and its basically available materials, leather tanning was one of the first industries established in the Ancient World. The craft underwent several changes and experienced remarkable development. The old traditional tanning methods used tanning agents from plant sources. Hides were soaked in a series of vats filled with increasing concentrations of chemical extracts from the leaves and barks of some plants containing tannic acid that acts on the protein constituents of the skins.

In modern age, another method became available thanks to a scientific development, which is the chromium salts tanning. Chromium salts are added to the leather and pH is slowly increased. This process makes the leather more resistant to temperature and to bacterial growth. During the tanning process, at least 300 kg of chemicals are used for treating a ton of hides.

Fabric dyeing is the process of adding color to the fabrics. Generally, the fabrics are dropped in a specific solution containing the dye and some particular chemicals. After dyeing, an uncut chemical bond is established between the dye molecules and the fabrics.

Dyeing can be done for the fabric or the yarns used to make them; some fabrics are dyed by printing. The techniques are different and each type of fabric has its specific class of dye that differs in chemical structures, effects, and application methods. Controlling the time and the temperature of the process is the key element of successful dyeing.

In the past, dyeing compounds were of natural sources like animals and plants. Then, chemical artificial dyeing compounds started to rise; more stable and resistant to water and daily usage.

Arabs paid major interest towards the improvement of the life-necessary arts and crafts; these crafts include dyeing and tanning. The scientific innovation Arab scientists made has influenced chemistry, pharmacology, metals science, drugs and chemical extractions from plants. Efforts made by famous scientists, such as Jabir Ibn Hayan, Al Razi, and Abu Mansur Bin Ali Harawi, improved the dyeing techniques and the materials used.

The Arab influence on these crafts can be seen on their influence in the nomenclature of many dyes and some terms used in the textile manufacture. For example, the indigo color, which is nil in Arabic, and from which comes the Portuguese anil, the Italian aniline, and the English aniline. There is also saffron, which comes from the Arabic *zafaran*.

Famous tanneries and dyeing facilities can be seen in the old cities of Morocco where traditional leather tanning and fabric dyeing facilities are equipped with numerous vats producing a wide variety of leathers and fabrics with different colors. These facilities are still functioning today, producing some of the finest products in the world.

Arabs pioneered in many crafts; they were known worldwide by their accuracy and their innovation. Arab former leaders paid a lot of attention to develop these crafts; a situation that sadly does not seem to persist these days. Crafts are losing their lustrous attraction and artisans are letting go of their crafts. Saving our traditions and crafts is a mission that we cannot neglect; reading and learning about Arabian crafts are essential steps to keep our patrimony and transfer it from generation to another.

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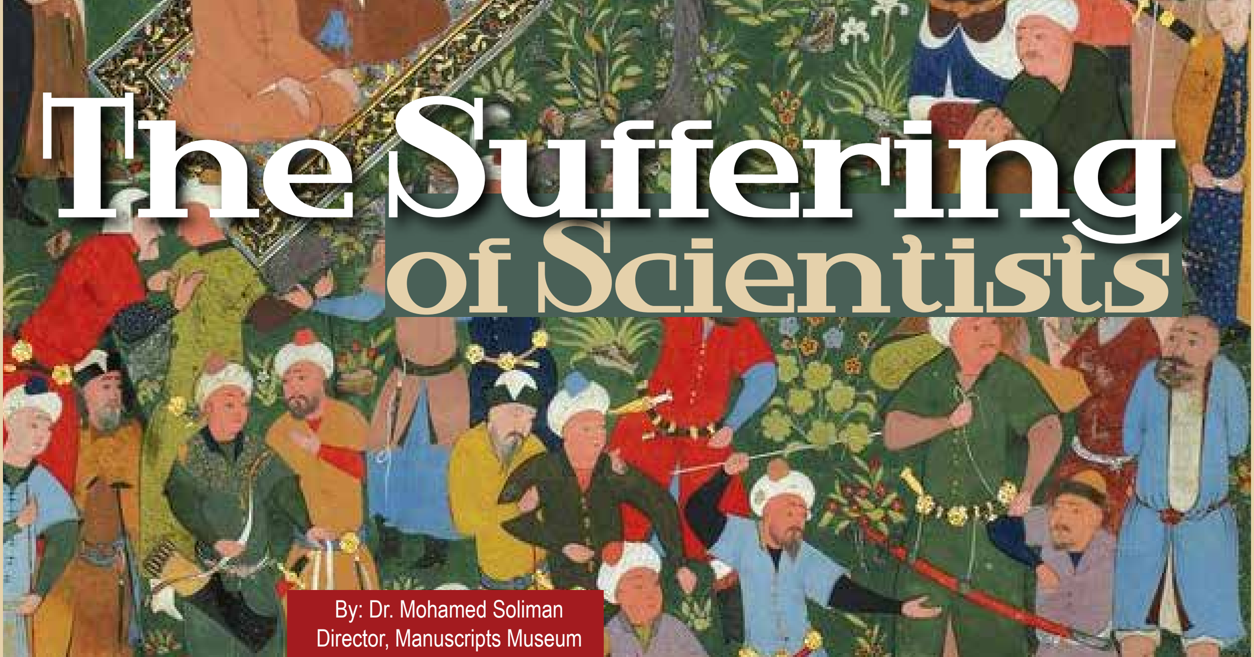


The Suffering of Scientists

By: Dr. Mohamed Soliman
Director, Manuscripts Museum

The vast body of knowledge we enjoy today in countless scientific and literary fields was not handed to us on a silver platter. It is the outcome of the suffering of numerous many scientists and scholars, which history is brimming of across the different ages. The road of those who sought knowledge has rarely been laid with rose petals; on the contrary, it is packed with killing, dragging, crucifixion, dismembering, exile, and accusations of blasphemy for the opinions and theories they documented in contradiction to what had been believed at the time of scientific facts, especially by men of the cloth and authority. It is thus normal to read the following in the biographies of scientists and scholars: “he/she was poisoned”, “he/she was crucified and killed”, “he/she was burnt to death”, “he/she died in prison”, “he/she died in exile”, etc.

For example, did you know dear reader that the Alexandrian scientist, Hypatia—mathematician, astronomer, and philosopher—who lived in Alexandria in the 5th century amongst the aisles of its Ancient Library was dragged across the streets of this ancient city?

Sources mention she was murdered at the hands of a group of religious extremists who accused her of witchcraft and heresy. After a scientific convention she held, a mob dragged her from her hair, stripped her from her clothes, tied her hands, and dragged her throughout the streets of Alexandria until her skin fell off her flesh and she died, after which they burned her; all in the name of religion!

Are you aware dear reader that there are names the human civilization takes pride in the owners of which died in the worst ways possible? The lives of these eminent scholars frothed with persecution and suffering at the hands of men of the cloth, who accused them of heresy and blasphemy, or it was spent fleeing the whims of kings and princes.

This led Andrew White to author his 19th-century book entitled *A History of the Warfare of Science with Theology in Christendom*, where he compiled the forms of persecution and the extent of suffering scientists had to face, including examples such as Nicolas Copernicus, Galileo Galilei, Cristopher Columbus, Al-Kindi, Abu Bakr al-Razi, Ibn Rushd, Al-Farabi, and many more.

History mentions how Abu Bakr al-Razi, a chemistry and philosophy genius of his time, was hit on the head by men of the cloth who fought him vehemently until he became blind and died as such. The worst of all murders may be the one Ibn al-Muqaffa’, the author of the famous *Kalila and Dimna* fables, faced; he was dismembered, decapitated, then burned by order of the Caliph al-Mansour who accused him of blasphemy and atheism.

Who of us does not know the great tragedy of the scientist and philosopher, Ibn Rushd, who was lucky enough to survive being burnt like his peers, but whose works were burnt instead. He was exiled and banned to the Jewish town of Lucena, a county near Cordoba, at the age of seventy, to suffer greatly in his old age.

Do not you also know dear reader that Ibn Sina, the author of the “*Canon of Medicine*”, died short of fifty years of age as a result of a disease he contracted while imprisoned and tortured after fleeing with one of his friends upon being accused of blasphemy and heresy? The examples are indeed extensive in this context.

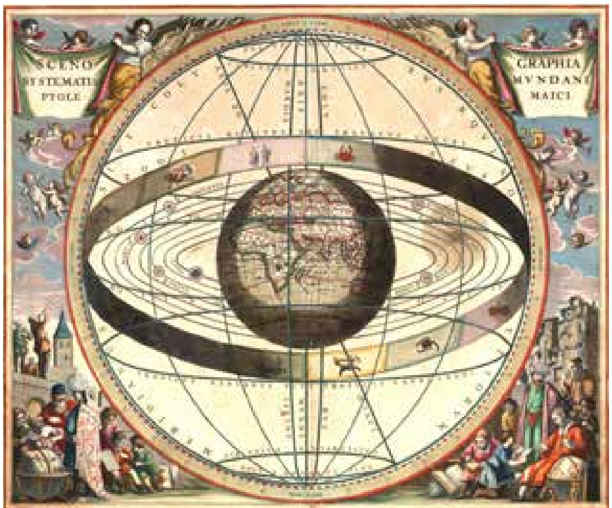
That is all beyond the different kinds of persecution suffered by scientists the such as of Al-Ghazali, Ibn Hayyan, Al-Jahiz, Al-Ma’ari, Al-Kawkabi, Al-Mutanabbi, Lisan ad-Din ibn al-Khatib, and Ibn Al-Haytham who claimed insanity to flee the wrath of the Caliph Al-hakim Bi-amr Allah. Heritage sources are filled with stories and tales that detail the extent of suffering scientists have had to endure, the efforts they have had to exert, and the journeys they have had to travel in pursuit of science and learning.

We only need to mention one such example, what Ibn al-Qifti mentioned in his book *The History of Learned Men*, speaking of Hunayn ibn Ishaq, the famous physician and translator, and his pursuit of Galen’s *The Proof*, which was rare at the time. Hunayn ibn Ishaq is said to have stated: “I have searched for it thoroughly, seeking it in the corners of Iraq, Syria, Palestine, and Egypt, until I reached Alexandria; however, I could only acquire nearly half of it in the city of Damascus”, which is quite an achievement taking into consideration the difficulty of traveling during the 9th century.

How then did thousands of Muslim scientists author their books, encyclopedias, as well as literary and scientific translations in past centuries, where each encyclopedia exceeded thousands of pages. It is without doubt that these scientists exerted extensive efforts that only those of strong will power could exert, believing that civilizations could only be built by science. They thus left behind a scientific and literary legacy of great value and influence, considered one of the main factors in building the human civilization in all fields. Said legacy is where the West has launched its civilization, while we dragged behind.

PTOLEMY'S *ALMAGEST*

The Arab Revival of Ancient Alexandria Science



By: Dr. Shaymaa Elsherif
In Charge of Cultural Programs and Activities, BA Center for Francophone Activities

It was not once upon a time, it was not in a fantasy land, not of the world of stories and tales; it was a living reality some thousand years ago. A reality that spoke Arabic, produced science in Arabic, spread knowledge in Arabic, and pushed people to learn Arabic. It was a time when Arab and Muslim scientists gobbled from the ancient rivers of knowledge, flooding them in turn with their own research, discovery, and explanation; when they taught the world its own lost legacy, adding to it their own.

In this shining star we find a great example, it is *Almagest*, the crown jewel of astronomy, and one of the most important scientific references of the Ancient World.

Almagest is the Arabization of the Greek word *Mégistos*, meaning "very big", which fits the description of this pioneering book of astronomy despite its original title *The Mathematical Thesis*. It acquired the description "very big" for its uniqueness, leadership, accuracy, and expansion of its theoretical content in physics and mathematics. Its description "very big" soon became its name; it thus changed from *Mégistos*, which was the name the Arabs transferred from Greek to Arabic (827/828 CE), to become *Almagest*, which was transferred back to Latin from Arabic, so that Europe, then the world, came to know it by the name the Arabs suggested: *Almagest*.

The author of this pioneer encyclopedia is the Egyptian-born and raised scientist Claudius Ptolemy (90−168 CE), one of the scientists of the Ancient Library of Alexandria. Ptolemy wrote his eternal book in Greek in the 2nd century CE, dividing it into thirteen extensive articles, explaining in his unique manner astronomical theories and mathematical calculations that represented detailed explanation, accurate and organized compilation, and clarification supported with various proofs of past and contemporary theories; it also included explanatory diagrams and astronomical tables.

Based on what we know today, *Almagest* is highly criticized for its scientific errors, the gravest of which is the complete article it dedicated to the centralization of Earth, and the elaborate proof it detailed for the delusion that the Universe revolved around it. Nevertheless, it is still regarded as a scientific treasure trove; one of the most important and prominent written productions in its field, measured by the extent of knowledge at the time. That is why the Abbasid Caliph Al-Ma'moun took special interest in *Almagest*, ordering it translated, disseminated, studied, criticized, explained, and analyzed, leading to the production of the first copy of its Arabic translation, from the heart of the House of Wisdom founded by Al-Ma'moun in Baghdad.

It is interesting to mention that *Almagest* was translated into Arabic twice. The first is the one already mentioned, which contained several issues with Greek terminology. It was translated into Arabic based on the premise that many Arab readers of the time had prior knowledge of Greek, resulting in the translation being difficult, making it incomprehensible for regular readers.

That translation remained the only available one until 892 CE, when *Almagest* was produced in its full Arabic glory, complete and comprehensive, embellished with perfectly correct and sound language, full of scientific terms. Naturally, between the production of the two translated works, an Arabic scientific revolution had taken place in astronomy, helping in the development of Arabic linguistic terms infused with new and innovative scientific terms that contributed to the production of this later translated copy in the best form possible. That version is the one copied by Europeans into Latin, and by which they came to know that exceptional scientific reference.

We conclude by mentioning the parts that make up *Almagest* and the unique scientific method by which Ptolemy divided it before offering it to the people to learn from it. It is also important to mention how influenced Ptolemy was by his contemporary great astronomer, Hipparchus, creating the different chapters of this book based on many of his astronomical theories and hypotheses.

In the first two articles of the book, Ptolemy lays general and basic definitions and specifications, then provides proofs and evidences on the roundness of Earth and that gravity always attracts towards the center of the Earth regardless of the point on its surface. He also describes the rotational movement of Earth and other planets, studying all this with the help of mathematical methods that are based on logical and proven facts.

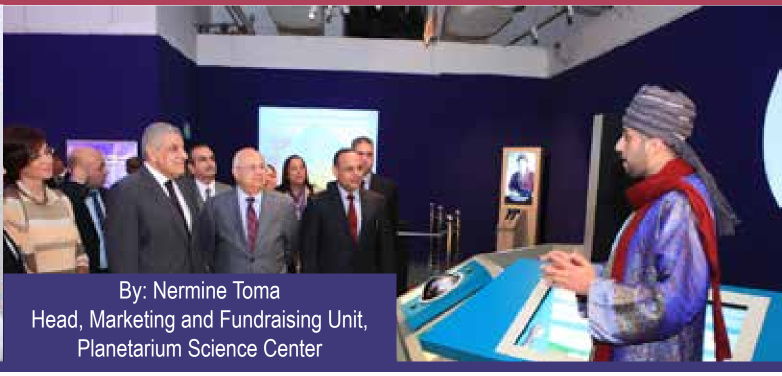
In the third article, he studies the calculations of time and its formulae; while in the fourth, he studies the motion theory itself. In the fifth article, he reveals the second deviated lunar motion; while in the sixth, he studies lunar and solar eclipses. In the seventh and eighth articles, he studies stationary stars. In the eighth article, he studies the Milky Way and the formation of planetariums, which he elaborates on more extensively in the ninth article.

In the tenth article, Ptolemy reaffirms the centralization of Earth; while in the eleventh, he focuses on other planets, such as Venus, Mercury, and Jupiter. In the twelfth article, he reaches confirmations on planetary motion that are still in use today. In the thirteenth and last article, Ptolemy pays attention to the study of transversal planetary motion, the curvature of planetary orbits, and the size of that curvature.

True indeed are the words of Imam Aly ibn Abi Talib in his poetic verse: "Work on science and do not seek an alternative; for people are dead, while the people of science are alive".

1001 Inventions:

An International Exhibition Personifying 1000 Years of Islamic Civilization



By: Nermine Toma
Head, Marketing and Fundraising Unit,
Planetarium Science Center

On Tuesday, 20 October 2015, the Bibliotheca Alexandrina inaugurated the international exhibition “1001 Inventions: Discovering our Past, Inspiring our Future” in cooperation with the Academy of Scientific Research and Technology, and the 1001 Inventions British Organization.

The Exhibition was inaugurated by Eng. Ibrahim Mahlab, former Egyptian Prime Minister and the President’s Assistant for National Projects; Dr. Ismail Serageldin, Director of the Bibliotheca Alexandrina; Dr. Mahmoud Sakr, Head of the Academy of Scientific Research and Technology; Mr. Ahmed Salim, Producer and Executive Director of 1001 Inventions Organization; Mr. Hany Elmessery, former Governor of Alexandria; Dr. Mohamed Abou El Fadl Badran, Secretary-General for the Supreme Council of Culture; Mr. Amr El Ezaby, Advisor to the Minister of Tourism; Dr. Abbas Schumann, Under-Secretary of al−Azhar; and Eng. Hoda Elmikaty, Head of the Bibliotheca Alexandrina Cultural Outreach Sector.

Eng. Mahlab asserted that the idea of hosting such an exhibition, which aims to highlight Muslim Scientific and Cultural Achievements during the Middle Ages, was proposed to him earlier, and that he thought it was a very important idea to be embraced by the nation at this critical time. He added that the Exhibition highlights a glorious period of the Islamic civilization, when science and knowledge flourished, and the Muslim contributions were of great importance.

Mahlab also stressed on the fact that the Exhibition attracts millions of visitors around the world, which is proof of the important status the Islamic heritage occupies within the human and scientific heritage. The Exhibition accurately displays the influence of the achievements of the Islamic civilization on our modern life, and stresses on the importance of the scientists’ roles in the human civilization through inventions and innovations in all fields, while Europe was swamped in darkness and ignorance.

Moreover, he elaborated on the importance of the Exhibition in reviving these facts for the new generations in an age characterized by extremism and violence.

In his speech, Dr. Ismail Serageldin stressed on the importance of this Exhibition in rectifying the false image propagated by several foreign entities, implying that the Western renaissance started with the Greek era, and that Muslims had no contributions in that renaissance.

In reality, Muslim scientists raised the banner of science and knowledge for nearly a millennia. They were open to all cultures, taking from and adding to them. They laid the foundations of the scientific method, changing civilization and knowledge through their contributions. Dr. Serageldin expressed his hope for the new generation to know their ancestors’ achievements, in order to face the West with confidence and determination.

On the other hand, Dr. Mahmoud Sakr insisted in his speech that this Exhibition was able, in a short period of time, to contribute in promoting science, technology, and innovation through shedding light on this Golden Age.

From her side, Eng. Hoda Elmikaty ensured that Alexandria has always been the cradle of knowledge, a forum for scientists and researchers, and a capital of culture and sciences. From Alexandria emerged the engineering theories of Euclid; from the Ancient Library of Alexandria appeared the theories of Archimedes and Galileo, and the experiments of Eratosthenes to measure the Earth’s circumference.

She added that the Bibliotheca Alexandrina, within its role of highlighting heritage, and from its cultural responsibility, is organizing this Exhibition to shed light on the contributions of Arab Muslim scientists in an innovative, interactive, and dramatic way. She expressed her hope that this knowledge would contribute to fostering a new generation that is aware of its ancestral scientific role, capable of facing future challenges.

Mr. Ahmed Selim spoke on behalf of the British 1001 Inventions Organization, explaining the reason behind founding it 10 years ago to celebrate the Golden Age of Islam through organizing this Exhibition, in addition to producing films and educational material related to it.

He added that the Exhibition highlights three facts; that the Golden Age of Islam was founded on scientific research, and that most scientists were from different countries and backgrounds, but had rulers who gave them the support and the funds.

From his side, Dr. Abbas Schumann assured that the current civilizations are based on Arab Muslim scientists, and that eminent universities teach the sciences the basis of which were laid by Arab Muslim scientists during the Golden Age of Islam.

He added that we suffer extensively nowadays from various movements. One such movement is extremely strict; rather than guiding the youth to what benefits them, they use them to invent what harms people. Another is outdated, frozen at a certain period of history and insists on pulling us backwards.

He also insisted that Arabs and Muslims face many challenges; on top of all is the inability to support the innovative youth. He indicated that inventions exist, waiting to be explored; he urged businessmen to adopt young inventors, and support them, and not leave the whole matter to the government.

A Beautiful Mind

Before Newton, there was Alhazen

However, Ibn al-Haytham was not satisfied with elucidating these theories only to himself; he wanted others to see what he had reached. The years of solitary work culminated in his *Book of Optics*; the seven-volume treatise, which expounded just as much upon his methods as it did his actual ideas.

Through his *Book of Optics*, his ideas influenced European scholars, including those of the European Renaissance, who consider him the "Father of Modern Optics". During his solitary years, he wrote extensively on many topics, in total 96 books and manuscripts, 55 of which have survived.

His legacy in astronomy is also evident; there is the Alhazen Crater on the Moon, as well as the Alhazen Asteroid. In addition to optics and astronomy, he studied and wrote about mathematics, particularly calculus. He had a great influence on Isaac Newton, who was aware of Ibn Al-Haytham's numerous studies of calculus, which led to the engineering formulae and methods used ever since.

In fact, Newton's Third Law of Motion—for every action, there is an equal and opposite reaction—was based on Ibn Al-Haytham's postulate on the movement of bodies and the attraction between two bodies: gravity.

It may thus be safe to conclude that it was not the legendary apple that fell from the tree that enlightened Newton about gravity, but rather the books of Ibn Al-Haytham.

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VISITORS INFO

Planetarium

Available Shows

Stars Show
45 min. Live Show by the PSC Resident Astronomer

Oasis in Space
25 min. Full-dome Show

Stars of the Pharaohs
35 min. Full-dome Show

Seven Wonders
30 min. Full-dome Show

The Life of Trees
33 min. Full-dome Show

Kaluoka'hina
35 min. Full-dome Show

Mystery of the Nile
45 min. IMAX Show

Cosmic Voyage
35 min. IMAX Show

Alexandria, The Cradle of Astronomy
22 min. Full-dome Show

Visitors INFO

- For the Planetarium daily schedule and fees, please consult the Center's official website: www.bibalex.org/psc
- Kindly note that, for technical reasons, the Planetarium maintains the right to cancel or change shows at any time without prior notification.

History of Science Museum

Visitors INFO

Opening Hours
Sunday–Thursday: 9:30-16:00
Saturday: 12:00-16:00

Guided Tours Schedule
Sunday–Thursday:
10:30, 11:30, 12:30, 13:30, 14:30, 15:30

- Museum entry fees are included in all Planetarium shows tickets.
- For non-audience of the Planetarium, Museum entry fees are EGP 2.-
- Museum Tours are free for ticket holders.

ALEXploratorium

Visitors INFO

Discovery Zone

Opening Hours
Sunday–Thursday: 9:00-16:00
Tuesday: 9:00- 12:30
Saturday: 12:00-16:00

Guided Tours Schedule
Sunday, Monday, Wednesday, Thursday:
9:00, 10:30, 12:00, 13:30,15:00
Saturday: 12:00, 14:00
Tuesday: 9:00, 10:30

Entry Fees
Students: EGP 5.-
Non-students: EGP 10.-

Listen and Discover

- For the list of shows available at the "Listen and Discover" and the schedule, please consult the Center's official website: www.bibalex.org/psc.
- For reservation, please contact the PSC Administrator, at least one week before the desired date.

Show fees

DVD shows:
Students: EGP 2.-
Non-students: EGP 4.-

3D shows:
Students: EGP 5.-
Non-students: EGP 10.-

4D shows:
Students: EGP 10.-
Non-students: EGP 15.-

BIBLIOTHECA ALEXANDRINA
مكتبة الإسكندرية

Chance Takers are Accident Makers

Illustrated by: Mohamed Khamis

Check out the "Human Flight: Adventures and Misadventures" article, page 8.